Hudson

Mechanical Procedure Manual

“A“ Series
FOREWORD

The information contained herein is to be used as a guide and reference for servicing Hudson Motor Cars.

A group index and an alphabetical index is placed in the front of the manual for easy reference and each section is self-contained. The procedures outlined herein are derived from the procedures established in preparing flat rate time schedules.

A thorough study of the operations, necessary tools and equipment will enable the Hudson Service dealer to perform reliable service at reasonable cost.

Special tools that have been developed are shown in their respective positions.

New Tools are developed only when it is found to be essential to good workmanship and the time saving is sufficient to warrant the cost of manufacturing.

Tools are developed in conjunction with the Kent Moore Organization and are sold by them direct to Hudson Distributors and Dealers.

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NEW CAR PRE-DELIVERY, 1000 MILE AND 2000 MILE INSPECTION SERVICE

Owner:  | Model:  | Serial No:  | License No:  
---|---|---|---
Address:  | Locker and Deck Key:  | Door and Ign. Key:  

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</tbody>
</table>

**LUBRICATION**: Perform all lubrication operations called for in Lubrication Chart and Mechanical Procedure Manual at inspections indicated.

*Items 33-46 apply to cars with Hydra-Matic Drive.*

There is no charge to the owner for these inspection and adjustment services when performed by the Selling Dealer, other than for oil and lubricants used. When performed by a Hudson dealer other than the one who sold the car, a charge of not more than $6.00 will be made for the 1000 mile inspection and $12.00 for the 2000 mile inspection. See Owner Service Policy.

### Inspection

<table>
<thead>
<tr>
<th>Repair Order</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Delivery</td>
<td></td>
</tr>
<tr>
<td>1000 Mile</td>
<td></td>
</tr>
<tr>
<td>2000 Mile</td>
<td></td>
</tr>
</tbody>
</table>
SECTION 1

LUBRICATION

The present day high speed driving, fast acceleration, and precision fitted engine parts have placed engine and chassis lubrication in the category of highly specialized services.

A definite plan of application is necessary to provide the various working surfaces with the right amount of the correct lubricant at the proper time.

Contrary to general belief, one type of lubricant will not suffice to all applications.

Varying load demands and operating conditions call for different types of lubricants.

Authorized Hudson Dealers have been provided with a Lubrication Chart covering correct factory lubrication specifications, and a definite plan of application. Observance of this chart and its requirements will be definite assurance of customer satisfaction and goodwill.

A copy of the Lubrication Chart is also included in this manual. Additional helpful information regarding the lubrication requirements are given in the Lubrication Schedules and the following paragraphs.

NOTE: The lubricants used at the time of assembly are of the best quality and need not be changed until the recommended change period shown in the Lubrication Schedule.

LUBRICATION SCHEDULES

500 Miles

Drain the original engine oil at 500 miles and refill with a good grade of oil of the viscosity rating shown in the temperature and viscosity illustration, Figure 3, Page 6. For engine oil capacities of six and eight cylinder engines refer to Figure 1 - Lubrication Chart and Capacities-- Page 10.

1000 Miles

Viscous Chassis Lubrication

<table>
<thead>
<tr>
<th>Points</th>
<th>Steering Spindle Pivot Pins</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Gear Shift Bell Crank Pivot</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Clutch Pedal Bearing</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Clutch Throwout Bearing</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Universal Joint Spline</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Rear Spring Shackle Bearing</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Points</th>
<th>Engine Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rear Compartment Door Striker</td>
</tr>
<tr>
<td>1</td>
<td>Rear Compartment Latch Rod</td>
</tr>
<tr>
<td>4</td>
<td>Hood Hinge</td>
</tr>
<tr>
<td>3</td>
<td>Windshield Wiper Pulleys</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Engine</th>
<th>Check Oil Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door Hinge</td>
<td>4 or 8</td>
</tr>
<tr>
<td>Gasoline Tank Filler Door Hinge and Spring</td>
<td></td>
</tr>
</tbody>
</table>
### General Lubrication Information

<table>
<thead>
<tr>
<th>Engine Lubrication</th>
<th>Refill Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-Cylinder</td>
<td>7 qts. (6.5 L)</td>
</tr>
<tr>
<td>8-Cylinder</td>
<td>7 qts. (6.5 L)</td>
</tr>
</tbody>
</table>

- Engine oil should be drained after 500 miles of driving, and thereafter at every 5000 miles of driving.

### Miscellaneous Points - Use HA

<table>
<thead>
<tr>
<th>2000 Miles</th>
<th>Use HA</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 qts.</td>
<td>5W-30</td>
</tr>
</tbody>
</table>

- Use SAE 20 for SAE 10W-30.
# WATER RESISTANT LUBRICANT

<table>
<thead>
<tr>
<th>Water Resistant Lubricant Points</th>
<th>Water Resistant Lubricant Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windshield Cables at Pulleys</td>
<td>4</td>
</tr>
<tr>
<td>Door Check Arms</td>
<td>2 or 4</td>
</tr>
<tr>
<td>Courtesy Light Switch</td>
<td>2 or 4</td>
</tr>
<tr>
<td>Door Lock Bolt and Slide</td>
<td>2 or 4</td>
</tr>
<tr>
<td>Door Striker</td>
<td>2 or 4</td>
</tr>
<tr>
<td>Rear Compartment Door Hinge</td>
<td>2</td>
</tr>
<tr>
<td>Rear Compartment Door Latch and</td>
<td>2</td>
</tr>
<tr>
<td>Striker</td>
<td>2</td>
</tr>
<tr>
<td>Hood Prop</td>
<td>1</td>
</tr>
<tr>
<td>Hood Upper Lock</td>
<td>1</td>
</tr>
<tr>
<td>Hood Lower Lock</td>
<td>2</td>
</tr>
<tr>
<td>Hood Lower Lock and Control Wire</td>
<td>2</td>
</tr>
</tbody>
</table>

**GEAR LUBRICANT**
- S.A.E. 80 Winter
- S.A.E. 90 Summer

- Transmission: Check Level
- Overdrive: Check Level
- Steering Gear: Check Level
- Rear Axle: Check Level
- Multi-Purpose Gear Lubricant: S.A.E. 90

- Universal Joint Needle Rollers - 3 Points
- Gear Oil: S.A.E. 140
- Check Battery Electrolyte level and gravity.

- Water or Anti-Freeze
- Check Coolant Level and Anti-Freeze strength.

- Hudson Hydraulic Brake Fluid
- Check Brake Master Cylinder fluid level.

- Hydra-Matic Transmission - Check Level

**2,000 Miles**

Perform operations included in 1,000 mile lubrication, in addition to the following:

- Hydra-Matic transmission fluid level should be checked when a chassis lubrication is being performed.
- The procedure for checking fluid level is included on pages 41 and 42 in Hydra-Matic Section No. 11.

**ENGINE OIL**

- Engine
- Generator
- Distributor
- Air Cleaner - Standard
- Air Cleaner - Oil Bath
- Throttle Operating Linkage
- Oil Filler Pipe Cap
- Brake Operating Linkage
- Drive-Master Operating Linkage
- Hydra-Matic Linkage

- Drain Oil and Refill
- 2 Points
- Wash and re-oil
- 4 Points
- Clean and add new oil
- All Joints
- Wash and re-oil
- All Joints
- Lubricate using light engine oil

**FIGURE 3**

- Average Temperature 90°
  - Use S.A.E. 30
  - S.A.E. 30 satisfactory for temperatures above 70°

- Minimum Anticipated Temperature 10°
  - Use S.A.E. 10W
  - S.A.E. 10 satisfactory for temperatures of minus 10° to 30°

- Minimum Anticipated Temperature 10°
  - Use 10W
  - 10W satisfactory for temperatures of minus 10° to 40°

- Below minus 10°
  - Use 10W plus 10% kerosene
  - 10W plus 10% kerosene recommended for temperatures below minus 10°
5,000 Miles

Perform operations included in 1,000 mile and 2,000 mile lubrications, in addition to the following:

| Hudsonite Clutch Compound | Drain and Refill |
| Clutch                    |                   |

| Transmission               | Drain and Refill |
| E.P. Gear Lubricant--S.A.E. 80 Winter, S.A.E. 90 Summer | Overdrive |

| Rear Axle                  | Drain and Refill |
| Multi-Purpose Gear Lubricant--S.A.E. 90 |                   |

| Viscous Chassis Lubricant | Renew Cartridge |
| Brake Cables              | Clean and Lubricate |

Perform operations included in 1,000 mile, 2,000 mile, and 5,000 mile lubrications, in addition to the following:

| Hydra-Matic Oil Level Indicator | Air cleaner in oil level indicator cap should be cleaned every 10,000 miles or twice a year. |

| Viscous Chassis Lubricant | Rear Spring Covers Inject lubricant with special lubricating clamp |

| Sodium Soap Base Lubricant | Front Wheel Bearings Remove, Clean, and Repack |
|                           | Rear Wheel Bearings Remove, Clean, and Repack |

| Hudsonite Shock Absorber Oil | Drive-Master Clutch Power Cylinder Remove plug and inject 1 ounce oil |
|                             | Drive-Master Transmission Power Cylinder Disconnect elbow and inject 1 ounce oil |

10,000 Miles

15,000 Miles

Hydra-Matic transmission fluid should be changed every 15,000 miles. Instructions for draining and refilling are shown on Page 41 and 42 of the Hydra-Matic Section.

IMPORTANT: When checking the level of the lubricant in rear axles and transmissions, make sure that the lubricant has stopped foaming. When car has been run for a considerable length of time, it should be permitted to stand long enough to allow the oil to reach the true level before checking.

OIL FILTERS

On cars equipped with oil filters the cartridge should be replaced at 5,000 mile intervals or when the oil shows evidence of becoming dirty. When replacing the cartridge, be sure to use a new cover gasket and see that it seats properly to prevent oil leaks.

BREAK-IN OIL

If a tune-up oil or break-in oil is used make sure it is made by a reputable manufacturer, who will guarantee his product as containing no harmful ingredients.
ENGINE OILING CIRCUIT

8 CYLINDER

Engine lubrication is by the Duo-Flow system which delivers oil in direct ratio to engine speed to bearing surfaces immediately from the first turn of the crankshaft. The oil is drawn from the oil pan by the double acting oscillating plunger type pump driven by the camshaft.

The oil is drawn from the sump and forced through oil lines to the front and rear of the engine where it is delivered to the front and rear troughs in the oil pan upper tray.

The oil is then picked up by the connecting rod dippers and distributed to the interior working surfaces through splash and a system of channels which convey it into wells over the crankshaft and camshaft bearings and timing gear compartment. Overflow oil running down the crankcase walls is diverted by drains in the oil pan tray into adjacent splash troughs until it reaches the center of the engine.

A this point, it is returned through the opening in the tray, then to the main oil supply where it is cooled and screened before again being used. The new design oil pan with sump at rear is provided with a floating type screened intake. This permits only the cleanest oil to be drawn off by the pump.

Both rear and front main bearing caps are packed to prevent oil leakage and a large oil retainer collects oil from the outside of the rear main bearing and returns it to the oil pan. The oil return tube leading from the rear main bearing to oil pan has a floating disc or "flapper valve", pinned on the lower end to prevent any loss of oil on extreme grades or on quick stops.

An oil check valve is mounted at the rear right side of crankcase, through which the oil from rear lead pipe of oil pump flows and controls a light on the instrument panel. A spring loaded, movable cup shaped plunger lies in the path of the oil flow. When oil pressure is too low, the plunger completes an electric circuit and lights the red dash signal. Normal oil pressure causes the plunger to recede and the circuit is broken.

OILING CIRCUIT

6 CYLINDER

Full pressure lubrication to bearings of the engine is maintained by a rotor type oil pump mounted on the right side of lower crankcase and driven from a worm gear on the camshaft. Oil is drawn by the suction side of the pump through a pipe connecting with a floating screen in the sump. Figure 4.

The oil pump parts consist of an inner and outer rotor, a shaft, and the body and cover. Outstanding characteristics of the pump are longer life and high pressure maintained at low speeds.

Oil pressure is regulated by a built-in non-adjustable release valve and spring accessible through a plug at the left rear side of the engine.
When starting the engine the release valve has moved to a position that closes the oil passage-way to the oil filter and allows full pump flow direct through the main oil gallery extending the full length of the crankcase. This oil gallery is intersected by drilled leads to main and camshaft bearings and valve lifters.

Oil pressure is supplied to the connecting rod bearings through the drilled crankshaft.

The angular hole drilled through the upper half of the connecting rod bearing shell seat is for the purpose of lubricating the cylinder walls. A tube fitted in the front end of main oil gallery directs a small pressure stream of oil at the point where chain meshes with crankshaft sprocket. Returned oil flows over the wide shallow portion of the oil pan where it is cooled before reaching the sump.

The oil measuring gauge seats on a tube pressed in the crankcase at left rear side. A sealed pressure type oil signal switch mounted just above the oil pump and connected with the main oil gallery, is wired to the dash oil signal light. Should oil pressure drop below approximately 13 pounds, the circuit is completed and lights the red dash oil pressure signal. Capacity of the oil pan is 7 quarts for refill and 7-1/2 quarts when pan is removed for cleaning.

**ENGINE OIL CAPACITIES**

The total engine oil capacity is 7-1/2 quarts for six cylinder and 8 quarts for eight cylinder engines. When the oil is drained in the conventional manner, the refilling quantity is 7 quarts for both six and eight cylinder engines.

When the oil pan is removed for cleaning or during service work, two quarts should be placed in the oil pan tray of eight cylinder engines before the pan is installed. The remaining seven quarts should then be placed in the pan through the crankcase filler opening. In six cylinder engines the entire quantity is poured through the crankcase oil filler pipe.

**CHECKING ENGINE OIL LEVEL**

An engine in normal operating condition is expected to use some oil, and it is therefore not unusual to add oil between change periods. Its rate of usage is governed by the individual engine and is dependent on operating speeds, temperatures, and the viscosity and quality of the oil used.

The oil level should be checked each time fuel is added. The gauge is located on the left side of the engine and is marked to show the "Oil Level Range" and the "Low Mark", Figure 5.

The oil measuring gauge seats on a tube pressed in the crankcase at left rear side. A sealed pressure type oil signal switch mounted just above the oil pump and connected with the main oil gallery, is wired to the dash oil signal light. Should oil pressure drop below approximately 13 pounds, the circuit is completed and lights the red dash oil pressure signal. Capacity of the oil pan is 7 quarts for refill and 7-1/2 quarts when pan is removed for cleaning.

For normal operation the oil level is satisfactory when it is within the "Oil Level Range". For high speed operation the level should be maintained at the full mark which is the top line on the "Oil Level Range".

To make an accurate check, wait a minute or two after shutting off the engine to permit the oil to drain back into the oil pan. Approximately three and one-half quarts of oil are required to bring the level from low to full in both
six and eight cylinder engines. If the level happens to be low and the speedometer indicates that the oil change period is near at hand, it is more economical to have the oil changed at that time.

WHEN TO CHANGE ENGINE OIL

The oil which is placed in the engine at the factory is satisfactory for the first 500 miles of operation and should then be changed.

Thereafter, at intervals of 2,000 miles, the oil pan should be drained and refilled. If the car is operated in dusty areas or for short distances at low speeds during cold weather, foreign matter and sludge will accumulate and the oil should be changed more frequently. However, the actual change period is largely dependent on the individual driving circumstances.

The oil is drained by removing the plug at the rear of the oil pan. To insure complete draining, it is important that the operation be performed while the engine is warm.

Recommend to your customer that it is a good practice to remove the oil pan at least twice a year, preferably in the spring and fall to permit thorough cleaning of the screens and pan.

CAUTION: The use of flushing oil or compounds is not recommended. However, in the event they are used, it will be necessary to remove the oil reservoir and thoroughly clean it out before installing the new oil.

THE PROPER ENGINE OIL TO USE

The use of high-grade engine oil of the correct type is of the greatest importance in obtaining maximum engine performance. Always select oils from well-known and dependable brands, and of the proper viscosity to suit the seasonal and customer driving requirements.

The oil refiners or marketers supplying engine oils are responsible for the quality of their products and their reputation, is the car owners best assurance of receiving high-grade lubricants.

TYPES OF OIL

The various types of oil marketed for engine lubrication have been defined by the American Petroleum Institute as follows:

REGULAR MOTOR OIL - This term is used to designate a straight mineral oil. Oils of this type are generally suitable under moderate driving conditions.

PREMIUM MOTOR OIL - This term is used to designate an oil having proved oxidation, stability, and bearing corrosion preventative properties. Oils of this type are generally suitable for use where operating conditions are such that regular oils do not give satisfactory service.

HEAVY-DUTY MOTOR OIL - This term is used to designate an oil having proved oxidation, stability, bearing corrosion preventative properties and detergent characteristics. Oils of this type are generally suitable for use in both high-speed diesel and gasoline engines under heavy-duty service conditions.

It is most important that the oil should have the ability to flow at low temperatures to permit easy starting, and at the same time afford adequate lubrication when the engine is at normal operating temperatures. The oil selected should be based on its ability to perform these two functions at the lowest anticipated temperatures expected before the next oil change period. The illustration, Figure 3, will be helpful in making this selection.

NOTE: Kerosene should be added only when temperatures below - 10° are expected for long periods.
OIL DILUTION

The lubricating oil in the crankcase is sometimes thinned or diluted due to gasoline leaking by pistons and rings and mixing with the oil. This leakage usually occurs during the "warming-up" period when the fuel is not thoroughly vaporized and burned.

The Hudson engines are equipped with automatic devices that are designed to reduce oil thinning caused by raw fuel dilution.

In order to assist the engine to warm up as quickly as possible the water temperature is controlled by a thermostat which prevents complete water circulation for cooling until a predetermined temperature has been reached.

Another thermostat automatically controls the opening of a valve mounted inside the exhaust manifold to vary the amount of heat applied to the walls of the intake manifold. This item combined with the previously mentioned features greatly reduces the cold running periods. As a further safeguard, the Hudson crankcase ventilating system is utilized to expel from the crankcase any ordinary collection of water or fuel vapors. In this system the rotating crankshaft acts as a blower to force such vapors from the case via the breather tubes on the valve chamber cover.

CRANKCASE VENTILATOR

Inlet:

The crankcase ventilator inlet is part of the crankcase oil filler cap assembly on the 6 cylinder engines. This filler cap contains copper gauze which filters the air passing into the crankcase.

The cap should be inspected every time oil is added and should be thoroughly cleaned at least every 5,000 miles. Clean in gasoline and blow dry. Re-oil the filter element gauze.

Outlet:

The crankcase outlet ventilator is mounted at the rear valve cover on both 6 and 8 cylinder engines.

In cases of excessive oil usage or leaks at rear main bearing, check the outlet breather pipe. This pipe may be plugged with dirt, and on the 8 cylinder engines, it may be restricting at the valve cover baffle. DO NOT tighten the breather outlet pipe attaching bolt more than 2 - 3/4 to 3 - 1/4 torque pounds.

CAPACITIES

<table>
<thead>
<tr>
<th></th>
<th>Engine Oil - Dry</th>
<th>Engine Oil-Refill</th>
<th>Clutch</th>
<th>Transmission</th>
<th>Transmission &amp; Overdrive</th>
<th>Hydra-Matic Refill</th>
<th>Rear Axle</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Quarts</td>
<td>7-1/2</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>3 - 1/4</td>
</tr>
<tr>
<td>Imperial Quarts</td>
<td>6-1/2</td>
<td>7-1/2</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SECTION 2

ENGINE TUNE-UP

SPECIFICATIONS

Cylinder Compression
Vacuum, Intake Manifold
Valve Tappet Clearance (Hot), 6 and 8 cylinder:
  Intake
  Exhaust
Battery Specific Gravity

<table>
<thead>
<tr>
<th>All Models</th>
<th>Minimum, 100 lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17-18&quot; Hq.</td>
</tr>
<tr>
<td>.008&quot;</td>
<td>.010&quot;</td>
</tr>
<tr>
<td>1 285</td>
<td></td>
</tr>
</tbody>
</table>

Starter Motor:
  Cranking Voltage
  Cranking Amperage
  (Engine Warm)
Stall test:
  Volts
  Amperes
  Torque
  Condenser Capacity
  Coil Amperage Draw:
    Engine stopped
    Engine idling
Distributor:
  Point Gap
  Cam Angle (Dwell)
  Spring tension
  Vacuum Advance:

<table>
<thead>
<tr>
<th>MODEL 4A</th>
<th>MODELS 5A, 6A, 7A AND 8A</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 Volts, 68 Max. Amps.</td>
<td>5.0 Volts, 65 Max. Amps</td>
</tr>
<tr>
<td>Approximately 160 Amps. at 120 RPM</td>
<td>Approximately 160 Amps. at 120 RPM</td>
</tr>
<tr>
<td>2.0 Volts</td>
<td>2.0 Volts</td>
</tr>
<tr>
<td>280 Max. Amps.</td>
<td>335 Max. Amps.</td>
</tr>
<tr>
<td>4.4 Min. Ft. Lbs</td>
<td>6.0 Min. Ft. Lbs.</td>
</tr>
<tr>
<td>.20-.25 mfd.</td>
<td>.20-.25 mfd.</td>
</tr>
<tr>
<td>5.0 Amps.</td>
<td>4.5 Amps.</td>
</tr>
<tr>
<td>1.5 - 2.0 Amps</td>
<td>2.5 Amps</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MODEL 4A</th>
<th>5A, 6A, 7A</th>
<th>8A</th>
</tr>
</thead>
<tbody>
<tr>
<td>.020&quot;</td>
<td>.020&quot;</td>
<td>.017&quot;</td>
</tr>
<tr>
<td>38°</td>
<td>38°</td>
<td>27°</td>
</tr>
<tr>
<td>17-20 oz.</td>
<td>17-20 oz.</td>
<td>17-20 oz.</td>
</tr>
<tr>
<td>4° at 12&quot; Hq</td>
<td>3.75° at 8&quot; Hq.</td>
<td>4° at 8&quot; Hq</td>
</tr>
<tr>
<td>10° at 1200 RPM.</td>
<td>9° at 2000 RPM</td>
<td></td>
</tr>
</tbody>
</table>

Generator Output:
  RPM Cold 870; Hot 950
  RPM Cold 1800; Hot 2000
Voltage Regulator:
  Cutout Relay points open
  Cutout Relay points close
Voltage Regulator Operates
Spark Plug Gap
Fuel Pump Pressure:
  Carter
  A.C.
Fuel Pump Vacuum
Fuel Pump Volume

<table>
<thead>
<tr>
<th>MODEL 4A</th>
<th>5A, 6A, 7A</th>
<th>8A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>3/16&quot;</td>
<td>3/16&quot;</td>
</tr>
<tr>
<td>16/64&quot;</td>
<td>5/16&quot;</td>
<td>5/16&quot;</td>
</tr>
<tr>
<td>1/2 to 1 - 1/2 turns open</td>
<td>1/2 to 1 - 1/2 turns open</td>
<td>1/2 to 1 - 1/2 turns open</td>
</tr>
<tr>
<td>Set at index</td>
<td>Set at index</td>
<td>Set one point lean</td>
</tr>
</tbody>
</table>

Carburetor:
Float Setting
Pump travel
Idle adjustment
Climatic Control
ENGINE TUNE-UP

Engine tune-up is important in maintaining engine performance, fuel economy, dependability, and complete owner satisfaction. Modern high compression, high speed engines demand accurate diagnosis and adjustment.

Performance of the gasoline engine depends upon:

1. Compression
2. Ignition
3. Carburetion

A master type engine tester is desirable for accurate diagnosis. If the complete engine tester is not available, the following individual units are essential:

- Compression gauge
- Vacuum gauge
- Carburetor float and metering rod gauges
- Neon timing light
- Voltmeter (1/10 volt divisions)
- Ammeter
- Hydrometer
- Feeler gauge stock
- Spring scale

The following additional units are desirable:

1. Cylinder balance tester
2. Fuel pump tester
3. Coil tester
4. Condenser tester
5. Distributor tester
6. Rheostat (3 amp. 50 ohm)
7. Combustion tester
8. Battery cell tester or Battery-Starter Tester

Accurate testing equipment in good condition is essential to proper diagnosis. If a master tester is used, the battery of the tester should be maintained in a fully charged condition. All connections should be clean, tight. Test leads and clips should be of proper size with soldered connections.

The tune-up procedure that follows is arranged in the usual order of performance, which is generally: compression, ignition, carburetion. Various manufacturers of testing equipment have specific procedures for their units which may be followed.

BATTERY

Many of the tests involved in tune-up are dependent upon a battery in good condition. If the battery is below standard, it should be recharged, or replaced with a fully charged battery before the tune-up.

BATTERY SPECIFIC GRAVITY

Check the battery specific gravity with a hydrometer, Figure 1. A uniform hydrometer reading below 1.225 at 70°F indicates a low battery that should be recharged.

FIGURE 1

If gravity varies more than 25 points between cells, battery should be recharged and tested under load.

BATTERY LOAD TEST

Battery may be tested under load by connecting a voltmeter across the battery terminals and cranking the engine. Battery is satisfactory if it will crank the engine at a good speed for 1/2 minute and the voltage does not fall below 4 1/2 volts. Slow cranking speed or lower voltage may be due to high resistance in the starter circuit. Check cables and retest. (DO NOT CRANK MORE THAN 1/2 MINUTE AT A TIME).
A standard cell tester may be used to make the load test. The cell tester has a shunt across the terminals which places each cell under load. Each cell should show 1 - 1/2 volts or over, and the variation between cells should not exceed .15 volts.

If a starter-battery tester, Figure 2, is available, make the load test as follows:

1. Connect ammeter and voltmeter positive leads to the battery positive terminal post.

2. Connect ammeter and voltmeter negative leads to the battery negative terminal.

3. Turn voltmeter knob to the 15 volt position.

4. Turn tester knob to the battery position until ammeter shows a 300 ampere discharge. Quickly read voltmeter and reduce discharge. At 300 ampere discharge the voltage should be 4 volts or more.

5. Recharge or replace battery if voltage is lower than 4 volts.

6. Turn knob to "off" position and disconnect leads.

An engine that fails to develop proper compression cannot be tuned to satisfaction. Compression should be checked with the engine at operating temperature with a reliable compression gauge, Figure 3.

1. Remove carburetor air cleaner and open throttle.

2. Remove all spark plugs.

3. Insert compression gauge in each spark plug hole in turn and crank engine with starter.

4. Compression at each cylinder should be at least 100 pounds. Compression between cylinders should not vary more than 10 pounds.

   **NOTE:** If gauge moves up in jerky steps of 10 or 20 pounds at a time, it generally indicates a sticky or leaking valve. If two adjacent cylinders show low compression reading, a leaking head gasket or loose cylinder head bolts are indicated.

5. If compression is low, inject a small quantity of oil in the cylinder to seal the rings and retest.
6. If compression is higher on second test, worn piston rings are indicated.

7. If compression remains low on second test, valve operation is faulty or piston may be cracked or damaged.

Correct any unsatisfactory conditions found on the compression test before continuing the tune-up.

2. Clean the plugs with an approved spark plug cleaner.

3. Adjust spark plug gaps to .032" using a bending tool and wire loop gauge, Figures 4 and 5.

4. Install NEW gaskets on the plugs and replace plugs in cylinder head.

5. Tighten plugs finger tight then tighten with a torque wrench, to 25 to 30 foot pounds. (If torque wrench is not available, tighten 3/4 of a turn).

6. Examine spark plug wires for loose terminals, cracked or broken insulation. Replace defective wires.

NOTE: Spark plug condition often indicates other engine troubles. See "Electrical Section."

SPARK PLUGS

Upon satisfactory completion of the compression test, inspect, clean and adjust spark plugs.

1. Spark plugs with burned, blistered, or cracked porcelain s, or with pitted or burned electrodes, should be replaced with new plugs of the same type. For cast iron and aluminum cylinder heads, use Champion H-8 spark plugs.

2. Clean the plugs with an approved spark plug cleaner.

3. Adjust spark plug gaps to .032" using a bending tool and wire loop gauge, Figures 4 and 5.

4. Install NEW gaskets on the plugs and replace plugs in cylinder head.

5. Examine spark plug wires for loose terminals, cracked or broken insulation. Replace defective wires.

VACUUM TEST

An engine in good condition will show a steady, or slightly fluctuating, high vacuum reading of from 17" to le. Vacuum readings are affected by altitude. Over 2000 feet the vacuum gauge will show about one inch lower for each thousand feet elevation.

1. Attach vacuum gauge to wiper hose connection, Figure 6. (If engine has a combination fuel and vacuum pump, disconnect the booster line and plug manifold connection opening.)
2. Check to see that carburetor and intake manifold nuts are tight.

3. Adjust carburetor to obtain smooth idle at 540 to 560 RPM. (If engine is equipped with Drive-Master, set idle at 580 to 600 RPM.) See "Section 11" on cars equipped with Hydra-Matic. Vacuum readings may be interpreted generally as follows:

17--18" Steady or with slight fluctuation: Engine in good condition.
15” Steady: Incorrect ignition timing.
10” Steady: Incorrect Valve timing or burned valves.
15 - -21" Fluctuating: Sticking valves or compression leak.
12 - -16" Drifting: Carburetor too rich or too lean.

Any number of engine conditions may cause the same action of the vacuum gauge. Exact cause must be established by elimination.

**TAPPET ADJUSTMENT**

To adjust tappets on six or eight cylinder engines, proceed as follows:

1. Raise front end of car and place stand jacks under frame crossmember.

2. Remove the right front wheel.

3. Remove the three headlight wires from terminal block to permit fender side dust shield removal.

4. Place a support below the hood and remove the top (right side) hood prop bolt to allow hood prop to remain attached to fender side shield.

5. Remove the twelve 1/4" - 20 hex bolts on the fender side dust shield and remove dust shield down and out under the fender.

6. From under the fender, reach up and remove the front tappet cover bolt.

7. Remove the rear tappet cover bolt and the breather pipe. Remove the rear tappet cover by sliding cover forward and out.

8. Remove the lower breather pipe bracket at engine rear end plate and remove breather pipe.


After tappet adjustment has been completed reinstall parts.

**NOTE:** Use care when tightening the rear tappet cover and breather pipe attaching screw on eight cylinder engines, so breather pipe will not bottom against valve cover inner baffle and restrict ventilator. Tighten to 3 pounds torque.

---

**VALVES AND TAPPETS**

Check the valve tappet clearance when engine is at normal operating temperature, Figure 7.

The intake and exhaust valve clearances are as follows:

<table>
<thead>
<tr>
<th></th>
<th>All 6 Cylinder</th>
<th>8 Cylinder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake</td>
<td>.008</td>
<td>.008</td>
</tr>
<tr>
<td>Exhaust</td>
<td>.010</td>
<td>.010</td>
</tr>
</tbody>
</table>
STARTER MOTOR

CRANKING VOLTAGE:
1. Connect the negative voltmeter lead to the starter switch terminal (where the battery to starter cable is connected), Figure 8.

2. Connect the positive voltmeter lead to the engine for a ground.
   If a starter-battery tester is used, turn the selector knob to the 15 volt position.
3. With the ignition key off, engage the starter motor and note reading on the voltmeter. The cranking voltage should read 5 volts or more.
   **CAUTION:** Crank engine intermittently (not more than 30 seconds) to prevent starter motor from overheating.
4. If the voltmeter reading is less than 5 volts, check the battery and engine ground straps, starter cable and the starter solenoid to determine the cause for the low reading.

BATTERY AND ENGINE GROUND STRAPS:
1. Connect the voltmeter positive lead to the battery ground terminal post, Figure 9.
2. Connect the voltmeter negative lead to engine ground and a jumper to the frame.
3. With ignition off, crank engine and make voltmeter reading, (should not be more than .2).
4. If more than .2, check ground strap connections from battery to frame and from engine to frame. Replace defective ground straps.

STARTER CABLE:
1. Connect the positive voltmeter lead to the "Bat" terminal of starter and negative lead to negative battery post.
2. Crank engine again (ignition off). Now if voltmeter reading is more than .2, check for loose connections or frayed cables.

STARTER SOLENOID:
1. Connect negative voltmeter lead to "Bat" terminal of starter solenoid switch and positive lead to motor terminal of the solenoid switch, Figure 10.
2. Close the solenoid electrically to crank the engine; and if the reading is more than 0.2 volts, replace the solenoid switch.

**AMPERAGE DRAW TEST:**

1. Turn battery starter tester knob "off" position.
2. Turn the voltmeter "selector switch" to the 15 volt position and connect test leads, Figure 11.
3. Press starter switch and crank engine for approximately 15 seconds and note the "exact" reading on voltmeter.
4. Release starting motor switch and turn battery tester control knob clockwise until voltmeter reads "exactly" the same as when cranking the engine with starter.
5. Rear "Test Ammeter" for starting motor amperage draw.
6. After completing amperage draw test, turn control knob to "off" position.
7. Current required to crank the engine should be approximately 160 to 180 amperes with engine warm.

Low readings indicate excessive resistance in the circuit caused by loose connections, worn brushes, or weak brush spring tension.

**DISTRIBUTOR**

**DISTRIBUTOR CAP AND ROTOR:**

1. Remove wires from cap and remove cap.
2. Inspect cap and rotor for cracks and burned or corroded contacts. Replace any defective part.

**CONTACT POINTS:**

1. Inspect distributor contact points for alignment, corrosion, burning or pitting.
2. Clean points with carbon tetrachloride.
3. Replace burned or corroded points. If points are badly pitted, check condenser for over or under capacity. DO NOT try to hone badly pitted contact points.
4. With a feeler gauge set the points for proper gap. Correct gap for 6 cylinder distributors is .020", for 8 cylinder distributors .017".

NOTE: Contact point adjustment is made by first loosening the clamp screw (B) Figures 12 and 13, holding the stationary contact plate, then turn the eccentric adjusting screw (D) to move the stationary contact point. Tighten clamp screw when correct gap is secured.

5. Bend stationary contact if necessary to secure correct alignment.

BREAKER ARM SPRING TENSION:

1. Hook a spring scale to the breaker arm at the contact and pull at right angles to the contact surface. Tension should be 17 to 20 ounces just as the points open.

2. Adjust spring tension by loosening screw attaching breaker arm spring to plate and move end of spring in or out of clip as necessary.

POINT RESISTANCE TEST:

1. Connect the negative lead (Sun Tach-Dwell Unit) to the distributor primary terminal Figure 14. Connect the positive lead to ground.

2. Crank engine until the distributor contact points close.

3. Turn the dwell control knob to 6-lobe position on Sun Unit No. 10, or to "Calibrate" on Unit No. 10-A or 150-A.

4. Turn ignition key on. The meter should read in the band marked "point resistance" on the right hand side of the dwell scale for normal distributor resistance.

5. Clean or replace points as necessary.

CONDENSER TEST

1. Block distributor points open with a piece of fibre. Disconnect the primary lead wire at the distributor.

2. Check condenser lead to see that it is not frayed or broken and is connected securely to breaker arm clip. Condenser mounting screw must make tight ground to breaker plate. Ground wire from breaker plate to subplate must be securely connected.
3. Connect the two condenser test leads together.

4. Turn the condenser control knob to the "Microhm" position and allow the tester to warm up for one minute. Then turn the control knob to read on the set line.

5. Connect the red lead to the distributor primary terminal and connect the black lead to the condenser shell, Figure 15.

6. With the control knob turned to the "Microhm" position, the meter should read in the blue bar marked "MIC" at the right side for satisfactory condenser circuit resistance.

7. Turn the condenser switch to the "Microfarad". The meter should read 20 to 25 microfarads for both six and eight cylinder engines.

8. Turn the condenser switch to the "Megohm" position. Meter should now read in the blue bar at left side marked "MEG" for satisfactory condenser insulation. If the meter reads in the red bar or over to the extreme right, replace the condenser.

NOTE: When making the above checks, the condenser should be at operating temperatures.

DISTRIBUTOR CAM ANGLE (DWELL):

1. With Sun Unit connected as for point resistance, Figure 16, replace distributor cap and spark plug wires, and replace distributor primary wire.

2. Turn switch to "Calibrate" position and adjust Dwell Regulator until meter reads to "Set Line".

   Turn the dwell switch knob to the 6-lobe position for the Hudson Six and the 8-lobe position for the Hudson Eight.

3. Turn on ignition and start engine. Note the reading on the Dwell Meter. The dwell angle on the Hudson Six is 38 degrees, breaker points set at .020", and the dwell angle on the Hudson Eight is 27 degrees, breaker points set at .017".
This test will indicate:

(1) The breaker contact opening.

(2) The condition of the breaker cam.

(3) The condition of the distributor shaft and bearings.

(4) The condition of the breaker plate bearing and support.

5. If the dwell angle is too great, the contact point gap is set too close. If the dwell angle is too small, the contact gap is too wide.

6. An erratic reading of the dwell angle meter will indicate faulty contacts, a faulty breaker plate, or a worn distributor shaft and bearings.

7. A change of dwell angle when accelerating or decelerating the engine will indicate a faulty breaker plate, bearing or support.

**VACUUM ADVANCE ADJUSTMENT:**

Vacuum advance should be checked on a distributor test fixture that has a controlled source of vacuum and a vacuum gauge.

1. Place distributor in the distributor clamp and tighten securely with the hand wheel at the right side of clamp.

2. Adjust the vertical screw so distributor shaft fits down into the drive chuck.

3. Use special wrench to tighten the distributor shaft in the drive chuck.

4. Connect red tipped distributor lead to binding post at the side of the distributor.

5. Attach vacuum pump connection.

6. Turn cam lobe switch to Battery Check position. Tachometer indicating hand should read in bar at right end of scale.

7. Test distributor point spring tension scale. The spring tension is 17 to 20 ounces on both the six and eight cylinder distributors.

8. Turn on battery switch at left side of tester head.

9. With cam lobe switch in the 6-lobe position and distributor contact points closed, the dwell meter indicating hand must read in black bar for satisfactory point resistance. If the reading is in the red band, it indicates dirty contact points, loose connections, or resistance within the distributor circuit.

10. Turn the motor drive switch to left or right hand rotation as indicated by the specifications for the distributor being tested.

11. Adjust the speed control crank until the Tachometer reads 200 RPM.

12. Adjust the distributor contact points until proper degrees of dwell is indicated.

13. Turn graduated degree ring until the arrow flash appears at 0.

14. Then check to see if all flashes appear at 60 degree intervals for the Hudson Six and at 45 degree intervals for the Hudson Eight. If the flashes do not appear to within one degree of the respective angles, it indicates an inaccurate cam.

15. Turn vacuum switch to the "ON" position.

16. Set degree ring so arrow will be on zero at a most convenient point to read.

17. Adjust vacuum regulator to obtain correct reading on vacuum regulator for exact point the vacuum advance starts to operate, and compare with specifications. Adjust the vacuum regulator to each specification and check the arrow flash on the degree ring.

18. Watch the arrow on the degree ring as the vacuum regulator is adjusted to the point vacuum advance starts to operate. Compare the reading with specifications and adjust the vacuum regulator to each specification check the arrow flash on the degree ring.

18. If the degree indicated on ring is more than specified, the unit is advancing too quickly showing the return spring is too weak.
20. If the degree indicated on the ring is less than the specifications, the unit is advancing too slowly showing the return spring is too strong.

21. Vacuum advance characteristics are varied by changing the spring pressure or by inserting or removing washers under the end of the spring in the vacuum chamber.

**AUTOMATIC ADVANCE CURVE:**

1. Adjust speed control so that distributor will rotate at the lowest RPM.

2. Set degree ring so arrow will flash at zero at a point most convenient to read.

3. Increase distributor RPM to correspond with specifications marked "Start".

4. Check the RPM required to advance the arrow flash to the specifications given.

5. Be sure the advance is opposite the rotation of the distributor shaft.

6. Continue to check the advance curve RPM against degree of advance and compare this with specifications.

7. If the degree of advance on the degree ring is more than specifications call for at the same RPM, it indicates that the governor spring tension is too weak and the advance is too rapid.

8. If the degree of advance on the degree ring is less than specifications call for at the same RPM, the spring tension is too stiff and the advance is too slow.

9. Check the advance both up and down the speed range so that the sluggish action of the governor mechanism will be indicated and may be corrected by cleaning and lubrication.

**NOTE:** Every 2,000 miles, lubricate contact arm pivot, wick top of shaft, cam lobes and 3 to 5 drops of medium engine oil at oiler.

---

**FIGURE 17**

**COIL**

**COIL TEST:**

1. Connect leads of coil breaker unit as shown in Figure 17.

2. Turn on ignition switch.

3. Turn on master control switch on Sun Tester.

4. Turn the switch to "Coil set" and adjust coil set regulator until the meter reads on set line. *(NOTE: Line one for Auto-Lite coils).*

5. Turn switch to coil test position, the meter reading must be within the "Good coil" band and hold steady to denote a good coil.

A reading outside the "Good coil" area or an erratic reading of 3 to 5 division inside "good coil" band indicates bad coil.

6. Turn ignition switch off.

7. Turn the tester control knob to the milliamp position.
NOTE: If the coil meter does not read in the "Good coil" band, remove the coil cap and connect test leads directly to the primary connections.

After making direct connections to the coil, retest, and if the meter does not read in the "good coil" band, replace the coil.

**FIGURE 18**

**COIL SECONDARY RESISTANCE CHECK:**

1. Connect ground (Blue) and positive primary (red insulator) test leads together.

2. Turn master switch "On".

3. Turn tester switch to Dwell-Ohm position, and adjust Dwell-Ohm Regulator until meter reads on "Set" line.

4. Separate the positive primary and ground test leads, connect the positive primary lead to the primary ignition wire which was removed from the distributor, Figure 18.

5. Insert the short test lead into the high tension post of the coil and connect the ground lead directly to the short test lead.

6. Meter should read from 2,000 to 10,000 OHM's resistance. If the meter reads outside this range, replace coil.

---

**FIGURE 19**

**SPARK PLUG MILLIAMPERE TEST:**

1. Connect test leads of the coil breaker unit shown in Figure 19.

2. Run engine at idle speed.

3. Turn switch to MILLIAMP position.

4. Read the coil meter Milliampere scale.

**NOTE:** The reading should be the same at each spark plug. A low reading (established on a comparative basis) might indicate a weak coil, excessive resistance either in the primary or secondary circuit, corroded terminals, or poor connections.

**NOTE:** The distributor cap has a built-in resistor which will give a slightly lower reading than previous models.

**IGNITION TIMING:**

The following procedure and timing applies to both the six and eight cylinder engines:

1. Connect the power timing light to No. 1 spark plug and battery as shown in Figure 19.

**NOTE:** With the engine idling properly the spark should occur when the dead center mark (long line) on the fly wheel is in line with the pointer at the opening of the rear engine support plate.

If timing is off, make the necessary correction by first loosening the distributor advance arm screw (on octane selector) and rotate distributor clockwise for retard and counter clockwise for advance.
ENGINE TUNE-UP 2 - 13

2. Increase engine speed.

**NOTE:** The vacuum advance should be at full retard position but should advance readily when the engine speed is increased. Spark setting may be advanced during continuous high altitude operation or with fuels of high octane rating of 80 or higher.

Maximum performance is attained only with the proper spark setting.

**FAN BELT ADJUSTMENT:**

Adjustment of the fan belt is possible by moving the generator towards the engine or away on the generator adjusting bracket.

This movement increases or decreases the tension on the fan belt. The proper adjustment is 3/4" slack, Figure 21. The fan belt is properly adjusted when the generator pulley can be just turned by hand. DO NOT TRY to turn the generator pulley with the fan belt.

**FIGURE 21**

**NOTE:** Be sure to tighten generator attaching bolts securely after adjustment.

**GENERATOR OUTPUT CHECK:**

1. Disconnect battery lead at voltage regulator "B" terminal; connect the ammeter negative lead to the regulator "B" terminal and the positive lead to the wire disconnected from the regulator, Figure 22.

2. Install a jumper from generator field terminal to a ground.

**FIGURE 22**
Momentarily raise the engine speed to approximately 2500 RPM, the reading on the ammeter should read 50 amperes — minimum output.

**CAUTION:** The engine MUST NOT be run for more than a few seconds while making the above test, due to the danger of burning out the generator.

**NOTE:** If the above test is made with a resistor type tester, the resistance knob must be turned to the out position.

**GENERATOR CIRCUIT RESISTANCE CHECK:**

1. Disconnect battery lead at voltage regulator or "B" terminal; connect the ammeter negative lead to the regulator "B" terminal and the positive lead to the wire disconnected from the regulator, Figure 23.

2. Install the negative voltmeter lead to the generator "A" terminal and the positive voltmeter lead to the battery negative terminal.

3. Connect a jumper between the generator "F" terminal and a ground.

4. Run the engine at 2000 RPM or 20 amperes. The voltmeter should read not over .8 (tenths) or less.

5. If the resistance is more than .8, make the following checks with the ammeter connected as in paragraph 1.
   A. Remove the positive voltmeter lead from the battery and install to the "A" terminal at the voltage regulator. Ammeter should show less than .1 (tenth).
   B. Connect the voltmeter negative lead to the regulator "A" terminal and the voltmeter positive lead to the regulator "B" terminal. Ammeter should not show more than .3 (tenths).
   C. Next, connect the voltmeter positive lead to the battery negative terminal, negative lead to "B" terminal on regulator. Ammeter should not show more than .5 (tenths).
   D. Connect the voltmeter positive leads to engine ground, negative wire to base of regulator. Ammeter should show .2 (tenths) or less.

**CIRCUIT BREAKER CHECK:**

To determine whether the circuit breaker points are closing at the proper generator voltage and also whether they will open upon deceleration by amperage from the battery proceed as follows:

1. Disconnect the battery wire at the voltage regulator "B" terminal and connect the ammeter between the voltage regulator "B" terminal and the wire disconnected, Figure 24.

2. Connect voltmeter positive lead to base of regulator and negative voltmeter lead to the generator "A" terminal.

3. Set carburetor throttle lever adjusting screw so engine will idle at approximately 400 RPM.

4. Increase engine RPM by carefully rotating the accelerator bellcrank while watching the voltmeter gauge.

**NOTE:** When the voltmeter reads at any point between 6.4 to 7 volts the circuit breaker...
points should close and the ammeter will now show that the generator is charging.

5. Next slowly reduce the engine speed and watch the ammeter.

**NOTE:** When the ammeter reads 4 to 6 amperes, negative side of zero, the circuit breaker should open and the ammeter needle will return to zero. Perform operations 4 and 5 several times until you are sure your readings are correct.

6. Proper adjustments can be made by bending the spring hanger on the circuit breaker.

**VOLTAGE REGULATOR CHECK:**

1. Disconnect the battery wire at the voltage regulator "B" terminal and connect the test ammeter between the voltage regulator "B" terminal and the wire disconnected.

2. Connect the voltmeter positive lead to the regulator base and the negative lead to the "B" terminal, Figure 25.

3. Run engine at approximately 2000 RPM.

4. Turn resistor knob in until ammeter reads 10 to 15 amperes and then check the voltmeter reading which should be 7.2 to 7.5 volts.

**NOTE:** If car is out of warranty the voltage regulator can be set by bending the spring hanger to get this necessary reading. The unit must be final-checked with the voltage regulator cap in place as generally it will change the reading from .1 to .2 of a volt and must be compensated for in making this adjustment.

5. Stop engine, disconnect battery negative terminal and then proceed to remove the tester leads from the voltage regulator and install the wires back onto the "B" terminal of the regulator.

6. Install the voltage regulator cover.

**CURRENT REGULATOR CHECK:**

1. Disconnect the battery wire at the voltage regulator "B" terminal and connect the test ammeter between the voltage regulator "B" terminal and the wire disconnected, Figure 26.

2. Connect a starter battery tester directly across the battery and set load to 50 amperes, or use the equivalent in seal beam lamps.

3. Run engine to approximately 2000 RPM amperage reading should be 36 amperes. If it is not within a tolerance of one to two amperes of this reading, the regulator should be removed and taken to an authorized Auto-Lite dealer for replacement.

**NOTE:** If car is out of warranty, remove the voltage cover and adjust the current regulator spring hanger to the necessary 36 ampere output. To prevent operation of the voltage regulator unit while making this adjustment, place a jumper across the voltage regulator points. For final checking, the regulator cover must be in place on regulator.

**CAUTION:** Momentarily touch the negative battery cable to battery negative post to determine that there is no sparking between the battery negative post and cable terminal, then connect negative cable.
FUEL PUMP

FUEL PUMP TEST:

The fuel pump should be tested to make certain that it will draw an adequate supply of fuel from the tank and deliver the fuel to the carburetor at a constant pressure under the varying conditions of fuel consumption and engine speed.
1. Remove and clean the fuel pump sediment bowl and screen.
2. Replace the screen if damaged.

NOTE: If the combination fuel and vacuum pump is used, remove and clean the air filter screen located under the cover at the top of the pump.

3. Make sure all connections and cover screws are tight after replacement.

4. Disconnect the fuel line at the carburetor and connect the fuel pump gauge, Figure 27.

5. Start the engine and run at 1800 RPM. Normal pressure should be 3 to 4 pounds with AC combination fuel and vacuum pump and 3 - 1/2 to 4 - 1/2 pounds with Carter M-729SZ. Stop engine and watch pressure gauge. Pressure should not fall perceptible after engine is stopped.
6. If pressure falls, leaking pump valves are indicated
7. If pressure is below specifications, attach the vacuum gauge to the inlet port of the pump and operate engine. Gauge should show a minimum of 6 inches of mercury for satisfactory operation.
8. If fuel pump pressure is low, but vacuum reading satisfactory: difficulty is in the gasoline tank or lines to the pump.
9. If pump pressure and vacuum are both low, pump should be repaired or replaced.

VACUUM BOOSTER CHECK:

To check the action of the vacuum portion of the combination fuel and vacuum pump, connect a vacuum gauge to the inlet port and disconnect outlet. Gauge should show 8-1/2” of mercury at 120 RPM and 12” at 1800 RPM.

MANIFOLD HEAT CONTROL:

Check the manifold heat control valve to see that spring is in good condition and valve is free.

CLIMATIC CONTROL:

1. Remove the carburetor Climatic Control cover.
2. Check the heat control tube for leaks or obstruction.
3. Check choke valve and piston for free movement. Choke valve should open of its own weight when cover is removed.
4. Reinstall the cover with graduations down and rotate counter clockwise to center graduation for WA1 and WGD-773 - S and one point lean for WGD-776-S.

CARBURETOR INLET STRAINER:

1. Remove bowl cover strainer nut, gasket, and strainer screen.
2. Clean screen and examine for breaks or corrosion. Replace defective screen.
3. Replace strainer screen, gasket and nut.

CARBURETOR FLOAT CHECK:

1. Remove air cleaner.
2. Remove carburetor dust cover.
3. Remove screws attaching carburetor air horn.
4. Disconnect throttle connector rod and remove bowl cover.
5. Float setting should be measured as in Figure 28 for WA1-749S and Figure 29 for WGD-773-S and WGD-776-S.

<table>
<thead>
<tr>
<th>Float Setting</th>
<th>Gauge Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>WGD-773-S</td>
<td>J-818-3</td>
</tr>
<tr>
<td>WGD-776-S</td>
<td>J-818-3</td>
</tr>
<tr>
<td>Carter WA 1 - 749-S</td>
<td>J-818-1</td>
</tr>
</tbody>
</table>

**NOTE:** Make sure needle is properly seated before checking float level.

6. To adjust, raise float and press down on float lever lip with a screwdriver. Bend only a small amount at a time and do not disturb curvature of the lip.

7. Reinstall float cover.

**PUMP TRAVEL (WGD) (WA1):**

1. Back out throttle adjusting screw to seat throttle valve.

2. Pump connector link should be in outer hole in pump arm (long stroke) on dual carburetor and in the lower hole (short stroke) on the single carburetor.

3. Pump travel should be as follows:

<table>
<thead>
<tr>
<th>Cyl.</th>
<th>Carter WGD-773-S</th>
<th>5/16&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Carter WGD-776-S</td>
<td>5/16&quot;</td>
</tr>
<tr>
<td>6</td>
<td>Carter WA J-749-S</td>
<td>16/64&quot;</td>
</tr>
</tbody>
</table>


3. Adjust pump travel by bending the throttle connecting link at lower angle for WA1 carburetors and at the upper angle for WGD carburetors at (C), Figure 30.

**METERING ROD SETTING (WGD):**

**NOTE:** The metering rods must be adjusted after the pump travel adjustment or when leaner than standard rods are installed. (No metering rod gauges are necessary for this
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adjustment).

FIGURE 31

1. With the throttle lever set screw backed out as in "Pump Adjustment", press down on vacuum link (I), Figure 31, until metering rods bottom.

2. With metering rods bottoming, revolve metering arm (K) until lip (H) (see insert) contacts vacuum link (I). Hold arm (K) towards connector link side and carefully tighten the metering rod arm set screw (J).

METERING ROD SETTING WA1:

1. Remove air cleaner and dust cover.
2. Remove hairpin clip and disconnect spring from metering rod.
3. Remove metering rod and disk.
4. Insert metering rod gauge, J-1265 (Carter No. T-109-102). Hold gauge vertical and be sure gauge is seated in metering rod jet, Figure 32.
5. Press down on vacuum piston link directly over piston until it contacts the pump arm.

Clearance between metering rod pin and shoulder of gauge should be less than .005" with throttle valve seated. Gauge must not drag on pin.

Adjust by bending lip on piston link at (A). Remove gauge and install metering rod and disk.

FIGURE 32

ANTI-PERCOLATOR ADJUSTMENT WA1:

NOTE: Carburetor must be removed from engine.

METERING ROD SETTING ON VACUUMETER CARBURETOR

FIGURE 33

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1. Crack throttle valve .020" by placing gauge J-1633 (Carburetor No. T-109-29), between throttle valve and bore of carburetor on side opposite the idle port, Figure 33.

2. Clearance between percolator rocker arm lip and pump arm should be .005" to .015".

3. Adjust by bending the rocker arm, Figure 34, using Bending Tool J-1389 to obtain this clearance.

**FAST IDLE ADJUSTMENT WGD:**

1. With the thermostatic coil housing, gasket and baffle plate removed, open throttle valve (F), Figure 35, and hold choke valve closed by holding arm down on choke lever (L).

2. Then close throttle. There should now be .026" clearance (use gauge KMO-658-T-109-189) between the throttle valve and bore of carburetor (side opposite idle port). Adjust by bending the choke connector rod at lower angle (M).

**FAST IDLE ADJUSTMENT WA1:**

1. With fast idle cam in normal idle position, tighten throttle lever adjusting screw, Figure 36, until it just seats against the cam.

2. Hold throttle lever closed and pull cam back until low step is against but not on set screw (B), Figure 35.

3. Clearance between lower edge of choke valve and air horn should be 5/8" as shown at (A), Figure 38.
UNLOADER ADJUSTMENT WGD:

This adjustment must be made after making the fast idle adjustment.

1. Hold the throttle valve wide open and close the choke valve as far as possible without forcing.

2. Check clearance between upper edge of choke valve and inner wall of air horn; this should be 1/8" (use Tool J-818-5), Figure 37.

3. If adjustment is necessary, bend arm (N) on choke trip lever (Use Tool T-109-187).

UNLOADER ADJUSTMENT WA1:

1. Open throttle wide open and check clearance between lower edge of choke valve and air horn. Clearance should be 7/16" (A), Figure 38.

2. Adjust by bending cam (B) on throttle lever.

IDLE ADJUSTMENT WGD:

1. With carburetor installed on engine, start engine and allow engine to warm up.

3. See that choke valve is wide open.

4. Set idle adjustment screws (A), Figure 39, to obtain smooth idle at 540 to 560 RPM. (If car is equipped with Drive-Master, set idle at 580 to 600 RPM). See "Section 11" on cars equipped with Hydra-Matic.

5. On eight cylinder engines the normal screw setting is 1 to 1 - 1/2 turns open, on six cylinder engines 1/2 to 1 - 1/2 turns open.

IDLE ADJUSTMENT WA1:

1. Start engine and allow to warm up.

2. See that choke valve is wide open.

3. Set idle adjustment screw (A), Figure 40, to obtain smooth idle at 540 to 560 RPM.

4. Normal setting is 1/2 to 1 - 1/2 turns open.
AIR CLEANER, GAUZE TYPE:

1. Remove the attaching Wing nut and cover from air cleaner.

2. Wash air filter in kerosene and blow dry.

3. Re-oil with engine oil and allow to drain and reinstall.

OIL BATH AIR CLEANER:

1. Loosen wing bolt sufficiently to allow the air cleaner reservoir to be slid out from the bracket attached to the motor.

2. Remove cover and filter unit.

3. Wash filter unit in kerosene and blow out until partially dry.

4. Clean out old oil and sediment from cleaner reservoir.

5. Refill to oil level line with 50 SAE engine oil for temperatures above 32°F and 20 SAE for lower temperatures. Reinstall air cleaner, reversing procedure of removal.

COMBUSTION ANALYSIS:

1. Start engine and warm up to normal operating temperature.

2. Connect tachometer cables to the distributor and ground one cable, Figure 41.

3. Insert exhaust hose from tester into exhaust pipe.

4. The correct reading for combustion efficiency and performance at idle speed should be 70%, plus or minus 3%. If reading is off, adjustment of the idle screw is necessary.

5. Increase the engine speed at 2000 RPM and check the meter reading which should now read 85%, plus or minus 5%. If the mixture shows on the rich side, proceed as follows:
   A. Remove the air cleaner and see if the additional air entering carburetor corrects the reading. If so, it indicates some restriction in the air cleaner.
   B. If the mixture still shows rich with the air cleaner removed, it indicates trouble in the carburetor.

6. With engine operating at 2000 RPM, advance and release the throttle quickly. The combustion meter reading should move toward “rich” 10% or more. If no movement is noted, the carburetor accelerating pump is not working properly.
# REFERENCE

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# SECTION 3

## ENGINE

### SPECIFICATIONS

#### ENGINE:
- **Arrangement**:
- **Compression Pressure**:
- **Firing Order**: 1-3-2-4-5-7-6
- **Serial No. Location**: Right hand front of block
- **Vibration Dampener**: Yes (in rubber)

#### BORE AND STROKE:
- **4A**: 3 - 9/16" x 3 - 7/8"
- **5A-6A**: 3 - 9/16" x 4 - 3/8"
- **7A**: 3 - 13/16" x 4 - 1/2"
- **8A**: 3 x 4 - 1/2"

#### HORSEPOWER-ACTUAL:
- **4A**: 112 at 4200 HP
- **5A-6A**: 123 at 4000 HP
- **7A**: 145 at 3800 HP
- **8A**: 128 at 4200 HP

#### CAMSHAFT:
- **Material**: Cast Iron Alloy
- **Drive**: Chain
- **Bearings**:
  - **Type**: Steel-Back Babbitt
  - **Number**: 4
  - **Diameter & Length**:
    - **No. 1**: 2.375" x 1 - 3/16"
    - **No. 2**: 1.997" x 15/16"
    - **No. 3**: 1.965" x 15/16"
    - **No. 4**: 1.497" x 1 - 5/16"
    - **No. 5**: .0015" to .002"

#### CRANKSHAFT:
- **Type**: Compensated
- **Journal Size**:
  - **No. 1**: 2.4988 to 2.4998
  - **No. 2**: 2.4988 to 2.4998
  - **No. 3**: None
  - **No. 4**: 2.1244 to 2.1254
  - **No. 5**: 2.1244 to 2.1254
  - **8A**: 2.373 to 2.374

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<td>Duo-Flo</td>
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<tr>
<td>Normal Pressure</td>
<td>40 lbs. at 30 MPH</td>
<td>40 Lbs. at 30 MPH</td>
<td>3 lbs.</td>
</tr>
<tr>
<td>Oil Pump Type</td>
<td>Rotor</td>
<td>Rotor</td>
<td>Oscillating Plunger-</td>
</tr>
<tr>
<td>Oil Pump Drive</td>
<td>Worm on Camshaft</td>
<td>Worm on Camshaft</td>
<td>Worm on Camshaft-</td>
</tr>
<tr>
<td>Oil Capacity</td>
<td>Dry, 7-1/2 qts.</td>
<td>Dry, 7-1/2 qts.</td>
<td>Dry, 8 qts.</td>
</tr>
<tr>
<td></td>
<td>Refill, 7 qts.</td>
<td>Refill, 7 qts.</td>
<td>Refill, 7 qts.</td>
</tr>
</tbody>
</table>
The six and eight cylinder engines are of the "L" Head type.

The crankcase and cylinder block are integral to provide maximum strength with a minimum of weight.

The engine is mounted on rubber cushions at three points, one at each side of the engine front support and a rear mounting located under the transmission bell housing on the #3 frame cross-member.

A full counterbalanced crankshaft of a high alloy steel balanced statically and dynamically, in four bearings on the 6 cylinder and five bearings on the 8 cylinder is used in the 480 series.

Crankshaft thrust is taken by the #3 main bearing.

Main bearing shells for service replacement are available in various undersize dimensions (Refer to your Hudson 480 Series Parts Book).

The eight cylinder engine connecting rods have the spun babbitt type bearings, while the six cylinder engine has replaceable bearing shells with the upper and lower shells being interchangeable.

Aluminum alloy pistons are used in both 6 and 8 cylinder engines. Pistons are cam ground. Two compression rings and two oil rings (one ring below pin) are secured by a steel stake pin at the ring gap to prevent the rings from turning in their
grooves.

Piston Pins are full floating. Lock rings set in grooves in each side of the piston serve to hold the pin in position.

Cam shafts are specially heat-treated alloy iron supported in steel backed-babbitt bearings.

Eight cylinder engines are equipped with a matched set of timing gears for camshaft drive.

Six cylinder engines are equipped with a chain and sprockets.

The eight cylinder engine is equipped with roller cam valve tappets fitted in cast iron guides which are held in position by a steel clamp and attaching screw. These tappets and guides can be removed without removing oil pan or cylinder head.

Mushroom type valve tappets are used in six cylinder engines. These tappets are fitted directly in the crankcase and may be removed from the bottom of the crankcase after removing oil pan and camshaft.

LUBRICATION

8 CYLINDER

Engine lubrication is by the Duo-flow system which delivers the lubrication oil in ratio to engine speed to all bearing surfaces immediately from the first turn of the crankshaft.
FIGURE 3
The oil is drawn through a pipe connecting with a floating screen in the oil pump by the oscillating plunger type oil pump which is driven from the camshaft.

Oil is forced through oil lines to the front and rear of the engine where it is then deposited in the splash troughs of the oil pan tray.

The oil is then picked up by the connecting rod dippers and vigorously distributed to interior working surfaces by the splash system and a series of channels which convey it to wells over the crankshaft and camshaft bearings.

Overflow oil running down the crankcase wall is diverted by drain troughs in the oil pan tray until it reaches the center splash troughs.

**LUBRICATION**

6 CYLINDER

Full pressure lubrication to friction surfaces of the engine is maintained by a rotor type centrifugal pump mounted on the right side of the cylinder block. The pump is driven by a worm gear on the camshaft. Oil is drawn through the suction side of the pump by means of a pipe connecting to a floating screen in the oil pan. The oil is then forced up into the horizontal oil gallery for distribution to the valve tappets, camshaft bearings, main bearings, connecting rod bearings, pistons, piston pins and bushings, timing chain and sprockets and all other movable parts requiring lubrication, Figure 10.

NOTE: Normal oil pressure is 40 lbs. at 30 MPH.

**OIL CHECK VALVE**

8 CYLINDER

The check valve assembly shown in Figure 4 is used in conjunction with the oscillating plunger type oil pump.

The function of the check valve is to indicate oil flow by building up enough pressure to operate the oil pressure indicator light on the instrument panel. This operating pressure ranges from 4 to 12 pounds.

The unit consists of a housing in which is carried the check ball (4) and a plunger (5) which operates against the pressure of a spring (6).

A bleed path is provided between the plunger and pin (7) to allow a small quantity of oil to pass by the piston to the outlet. This hole must be kept clean or the lamp will not light immediately when the oil flow stops because the ball (4) would prevent or delay the escape of oil and delay the contacting of pin (9) by the plunger.

At speeds above idling, the oil pressure holds the check valve plunger off its seat so that the indicator lamp does not burn or flash.
If the indicator lamp does not light when the ignition is turned on, then ground the check valve terminal to the engine. If the lamp does not light, replace the bulb. If the lamp does light, remove the terminal pin and see that it is straight and clean. Take off the plug on top of the check valve housing, remove the plunger and see that it is clean and moves freely up and down. Examine the spring above the plunger.

CAUTION: Oil loss and ruined engines can result from failure to tighten the plug (2) and indicator pin nut (12) on the oil check valve, allowing these parts to back off and become lost. Under such conditions, the driver seldom learns of the difficulty until it is too late as the disablement of the check valve prevents the oil pressure tell-tale signal from doing its job of warning him that something is wrong with the oiling system.

**OIL CHECK VALVE**

6 CYLINDER

Oil pressure is regulated by a built-in non-adjustable oil check valve consisting of a plunger, spring, plug retainer, and plug gasket. The valve function is similar to the 8 cylinder models.

**OIL CHECK VALVE REMOVAL**

8 CYLINDER

1. Remove the right front wheel.
2. Remove four 1/4 - 28 hex bolts from right front fender side dust shield extension.

3. Disconnect the tell-tale wire and remove bake lite plug from check valve.
4. Disconnect the oil lines at the check valve.

5. Remove oil check valve using tool J-1454.

**NOTE:** To install, reverse procedure of removal.

**OIL PUMP**

8 CYLINDER

The oscillating plunger type oil pump is driven by an integral gear on the camshaft.

The reciprocating motion of the plunger allows the slots to register with the inlet and outlet openings of the pump, therefore acting as a double acting piston.

**REMOVAL:**

1. Disconnect the inlet and outlet lines from the oil pump.
2. Remove the two attaching bolts and remove the oil pump.

**DISASSEMBLY:**

1. Remove the hex plug (2) and gaskets (3) from either end of oil pump. Figure 7.
2. Inlet connections at the cylinder block and at the oil pump should be inspected. Leakage at these points will cause air to be sucked into the system and the flow of oil will be reduced and possibly stopped.

INSTALLATION:

To install, reverse procedure of removal.

OIL PUMP
6 CYLINDER

A centrifugal operating rotor type pressure pump is used on all six cylinder engines.

The pump is very simple in construction and efficient to the extent that service of the unit is very seldom necessary.

To remove the oil pump and still maintain the correct engine timing during installation, proceed as follows:

1. Lift off distributor cap and rotate crankshaft until distributor rotor is in firing position for #1 cylinder. Keep engine in this position while pump is removed.

2. Remove the three oil pump to block attaching studs and remove oil pump.

FIGURE 8

1. Remove cover screws (1), Figure 8, cover (2), and gasket (3).

2. Hold hand over cover opening and with pump upside down, turn drive shaft until outer rotor (4) slips out.
3. Drive out straight pin (10) which holds pump drive gear (9) to shaft.

4. Press shaft (7) out of gear (9) by supporting oil pump body (8) on cover face in a suitable arbor press allowing inner rotor and shaft to clear when pressing shaft out of gear.

5. Wash all parts in dry cleaning solvent and dry with compressed air.

INSPECTION

1. Install rotors and shaft in pump body with inner rotor rotated so that one lobe of inner rotor is contacting the corresponding notch in the outer rotor. Measure clearance between opposite lobe of inner rotor and outer rotor. This clearance should be .010” or less. If more than this, replace both rotors and shaft.

NOTE: The shaft, inner rotor, and outer rotor are sold in matched sets only.

2. Measure thickness and diameter of outer rotor. This thickness should be .873” or more and diameter 2.746 or more. If rotor measures less than these figures, replace with a new shaft assembly and new rotors.

3. Inner rotor thickness should be .873”. If less than this figure, replace with new rotors and shaft assembly.

4. With rotors and shaft assembled in pump body place a straight-edge across pump body between screw holes and using a feeler, measure clearance between top of rotors and straight edge. This clearance should be .004” or less. If clearance is greater than this, replace oil pump body.

5. With outer rotor (4) pressed to one side of pump body, with feeler gauge, measure clearance between the outer rotor and body at opposite side. This clearance should measure .008”. If clearance is more than this, replace pump body.

NOTE: Inspection operations #4 and #5 should be made after determining that the old rotor are satisfactory or new rotors used.

6. Body cover (2) should be smooth. It should be replaced if scratched, grooved, or worn. Lay a straight-edge across the inner surface of cover and try to insert a .002” feeler between cover and straight-edge. If feeler can be inserted, replace cover.

ASSEMBLY:

1. Install outer rotor (4) in pump body, Figure 8.

2. Slide shaft (7) and rotor (5) assembly into pump body.

3. Support oil pump body and shaft, and rotors assembly on a suitable clean surface and press oil pump drive gear (9) on shaft (7). End play between hub of gear and pump body should be .004” to .008”.

4. Install gear pin, peening over both ends securely.

5. Make sure pump is thoroughly clean, then install cover gasket (3) in recess of pump body.

6. Install cover (2). Tighten screws evenly and securely.

INSTALLATION:

NOTE: If the engine has been rotated after the pump has been removed, the timing will be disturbed. It will then be necessary to proceed as follows:

1. Remove distributor mounting screw and disconnect octane selector tube. Remove distributor.

2. Set flywheel timing with #1 piston on T.D.C.

3. Insert aligning tool J-2794 in the distributor shaft hole with aligning pin in line with the distributor mounting screw hole, Figure 9.
4. Install the oil pump, engaging oil pump drive gear with camshaft worm gear and engaging slot in the oil pump shaft with tongue on aligning tool, entering pump and at the same time, pushing out tool J-2794.

NOTE: The slot in the oil pump drive shaft is off center, also the tongue on end of the distributor shaft, Figure 10.

1. Remove aligning tool J-2794.

1. Set distributor in #1 firing position and install.

1. Install distributor mounting screw, distributor cap, octane selector connector, and coil lead wire.

OIL PAN 8 CYLINDER

REMOVAL:

1. Raise front end of car and place stand jacks under each side at #3 frame crossmember.

2. Drain oil from engine and reinstall drain plug.

3. Place a hydraulic jack under the center of #2 frame crossmember and raise jack until pressure is exerted against the #2 cross-member sufficiently to hold the member in place against the coil spring expansion pressure when the attaching studs are removed.

NOTE: The #2 crossmember has two locating dowels (one each side) to insure proper alignment of the front suspension in the frame side-members.

4. Remove one bolt and loosen the second bolt in each shock absorber anchor plate which will allow the shock absorbers to slide out of the anchor plates.

5. Remove the outer bolt (each side) of #2 crossmember at front of coil springs and insert the 1/2"-20 x 6" special studs.

6. Remove two bolts (each side) from #2 crossmember at rear of coil springs and insert the remaining four 1/2"-20 x 6" special bolts.

7. Remove the other four bolts holding cross-member at front of coil springs.

NOTE: All the pressure exerted by the front coil springs against the crossmember is now supported by the hydraulic jack.

8. Release the pressure of the hydraulic jack slowly and allow the crossmember to settle on the heads of the six special studs.

9. Remove two bolts from the flywheel dust cover and remove cover.

10. Remove the 5/16" hex bolts from the oil pan and remove pan.

NOTE: The 1/2"-20 x 6" hex bolts must be made special and the 6" dimension under head must be followed precisely since a longer bolt could not be used.

The bolts should not be threaded more than 1" from bolt end to avoid suspension hanging up on threads.

The clearance gained by dropping the #2 crossmember will be 5 inches which will be ample to clear oil pan and trough.
INSPECTION:
1. Remove all traces of old gaskets from oil pan trough and oil pan. Install new gaskets. (Apply a light coat of Hudson Perfect Seal Gasket Paste on both sides of gasket when installing new gaskets.

![Figure 11](image1)

2. Remove cotter pin (1) attaching Floto-Screen to outlet pipe. Clean screen thoroughly or replace.
3. Install Floto-Screen to outlet pipe. Check to make sure there is no binding action and screen swivels freely.
4. Secure ends of cotter pin.

![Figure 11](image1)

INSTALLATION:
1. Install rubber gasket on outlet tube.
CAUTION: The cylinder block machining locating hole at the left rear side of the cylinder block base is so located that one half of the hole opens into the crankcase. A cup shaped plug 9/16' outside diameter is used to close this hole after machining, Figure 12.

![Figure 12](image2)

2. Before installing oil pan, place two quarts of recommended oil in the oil pan troughs, and install oil pan to engine, installing two screws each side to hold oil pan until all screws have been entered.
3. Tighten screws evenly to 15 - 20 lbs. torque.
4. Raise jack until the #2 crossmember dowels are located and insert two front suspension attaching bolts (each side). Remove the six special bolts and install the remaining standard bolts.

If this part of the job is done properly, the alignment of the front suspension will not have been disturbed.

NOTE: Balance of installation, reverse procedure of removal. Refill engine with six quarts of recommended engine oil. This is in addition to the two quarts placed in oil pan troughs.

OIL PAN
6 CYLINDER

REMOVAL:
1. Raise car and place stand jacks under the #2 frame crossmember.
2. Remove the three bolts attaching the center steering arm support bracket to #2 crossmember which will allow the center steering arm and tie rods to drop.
3. Remove two bolts attaching flywheel dust cover and remove cover.
4. Remove oil pan plug and drain oil.
5. Remove bolts and lockwashers attaching oil pan to cylinder block, remove oil pan.

NOTE: Do not lose the round rubber gasket at oil outlet tube.

INSPECTION:
Follow same procedure as outlined for 8 cylinder Oil Pan Inspection.
INSTALLATION:

Reverse procedure of removal. Check to make sure that center steering support bracket is properly secured.
Refill oil pan with seven quarts of recommended oil.

**CYLINDER HEAD REMOVAL**

**8 CYLINDER**

1. Drain cooling system.
2. Loosen carburetor air horn attaching screw and clamp. Remove brace from opposite side and remove air cleaner.
3. Disconnect top radiator and by-pass hose.
4. Disconnect heater hoses (if so equipped).
5. Disconnect throttle rod at carburetor.
6. Disconnect temperature gauge wire at cylinder head sender unit.
7. Disconnect spark plug wires and remove spark plugs.
8. Remove cylinder head stud nuts or cap screws and washers and remove cylinder head.
9. Remove temperature gauge sender unit from cylinder head.

**6 CYLINDER**

Follow the same procedure as outlined under "Cylinder Head Removal-8 cylinder" and in addition the following operation.
Remove vacuum advance tube at octane selector.

**INSTALLATION:**

1. Make sure cylinder head is free from carbon and dirt.
   Check cylinder head with a straight edge for warpage or roughness, especially in cases of frequent "blowing" of head gaskets.
2. Install new head gasket with letters on gasket facing up. (Head gasket should be treated with a light coating of "Hudson Perfect Seal Gasket Paste").

NOTE: Cylinder head and gasket installation on 6 cylinder can be facilitated by using two J-2969 locating studs to position the gasket and head. These studs have a screw driver slot for removal after the cylinder head has been positioned, Figure 13.
CAUTION: If the threads in the cylinder block are corroded or filled with dirt, an incorrect reading will be indicated on the torque wrench as a large percentage of the torque will be absorbed by the threads. ALWAYS CLEAN OUT THREADS IN CYLINDER BLOCK BEFORE INSTALLING CYLINDER HEAD. Apply "Hudson Perfect Seal Gasket Paste" to the threads of cap screw to facilitate the tightening of the cap screw to the proper tension.

MAIN BEARINGS
6 CYLINDER

REMOVAL:

Main bearing caps and shells can be removed from the 6 cylinder engine without removing the crankshaft.

1. Remove main bearing cap screws and remove No. 2 and No. 3 main bearing caps.
2. Remove front and rear main bearing caps with Puller -2955, Figure 16.

CAUTION: DO NOT DAMAGE the engine timing gear cover plate gasket when removing the front bearing cap.

INSTALLATION:

Recommended main bearing clearance is 0.0005" to 0.0015". These close clearances must be maintained when fitting new bearings.

One method for checking bearing clearance is as follows:

1. Inspect the crankshaft for scoring, out of round and taper. Crankshafts with journals that have more than .001" taper or out-of-round, should be reground or replaced.
2. Install all bearings and bearing caps and tighten all bearing cap screws to 75 - lbs. torque.
3. Rotate crankshaft by hand, if crankshaft can be turned by hand one complete revolution; bearing to journal clearance is at least .0005".
4. If crankshaft turns too freely, check for loose bearings working one bearing at a time by placing a piece of brass shim stock .002" thick, 1/2" wide and 1" long between the bearing face and the crankshaft journal, Figure 18.
5. Oil the shim freely with light engine oil and install the bearing and bearing cap to the block with the shim equally spaced on the bearing. Tighten to 75 foot lbs.

6. Rotate the crankshaft one-half turn by hand; if the crankshaft drags or if the crankshaft cannot be turned by hand with a .002" shim in place, but turns freely without the .002" shim it indicates that the clearance is more than .0015" and that the standard size bearing can be used. If, however, the crankshaft turns freely with out any drag, it indicates that the bearing which has the .002" shim stock is too loose.

7. If bearing is too loose in paragraph 6, remove the .002" shim and insert a .003" shim as a checking gauge; now if bearing drags when crankshaft is turned by hand a .001" undersize bearing can be used.

NOTE: The same procedure can be used for checking .002", .010" or .012" undersize bearings keeping in mind that the .0005" to .0015" clearance must be maintained.

Main bearings for the 6 cylinder engines are furnished in standard size and .001", .002", .010" and .012" undersizes. Bearing upper and lower halves are interchangeable. However bearing No. 1 is not interchangeable with No. 2, 3 or 4. Bearing shells are stamped with the part number or size. Bearings should be replaced in pairs; never use a new bearing half with an old bearing half.

CAUTION: No. 2 and No. 3 bearing caps can be reversed in error. Always place punch marks on the caps and the block before removal to insure proper installation.

1. After the proper bearing sizes have been selected, start the upper shells in place, and with KMO-734 Bearing Shell Remover and Replacer Tool entered in oil hole of crankshaft and with hinged head of Replacer against bearing end, rotate crankshaft, pulling the bearing into position, Figure 17.

NOTE: The bearing shells are held in position by a raised tongue in the bearing shell which fits into a machined groove in the bearing cap. When installing the upper shells, the end opposite the notched end should be entered first. When installing the bearing cap, the end with the machined groove should be on the same side and next to the corresponding groove in the cylinder block.

**SIX CYLINDER**

**MAIN BEARING, CRANKSHAFT, AND CAP BORE DIAMETERS**

<table>
<thead>
<tr>
<th>BEARING SHELL THICKNESS</th>
<th>CRANKSHAFT DIAMETER</th>
<th>CAP BORE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard .0955</td>
<td>2.4998</td>
<td>2.692</td>
</tr>
<tr>
<td>.001 U.S. .0952</td>
<td>2.4988</td>
<td>2.691</td>
</tr>
<tr>
<td>.002 U.S. .0960</td>
<td>2.4998</td>
<td>2.692</td>
</tr>
<tr>
<td>.0957</td>
<td>2.4988</td>
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<tr>
<td>.0965</td>
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<td>2.4973</td>
<td>2.691</td>
</tr>
<tr>
<td>.1005</td>
<td>2.4898</td>
<td>2.692</td>
</tr>
<tr>
<td>.010 U.S. .102</td>
<td>2.4893</td>
<td>2.691</td>
</tr>
<tr>
<td>.012 U.S. .1015</td>
<td>2.4878</td>
<td>2.692</td>
</tr>
<tr>
<td>.1012</td>
<td>2.4873</td>
<td>2.691</td>
</tr>
</tbody>
</table>

**REAR MAIN BEARING CAP**

**INSTALLATION:**

Check the rear bearing cap oil seal and if replacement of the seal is necessary, proceed as follows:

1. Crowd the seal material into the outer groove of the bearing cap by hand and with Main Bearing Oil Seal Installer J-2779, drive the seal tightly into the groove by tapping handle of tool with a bronze hammer, Figure 19.

NOTE: Large diameter of the tool cylinder should be to the front of cap with the lesser dimension compressing the seal at rear of cap.

After the seal has been properly seated in the bearing cap and in the block, and while the tool is still compressing the seal, but the seal off flush with the top face of the cap. Make a good clean straight cut so that no frayed ends will be clamped between upper and lower caps. DO NOT CUT SEAL TOO SHORT. The seal must entirely fill the groove; otherwise an oil leak will occur.
3. Install upper and lower bearing shells. **CAUTION:** Do not file bearing shells or bearing caps.

4. Tighten all bearing cap bolts to 70-80 foot pounds with J-1264 torsion wrench.
   After installation of new bearing shells, check crankshaft end play which should be .003 minimum to .009 maximum.

5. Install wood packing into the vertical holes (1) and (2) in front and rear caps first, then into the horizontal holes (3) of the front bearing cap, Figure 20.

Packing must be soaked in engine oil before installing and should be driven until seal bottoms. DO NOT allow seal to protrude beyond top face and front face of bearing cap.

**MAIN BEARINGS**

*(8 Cylinder)*

**EIGHT CYLINDER MAIN BEARING CLEARANCE, CRANKSHAFT AND BORE DIAMETERS:**

<table>
<thead>
<tr>
<th>BEARING NUMBER</th>
<th>DIAMETRAL CLEARANCE</th>
<th>CRANKSHAFT DIAMETER</th>
<th>BORE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1</td>
<td>.001</td>
<td>2.280</td>
<td>2.6535</td>
</tr>
<tr>
<td>No. 2</td>
<td>.001</td>
<td>2.312</td>
<td>2.6855</td>
</tr>
<tr>
<td>No. 3</td>
<td>.001</td>
<td>2.342</td>
<td>2.7155</td>
</tr>
<tr>
<td>No. 4</td>
<td>.001</td>
<td>2.374</td>
<td>2.7475</td>
</tr>
<tr>
<td>No. 5</td>
<td>.001</td>
<td>2.405</td>
<td>2.7785</td>
</tr>
</tbody>
</table>

**NOTE:** To determine shell thickness proceed as follows:

1. Add the diametral clearance to the crankshaft diameter.
2. Subtract the total from the block bore diameter.
3. Divide the answer by two to determine the thickness of the bearing shell.

*EXAMPLE:*

\[
\begin{align*}
2.280 & \quad \text{Crankshaft} \\
+ 0.001 & \quad \text{Diametral Clearance} \\
2.281 & \quad \text{TOTAL} \\
- 2.6535 & \quad \text{Bore Diameter} \\
\frac{+2/0.3725}{0.18625} & \quad \text{Thickness of bearing shell}
\end{align*}
\]

**REMOVAL:**

The upper and lower main bearing shells are each held in place in the crankcase and bearing caps with slotted flat head brass machine screws.
NOTE: Crankshaft bearings are not adjustable as no shims are used. NEVER FILE bearings or bearing caps to reduce clearance.

1. If all new main bearings are to be installed, it is advisable to remove the engine from the chassis and place in a suitable overhaul stand. See "Engine Removal", page 19.

2. Remove oil pan and trough.

3. Remove main bearing cap screws and remove bearing caps.

NOTE: Front and rear bearing caps can be easily removed with Bearing Cap Puller J-2955, Figure 15.

CAUTION: DO NOT DAMAGE the front end plate gasket when removing front bearing cap.

4. Thoroughly clean all traces of cotton packing from the grooves in the case and cap, Figure 21, to avoid clogging of the oil passages.

FIGURE 21

5. Remove crankshaft (See "Crankshaft Removal", page 30.

6. Remove slotted screws retaining bearings in cylinder block and remove bearings.

INSTALLATION:

Recommended total diametral clearance between crankshaft journals and main bearings is .001. This close clearance must be maintained when fitting new bearings.

NOTE: Hudson main bearings are furnished in standard or .010 undersize finished reamed, or unfinished (for shops with line reaming equipment).

SIZE CODE

When replacing crankshafts, the undersize dimension is located on the front face of No. 1 counterweight.

When replacing main bearings, the .010 undersize dimension is noted by a spot of green paint and the part number stamped on the bronze back in indelible ink for eight cylinder engines. On six cylinder engines the part number and size are stamped on the steel back of the bearing shells only. Refer to your 480 series parts book for proper identification.

Engines built with undersize associate parts are identified by the following designated marks stamped on the bottom face of the cylinder block at the left front corner in a clear area beyond the oil pan gasket.

P.U. means crankshaft has .010 undersize crank pins.

M.U. means crankshaft has .010 undersize main bearing journals.

P.M.U. means crankshaft has .010 undersize pins and main bearing journals.

In cases where new unfinished bearings are being fitted, the caps and bearing shell assemblies should be installed in the case and tightened to 70 to 75 foot pounds torque, then line reamed to size.

Crankshaft should have .006 to .012 end play measured at the center main bearing in each case. When installing new factory unreamed shells, it may be necessary to machine the thrust flange face of the center bearing shells in order to obtain this amount of end play.
When assembling new or old bearing shells to caps, tighten the retaining screws just snugly to allow self-centering of shell on screw. Make sure that screw heads are below the babbitt surface.

Shells are punch marked on the edge to facilitate correct reassembly.

**NOTE:** Shells should fit flush with parting face of case, but should project .002 beyond parting face of caps to provide a slight "pinch" for correct seating.

Before bolting front and rear caps and shell assemblies into case for reaming, and always at final assembly, they should be centralized on studs for proper bearing alignment. This can be easily accomplished by inserting a 1/4" drill rod in the vertical packing holes before tightening bearing cap bolts.

At final assembly after the cap and shell assemblies have been bolted in place with 70-80 pounds tightening torque, the palnuts must be installed and the packing inserted in front and rear bearing caps as follows:

Install palnut with smooth face next to nut and spin onto stud until it just contacts the nut. Tighten palnut 1/4 to 1/3 of a turn further for final locking.

---

**EIGHT CYLINDER ENGINE**

**REMOVAL:**

**NOTE:** The engine and transmission are removed as one unit with electrical units and carburetor attached to engine.

The sequence of operations follows:

**REMOVING HOOD:**

1. Remove the two hood hinge bolts (each side) at the rear of the hood.
2. Before removing the hood prop bolts (one each side) place a support under the front of the hood.
3. Lift and remove the hood.

**PREPARATION OF ENGINE FOR REMOVAL:**

1. Drain cooling system, open drain at bottom right side of radiator and remove plug from left rear side of engine.
2. Disconnect the throttle linkage.
3. Disconnect fuel line at junction of fuel pump flexible hose and steel gas line.
4. Remove the bolts from exhaust pipe to exhaust manifold flange.
5. Remove radiator hoses.
6. Disconnect the remote control cable from steering column to the transmission by removing the hairpin lock at steering column and leave attached to transmission.
7. Disconnect wire at starter solenoid.
8. Disconnect wire at starter motor and remove cable from battery.

---

Install cotton wicking into the vertical holes in front and rear caps first, then into the horizontal holes of the front bearing cap. Insertion of packing is greatly facilitated by using tool J-392, Figure 22.
9. Disconnect the water temperature gauge wire from the side of the cylinder block.
10. Disconnect the oil gauge check light wire.
11. Disconnect the vacuum tube from the windshield wiper motor.
12. Remove the two generator lead wires. 13. Disconnect the coil wire.

REMOVING CRANKCASE BREATHER:
1. Remove slotted head screw holding breather to rear tappet cover.
2. Remove bolt from bracket attaching breather to engine end plate.

REMOVING RADIATOR:
1. Disconnect hood lock conduit; pull wire at lower hood lock support.
2. Remove one Phillips head screw at top of front ornament and two screws located under the upper grille moulding and remove.
3. Remove the nine hex cap screws from the fender tie panel and hood lock support panel and remove tie panel as an assembly.
4. Remove the four hex bolts attaching radiator to channel. (Note: Remove the nuts located in side the radiator channel).
5. The radiator may now be lifted up and forward out of the channel. (Note: Approximately 8" of forward clearance is gained by removing the radiator.)
6. Remove the two front engine mounting bolts.

REMOVING CONNECTIONS BENEATH CAR:
1. Drain the transmission oil and leave the drain plug out. (Note: The drain plugs in some cases have caused interference when removing the engine; therefore, it is recommended that plugs be left out.)

NOTE: On cars equipped with the HydraMatic Drive, it will not be necessary to drain the unit.
2. Drain engine oil from oil pan.
3. Remove propeller shaft center bearing support bolts to allow rearward movement of the drive line to clear companion flange at transmission. Disconnect front propeller shaft at the transmission companion flange and at the rear axle remove propeller shafts.

5. Remove the bolt and bracket attaching exhaust pipe to engine rear end plate.
6. Remove two bolts from the clutch cross shaft bracket, disconnect clevis and remove cross shaft.
7. Remove remote control shifter lever rod from transmission and leave rod attached to frame.
8. Remove the engine (rear) mounting bolts.
9. Attach Motor Lift Bracket J-2782 and raise engine up and out of chassis, Figure 23.

FIGURE 23
ENGINE
8 CYLINDER

INSTALLATION:
1. Loosen bolts holding front motor insulators to crossmember.

NOTE: This will allow proper front motor support alignment when entering motor to car.
2. Enter engine to car using care to enter at a proper angle.
3. Align engine with front motor support bolts, install nuts and washers, but do not tighten at this time.

4. Raise car and place stand jacks.

5. Align rear motor support with holes in cross-member and install spacers, flat washers, lock-washers, and nuts; tighten securely.

6. Install transmission drain plug.

7. Install clutch cross shaft and bracket assembly.

**NOTE: Use a new rubber bushing at clutch cross shaft.**

8. Install clutch adjusting rod and make necessary adjustment.

9. Install clutch pull back spring.

10. Install shift shaft to control tube rod assembly.

11. Install speedometer driven gear and speedometer cable.

12. Install universal joint to transmission companion flange and lock plates securely.

13. Install propeller shaft center support bracket and attaching screws.

14. Install exhaust pipe flange at manifold before tightening clamp at transmission.

15. Tighten front motor support bolts to 40 lbs. torque.

16. Install oil pressure indicator contact (bakelite) and wire. Use care in tightening to prevent breakage.

17. Install exhaust pipe clamp at rear motor support.

18. Install flexible gas line.

19. Insert 2 pounds of S.A.E. 80 or 90 E.P. lubricant in transmission, 3 - 1/4 lbs. with over drive.

20. Lower car.


22. Install oil gauge wire at check valve, coil wire, temperature gauge wire, generator wires, starter, starter cable and windshield wiper hose.

23. Install remote control cable to control tube and attach bracket to control lever support bracket.

**NOTE: Shifter lever at steering wheel and transmission must be in neutral to insure proper shift.**

24. Install Weather Control cylinder head connection, apply Hudson Perfect Seal on threads and connect heater hose.

25. Install Weather Control hose at water pump tube or at water pump.

26. Install air cleaner.

27. Install radiator and hose.

28. Attach headlight harness to junction post.

29. Install front fender tie panel and hood lock support and attach hood lock release cable wire.

30. Attach accelerator rod at throttle bell crank and insert cotter pin and nut.

31. Install hood, reverse procedure of removal.

32. Refill crankcase to recommended level. See "LUBRICATION", Section 1.

## SIX CYLINDER ENGINE

**REMOVAL:**

**NOTE: Follow the same procedure as outlined in "Eight Cylinder Engine Removal and Installation."**

### PISTONS, PINS, AND RINGS

**ROD AND PISTON REMOVAL (6 & 8 CYLINDER)**

**NOTE: Before removing rods and pistons, remove the ridge from the top of cylinder walls with an accredited**
ridge reamer. This precaution will prevent cracked or broken piston ring lands or piston rings.

The 6 cylinder connecting rods and pistons must be removed through the top of the cylinder block while the 8 cylinder rods and pistons can be removed from either the top or bottom. Thus, on the 6 cylinder engine it will be necessary to remove the oil pan and cylinder head. Although it is not necessary to remove the cylinder head in order to remove the rod and piston assemblies on the 8 cylinder, it is advisable in order to facilitate proper checking of cylinder walls and fitting of piston rings as well as removing cylinder ridge and carbon deposits.

PISTON RINGS

The piston rings used in the 6 and 8 cylinder engines are cast iron and are pinned to prevent rotation in the piston grooves.

NOTE: The top compression ring for the 7A 6 cylinder engine is a chromium ring.

The rings are notched on the inner diameter at the gap slot.

It will also be noted by reference to Figure 24 that the end gap is equal to the backlash of the ring notch on pin. Therefore, if the ends of a ring are filled to obtain the desired .005 to .009 gap on 8 cylinder and .006 to .014 on 6 cylinder, it is necessary to file a n equal amount from the notch in order to maintain the pin backlash at the same value as the gap.

NOTE: To insure that the gap and backlash be maintained equal, ring filing to fit a bore size smaller than the ring size should be avoided.

Service piston rings are available in .002, .005, .010, .015 and .020 over-size for the 6 cylinder engines, and .003, .005, .010, .015, .020 and .030 over-size for the 8 cylinder engine. Refer to your service parts manual for the proper part number and size.

When installing rings to piston, be sure that successive rings are assembled to the grooves with their gap on opposite sides of center line of the ring retaining pin. In other words, if the top ring is installed with the short half of the notch on the right side of the pin, the 2nd ring should be installed with the short half on the left side of the pin and the 3rd in the same relative position as the first.

To avoid damaging piston rings or pistons, use KMO 297 H Piston Ring Remover and Installer.

PISTON SIZE CODE

(8 Cylinder)

A code letter is stamped on the cylinder block along the lower face of the valve chamber, Figure 25, to show the original size of each cylinder.
A code letter and the piston weight in ounces and quarter ounces is stamped on the head of each piston. In addition to these size and weight marks, all original factory piston installations are numbered on the head of the piston with the block number and the number of the cylinder in which the piston is fitted.

Example - The piston from No. 2 cylinder of a certain engine is marked as shown in Figure 26. The mark "547" is for identifying this piston which is one of a matched set so that it will be installed in the cylinder selected. The cylinder block is also stamped "547" on the front end face to the right of water pump. The mark "B" is the code letter stamped on both the piston and the lower face of the valve chamber and can be translated into a definite size by referring to the code tables shown on page 23. The mark "10" indicates the weight and means 10-3/4 ounces. (If marked "10" the weight would be 10-1/4 ounces.) The mark "2" is the number of the cylinder in which the piston is installed.

When any piston is being replaced, it should be of the same weight as the one removed. A complete set of new pistons should always be of the same weight because unequal piston weight will cause rough engine operation.

**KEY TO CODE MARKINGS**

(8 Cylinder)

**PISTON, CYLINDER, RING SIZES**
(Ring Oversizes Apply Only to Production Type Rings)

<table>
<thead>
<tr>
<th>Cylinder Size</th>
<th>Piston Code</th>
<th>Piston Size</th>
<th>Piston Ring Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.005</td>
<td>B</td>
<td>2.9985</td>
<td>3.000</td>
</tr>
<tr>
<td>3.015</td>
<td>D</td>
<td>2.9995</td>
<td>3.000</td>
</tr>
<tr>
<td>3.002</td>
<td>F</td>
<td>3.0005</td>
<td>3.000</td>
</tr>
<tr>
<td>53.00</td>
<td>J</td>
<td>3.0025</td>
<td>3.003</td>
</tr>
<tr>
<td>453.0</td>
<td>L</td>
<td>3.0035</td>
<td>3.005</td>
</tr>
<tr>
<td>055.3</td>
<td>P</td>
<td>3.0055</td>
<td>3.005</td>
</tr>
<tr>
<td>00753</td>
<td>BO</td>
<td>3.0085</td>
<td>3.010</td>
</tr>
<tr>
<td>.0105</td>
<td>DO</td>
<td>3.0095</td>
<td>3.010</td>
</tr>
<tr>
<td>3.011</td>
<td>FO</td>
<td>3.0105</td>
<td>3.010</td>
</tr>
<tr>
<td>53.01</td>
<td>JO</td>
<td>3.0125</td>
<td>3.015</td>
</tr>
<tr>
<td>253.0</td>
<td>PO</td>
<td>3.0155</td>
<td>3.015</td>
</tr>
<tr>
<td>1453.0</td>
<td>LO</td>
<td>3.0135</td>
<td>3.015</td>
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<td>BB</td>
<td>3.0185</td>
<td>3.020</td>
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<tr>
<td>.0155</td>
<td>DD</td>
<td>3.0195</td>
<td>3.020</td>
</tr>
<tr>
<td>3.020</td>
<td>FF</td>
<td>3.0205</td>
<td>3.020</td>
</tr>
<tr>
<td>53.02</td>
<td>BOOO</td>
<td>3.0285</td>
<td>3.030</td>
</tr>
<tr>
<td>153.0</td>
<td>EOOO</td>
<td>3.0300</td>
<td>3.030</td>
</tr>
</tbody>
</table>

NOTE: Piston size shown above is the major diameter at top of skirt at (A), Figure 26, just below chamfer under No. 3 ring groove.

The difference between the cylinder size in the chart and the piston size in the chart gives the recommended clearance.

Cylinder bore sizes from standard to .030 oversize are given in this chart and the recommended piston sizes and ring sizes for each bore size.

It is always advisable to hone the cylinder to the smallest dimension for which a given ring is recommended. Ring oversizes shown in table are available only in production type rings.

Service piston rings are available in .003, .005, .010, .015, .020 and .030 oversize for the eight cylinder engine.

**PISTON SIZE CODE**
(6 Cylinder)

A code letter is stamped on the cylinder block along the lower face of the valve.
chamber, Figure 26, to show the original size of each cylinder. A corresponding letter appears at the top of the piston. The numbers 1 to 6 indicate the cylinder in which the piston is installed.

**KEY TO CODE MARKINGS**

(6 Cylinder) 4A-5A-6A

**PISTON, CYLINDER, RING SIZES**

(Ring Oversizes Apply Only to Production Type Rings)

<table>
<thead>
<tr>
<th>Cylinder</th>
<th>Piston</th>
<th>Piston Ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Code</td>
<td>Code</td>
</tr>
<tr>
<td>3.5625</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>3.563</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>3.5635</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>3.564</td>
<td>E</td>
<td>E</td>
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<tr>
<td>3.5645</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>3.572</td>
<td>AO</td>
<td>AO</td>
</tr>
<tr>
<td>3.5725</td>
<td>BO</td>
<td>BO</td>
</tr>
<tr>
<td>3.573</td>
<td>CO</td>
<td>CO</td>
</tr>
<tr>
<td>3.5735</td>
<td>DO</td>
<td>DO</td>
</tr>
<tr>
<td>3.574</td>
<td>EO</td>
<td>EO</td>
</tr>
<tr>
<td>3.5745</td>
<td>FO</td>
<td>FO</td>
</tr>
<tr>
<td>3.5825</td>
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<tr>
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<td>3.5845</td>
<td>FF</td>
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</tr>
</tbody>
</table>

(6 Cylinder) 7A

<table>
<thead>
<tr>
<th>Cylinder</th>
<th>Piston</th>
<th>Piston Ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Code</td>
<td>Code</td>
</tr>
<tr>
<td>3.812</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>3.8125</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>3.813</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>3.8135</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>3.814</td>
<td>E</td>
<td>E</td>
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<tr>
<td>3.822</td>
<td>AO</td>
<td>AO</td>
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<td>3.8225</td>
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<td>3.823</td>
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<tr>
<td>3.8235</td>
<td>DO</td>
<td>DO</td>
</tr>
<tr>
<td>3.824</td>
<td>EO</td>
<td>EO</td>
</tr>
<tr>
<td>3.8325</td>
<td>BB</td>
<td>BB</td>
</tr>
<tr>
<td>3.8335</td>
<td>DD</td>
<td>DD</td>
</tr>
<tr>
<td>3.8345</td>
<td>FF</td>
<td>FF</td>
</tr>
</tbody>
</table>

NOTE: Piston size shown above is the major diameter at top of skirt at (A), Figure 26, just below chamfer under No. 3 ring groove.

Cylinder bore sizes from standard to .020 oversize are given in this chart and the recommended piston sizes and ring sizes for each bore size.

It is advisable to hone the cylinder to the smallest dimension for which a given ring is recommended. Ring oversizes shown in table are available only in production rings.

Service piston rings are available in .002, .005, .010, .015 and .020 oversize for 6 cylinder engines.

**FITTING PISTONS**

NOTE: Before fitting pistons remove the ridge from the top of the cylinder with a suitable ridge reamer.

The pistons for Model 4A differs from the 5A and 6A pistons due to the change in crankshaft stroke as follows:

The overall dimensions of the pistons are the same. The distance from the centerline of the piston hole to the top of the piston is 2.310" to 2.314" for Model 4A, Figure 27, and 2.060" to 2.064" for Models 5A-6A, Figure 28. Also note dimensions for Model 7A piston, Figure 29.

![Figure 27](image-url)
The piston skirt is cam ground to elliptical shape and tapered. Maximum skirt diameter is at "A", Figure 26 and 30, just below the third ring groove at right angles to the piston pin. The cam grinding makes it necessary that a .002 feeler blade 1/2" wide be used directly opposite the skirt slot when checking piston clearance.

After inserting the piston in the cylinder with the .002 feeler gauge in the position described above, the feeler should be movable under a 3 to 4 pound pull. Use tool J-888 Piston Feeler Scale to measure this pull as in Figure 30.

CAUTION: A thousandth of an inch variation will change the pull on the feeler only a few pounds and the use of this scale will eliminate guessing.

CAUTION: When pistons are fit to reconditioned bores, the cylinder block should be allowed to cool to normal room temperature and the piston fit rechecked before installing pin in piston.

Cylinder bores can be readily checked for wear with "Cylinder Checking Gauge KMO-913".

Reconditioned cylinder bores should be held to not more than .005 out-of-round or taper.

NOTE: It is important that reconditioned cylinder bores are thoroughly washed to remove all traces of abrasive material.

PISTON PINS

Piston pins are of full-floating design. The pin rotates in the connecting rod bushing and has sufficient movement in the piston to equalize wear. The piston pin hole in the piston is diamond bored for close fitting of the pin.
The piston pin and connecting rod bushing should be replaced when necessary by selecting the proper size pin to fit the piston and reaming the connecting rod bushing to size.

NOTE: See "Connecting Rod Bushing Replacement" for proper procedure.

Piston pins are furnished in standard, .002, .005, and .010 oversizes. Piston pins should be a hand push fit when piston is heated to 200°F. Heat the piston in boiling water or an electric furnace. NEVER heat piston with a blow torch as this will distort the piston. After fitting pins to pistons, check piston pin in connecting rod bushing. Ream bushing to .0003 larger than the pin diameter.

Check the fit by holding the piston with the connecting rod in a horizontal position. The rod should just turn on the pin under its own weight.

PISTON PIN LOCK RINGS

The piston pin is retained in the piston by two snap rings held in grooves at each end of the piston pin bore. This ring can be removed with any suitable pliers.

CONNECTING ROD BUSHINGS
(6 & 8 Cylinder)

This piston pin bushing in the upper end of the connecting rod is of bronze, burnished in place, and broach finished on the 8 cylinder engine; and steel backed, bronze bushing, burnished in place and diamond bored on the 6 cylinder engine.

REPLACEMENT:

1. Press out old bushings by supporting the bushing end of the connecting rod on Bushing Burnisher Block J-2850 for 6 cylinder and J-2951 for 8 cylinder. Remove the bushing.
2. Install new bushings, reverse procedure of removal using the same tools required for removing.
3. After bushing has been pressed into the rod, using Burnisher Block J-2950, 6 cylinder and J-2951, 8 cylinder and with X-2791 Burnisher and Broach 6 cylinder and J-2949 Burnisher 8 cylinder iron the bushing in place in the rod, Figure 31.

NOTE: This operation swages or expands the bushing into eye of the rod. This is important as the bushings may work out of the rod if they have not been properly burnished in place.

4. Remove the bearing cap of the connecting rod and install connecting rod on Aligning Fixture J-874 - H arbor, 1.9375 -- 8 cylinder, 2.2505 - 6 cylinder. (Tighten rod on arbor and lock arbor in position with lock screw located on side of alignment fixture).
5. Insert the reamer pilot in the upper hole in the alignment fixture face plate and align bushing hole of rod with pilot hole in face plate.
6. Insert reamer pilot bushing in upper hole in fixture and lock lower arbor in place with locking handle.
7. Insert reamer through connecting rod bushing and into pilot bushing, Figure 32.
8. Perform reaming operation to the following dimensions:

   6 Cylinder -- .9685 to .9688
   8 Cylinder -- .7496 to .750
The connecting rods have steel side thrust faces. A lead tin alloy bearing metal is used to line the connecting rods and the bearing lining thickness is .015.

The radial clearance at the connecting rod big end is .001 and the end clearance is .007 to .013.

Connecting rods are right and left hand; the crankshaft end tieing offset on the rod proper. 8 cylinder engines.

Connecting Rods 1 - 3 - 5 - 7 are Right Hand.
Connecting Rods 2 - 4 - 6 - 8 are Left Hand.

**EIGHT CYLINDER ROD BEARING CLEARANCE, CRANKPIN DIAMETER AND FINISHED BORE DIAMETER**

<table>
<thead>
<tr>
<th>BEARINGS</th>
<th>DIAMETRAL CLEARANCE</th>
<th>CRANKPIN DIAMETERS</th>
<th>FINISHED BORE DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1 thru No.8</td>
<td>.0003</td>
<td>1.935</td>
<td>1.9353</td>
</tr>
<tr>
<td></td>
<td>.0006</td>
<td>1.9353</td>
<td>1.9359</td>
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</tbody>
</table>

**CONNECTING ROD BEARING**

<table>
<thead>
<tr>
<th>BEARING SIZE</th>
<th>SHELL THICKNESS</th>
<th>CRANKPIN DIAMETERS</th>
<th>BORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>.0622</td>
<td>2.1254</td>
<td>2.2505</td>
</tr>
<tr>
<td></td>
<td>.0619</td>
<td>2.1244</td>
<td>2.2500</td>
</tr>
<tr>
<td>.0005 U.S.</td>
<td>.0627</td>
<td>2.1250</td>
<td>2.2505</td>
</tr>
<tr>
<td>.002 U.S.</td>
<td>.0624</td>
<td>2.1240</td>
<td>2.2500</td>
</tr>
<tr>
<td>.010 U.S.</td>
<td>.0672</td>
<td>2.1154</td>
<td>2.2505</td>
</tr>
<tr>
<td>.012 U.S.</td>
<td>.0669</td>
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<td>2.2500</td>
</tr>
<tr>
<td>.012 U.S.</td>
<td>.0672</td>
<td>2.1154</td>
<td>2.2505</td>
</tr>
<tr>
<td></td>
<td>.0669</td>
<td>2.1149</td>
<td>2.2500</td>
</tr>
</tbody>
</table>

**CONNECTING RODS**

(8 Cylinder)

DO NOT FILE bearing caps to take up radial clearance.

**SIX CYLINDER CONNECTING ROD BEARING SIZES, CRANKPIN DIAMETERS AND BORE**
CONNECTING ROD BOLT NUT LOCK

Tighten the regular connecting rod bolt nuts on both 6 and 8 cylinder to 40-45 foot pounds.

After properly tightening the bolt nuts, place the Palnut on the bolt with the smooth face against the bolt nut, spin the Palnut with the fingers until it is snug against the bolt nut. Then tighten the Palnut 1/4 to 1/3 more to lock the Palnut.

Always use new Palnuts when reassembling rods.

CONNECTING ROD ALIGNMENT

PIN TO ROD ALIGNMENT:
(6 & 8 Cylinder)

Clamp the connecting rod on the arbor.

NOTE: It is necessary to remove the bearing shells on the 6 cylinder rod before clamping rod to arbor. (Use Arbor size 2.2505.)

Place the "V" block against either the piston or piston pin. The amount of misalignment will be shown between the pins on the "V" block and the face plate.

CONNECTING ROD BEND OR TWIST:

If the two top pins rest against the alignment fixture face plate and the two bottom pins are away from the face plate, it indicates the connecting rod is cocked or bent. This is also true if the two bottom pins rest against the face plate and the top pins are away from the plate. If the two horizontal pins on the front side rest against the face plate and the two back pins are away from the plate or vice-versa, it will indicate that the rod is twisted.

CONNECTING ROD OFFSET:
(8 Cylinder ONLY)

1. Place "V" block on the piston pin so that the block rests against the outside edge of the connecting rod (pin end) and move the rod and "V" block toward the face plate until all four pins of "V" block touch it.

Place the index pin (located at the bottom of the fixture) so that it touches the connecting rod bearing end.

2. Remove the rod from the arbor and turn the rod around and reassemble the rod to the arbor, placing the "V" block on the piston pin in the same place as when checking the opposite side.

3. Move the connecting rod and the "V" block toward the face plate until either the index arm touches the bearing at the lower end or the "V" block pins touch the face plate.

NOTE: If the index arm does not touch the rod bearing with the four pins touching the face plate, check the distance between the index arm and the rod bearing. This should not exceed .025. If greater than this dimension, rod should be straightened. If the index arm touches the rod bearing and the four pins do not touch the face plate, check the distance between the pins and the face plate. This should not exceed .025. If this distance is greater, straighten the rod until the pins of the "V" block touch the face plate and the index arm is within .025 of touching the rod bearing.

ALIGNING ROD WITH PISTON
(6 & 8 Cylinder)

A quick check of a piston and connecting rod assembly can be made for both twist and bend without disassembling the piston from the connecting rod.

1. Mount the connecting rod and piston assembly on the alignment fixture and set the piston in line with the connecting rod, Figure 33.

2. Place the "V" block on the piston skirt and if both pins on the block contact the face plate, then the rod is not straight.

3. With the "V" block on the piston skirt and the pins against the face plate, tip the piston first in one direction and then in the other.
NOTE: If the pins on the "V" block follow the face plate there is no twist in connecting rod, but if one pin leaves the face plate while the piston is being tipped in one direction and the other pin leaves the face plate while the piston is in the other direction, then the connecting rod is twisted and should be straightened until both pins follow the face plate.

Rod Straightening

Always bend beyond the straight position and then bend back to straight so as to relieve the strains that are set up by bending. If this is not done, the rod will not remain straight after it is installed in the engine.

PISTON AND ROD INSTALLATION
(6 and 8 Cylinder)

When installing connecting rods and pistons to engine, oil metering hole in upper half of connecting rod bearing in 6 cylinder engines must be toward the valve side of engine, Figure 35. On the 8 cylinder engine the connecting rod dipper opening must be toward valve side of engine. Figure 36.

NOTE: The notches in the lower and upper caps should be on the same side when installing rods to crankshaft.

Use Piston Inserter KMO-357 when installing piston and ring assemblies. This tool is designed to compress the rings in the piston grooves so the piston assembly may be installed in the cylinder without damaging the piston rings or piston.

CRANKSHAFT

Removal
(6 & 8 Cylinder)

The crankshaft can be removed from the engine on either 6 or 8 cylinder without removing the engine from the car. However, it is recommended to be more practical to remove the engine when replacing the crankshaft.

Follow the procedure of engine removal, pages 19 and 21 and proceed as follows:

1. Remove transmission and clutch assembly.
2. Remove flywheel and crankshaft oil thrower.
3. Remove oil pan and oil pan baffle.
4. Remove vibration dampener lock screw, lock, and remove vibration dampener using Puller J-676-C, Figure 34.

DO NOT HAMMER DAMPENER to remove.
5. Remove gear case cover and camshaft plunger (8 cylinder).

6 Using puller J-471, remove crankshaft gear. Figure 37.

NOTE: It is necessary to remove the camshaft gear and timing chain on the 6 cylinder engine before crankshaft gear can be removed.

7. Remove connecting rods and pistons.
8. Remove front and rear main bearing caps with Puller J-2955, remove balance of bearing caps.
9. Using a rope sling and chain fall, remove the crankshaft.

NOTE: Before replacing crankshaft, check condition of crankshaft journals and pins, bearings, and bearing clearances. Clean the oil pan and screen and blow out oil lines.

To install, reverse procedure of removal, check the information contained under "Main Bearings, Connecting Rods, and Pistons; Remove and Replace Engine; Remove and Replace Clutch; Remove and Replace Timing Gears or Timing Chain and Gears."

NOTE: On 8 cylinder engines, before installing the flywheel to the crankshaft, check to make sure that lower half oil retainer fits squarely and tightly against the upper half retainer, Also make sure that gaskets are in good condition.

Screw holes in cap mounted oil retainer are elongated to permit it to be squarely contacted with the upper retainer. If contacting faces are nicked, install new retainer as a gap or other discontinuity of contact will permit loss of oil.

---

**TIMING GEARS**

(6 & 8 Cylinder)

Timing Gear Cover Removal

1. Drain cooling system.

2. Disconnect hoses and remove radiator (2 bolts each side of radiator cradle).

3. Remove fan blade, pulley, and fan belt.

4. Remove dampener screw, lock, and dampener. (Use Puller J-676C to remove dampener, Figure 34.

5. Remove timing gear cover and gasket.

Timing Gear Removal

Perform operations under "Timing Gear Cover Removal" to No. 5 inclusive and proceed as follows:

1. Crank engine until timing gear marks line up and remove camshaft gear and thrust plunger (8 cylinder).

2. Using Puller-471, remove crankshaft gear, Figure 37.

NOTE: It is necessary to remove the camshaft gear and timing chain on the 6 cylinder engine before crankshaft gear can be removed.

Timing Gears Installation

8 Cylinder

1. Install crankshaft gear using Pushr tool J-483, Figure 38.
2. Install camshaft gear, meshing the punch marked tooth of the crankshaft gear between the two punch marked teeth of the camshaft gear, Figure 39, install camshaft screws and lock wire. Gear backlash should be .002 to .004.

CAUTION: Care must be exercised when installing the aluminum gear to avoid any blow or pressure that might cause damage to the teeth and result in noisy gears. Any small burrs on high spots should be dressed down with a honing stone or 6 inch knife edge mill file.

Balance of installation refer to "Timing Gear Cover Installing".

Timing Gear Installation
6 Cylinder

1. Install crankshaft gear with Pusher Tool J-483, Figure 38.

2. Place timing chain on camshaft gear and install both, at the same time engaging the chain with the crankshaft gear.

NOTE: If crankshaft has not been rotated during the removal, it will not be necessary to check the timing. If timing has been disturbed, refer to sections "Camshaft Installing and Valve Timing".

Balance of installation refer to "Timing Gear Cover Installing".

TIMING GEAR COVER OIL SEAL REPLACEMENT

The timing gear cover has an oil seal which fits closely over the vibration damper spacer to prevent oil leaking out of the front end. The oil seal is a tight press fit in the cover and can be removed with J-2776 Timing Cover Oil Seal Remover and Installer Set, Figure 40, by placing the collar so that slot in collar engages depression in cover, supporting the cover when driving out the seal with the straight side of the driver.

NOTE: The tool head is reversible on the handle. The side with the tapered pilot is used for installing and the large size for removing.

Check oil seal to be certain that lip is not curled over. Before installing a new oil seal, apply a coating of white or red lead in the well in the timing cover.

With J-2776 Oil Seal Installer set, install oil seal in cover using tapered pilot side of tool, Figure 41, using T-872 - 5 handle screwed into opposite side of tool, and with a suitable arbor press or soft hammer, press the seal tightly in place.

After seal is installed, recheck to make certain that lip of leather is in good condition.
FIGURE 41

Timing Gear Cover Installation

To Install, reverse procedure of removal.

Use a new timing gear cover gasket; tighten Vibration Dampener screw to 100-120 pounds and turn lip of Dampener screw lock.

FRONT ENGINE MOUNTING AND ENGINE SUPPORT PLATE

Front Engine Support
Removal

Perform operations under "Timing Gears Removal" and proceed as follows:

1. Place a wood block under oil pan and block up engine while removing the self-locking nuts at front insulators

2. Remove two countersunk bolts, five bolts and lockwashers, holding end plate to cylinder block and remove end plate.

Installation:

Clean all traces of old gasket from front face of cylinder block. Install a new or the original support plate and a new gasket. Reinstall balance of parts in reverse order of their removal.

Check location of timing gear marks; adjust fan belt, and refill cooling system.

Front engine mountings can be removed without removing the front engine support plate by placing a block of wood between head of jack and oil pan and after removing the self-locking nuts and lockwashers from the mounting center bolts, and the two bolts, nuts and lockwashers attaching the mounting to the frame (each side), jack engine up sufficiently to clear threads of center bolts and remove mounting.

CAMSHAFT

Removal: - 8 Cylinder

1. Drain cooling system, disconnect radiator hoses and remove radiator. (See "Cooling for Radiator Removal").
2. Remove cylinder head. (See "Cylinder Head Removal", pages 14 and 15.
3. Remove Right Hand front wheel.
4. Remove Right Hand fender side shield.
5. Disconnect vacuum pump line, windshield wiper, hose and fuel pump.
6. Remove distributor.
7. Disconnect oil lines at oil pump and remove oil pump.
8. Remove valve covers and breather pipe. (Disconnect clamp at transmission housing and bolt at valve cover).
9. Remove coil and bracket.
10. Using valve lifter KMO-484, remove valve keepers and valves, Figure 42.
11. Remove valve springs, tappet retainer screws, plates, washers, and lockwashers, tappets and guides.

12. Remove the grille assembly as a complete unit as follows:
   (a) Remove 7 hex head sheet metal screws attaching the upper grille to the fender tie panel and 1 screw at top of ornament.
   (b) Remove the front bumper and grille guard.
   (c) Remove screws attaching grille baffles to front fender extension, 3 each side.
   (d) Remove 6 screws attaching lower grille baffle to the front splash apron, 2 each side and remove grille and baffle assembly complete.

13. Place a block of wood between oil pan and head of jack, and raise engine 1 - 1/2 inches so camshaft will clear front splash guard upon removal.

14. Remove vibration dampener, screw lock and dampener.

15. Remove dampener key and gear case cover.

16. Align gear markings and remove camshaft gear and thrust plunger.

17. Remove camshaft and thrust washer.

   Remove camshaft slowly and carefully to prevent damage to camshaft bearings.

   CAMSHAFT BEARINGS
   (6 & 8 Cylinder)

   Replacement camshaft bearings are available through the service parts department in both reamed and unfinished state. The finish-reamed bearings are sufficiently oversize so that when pressed into place they will be the proper dimensions, thus eliminating the need for scraping or reaming. The unfinished bearings have sufficient wall thickness to permit line reaming where proper equipment is available for this operation. These bearings should be line reamed after installation to a diameter .001 larger than the individual camshaft journals.

   Service replacement camshaft bearings are a press fit of .0026 to .0055 in cylinder block.

   When pressing in new bearings, always install bearings with the locating notch at the top.

   It is advisable to remove the engine from the car if it is found necessary to replace camshaft bearings.

   CAMSHAFT

   Installation
   8 Cylinder

   1. Use anew fibre thrust washer when installing camshaft.

   NOTE: Use care when installing the camshaft to avoid damaging bearings or camshaft lifts. Use a bronze drift through oil pump, distributor and fuel pump holes to guide camshaft through bearings.

   2. Install camshaft gear aligning timing marks with crankshaft gear. Install lock wire through bolt heads and secure.

   3. Install gear case cover; remove old gasket, and replace. (Check end plate gasket and gear cover oil seal).

   4. Install dampener spacer, key, dampener, lock and lock screw, (Use new lock).

   5. Install tappets and guides in sequence removed.

   NOTE: Tappet guides must be accurately aligned with cams on camshaft. Position of guides is controlled by the guide clamps; the inner sides of which should be in full contact with matching flat surfaces on front face of each pair of tappet guides within .0015, Figure 44.

   ![VALVE GUIDE CLAMP](image)

   FIGURE 44
6. Install guide clamps, flat washers, lock-washers, and screws.

6. Install valve springs and retainers.

NOTE Installation of valve springs on the 8 cylinder will be facilitated by the use of J-587-A Valve Spring Inserter, Figure 45.

8. Install valves in sequence removed, compress springs, and install valve keepers. (Valves should be checked for warpage and cracks and replaced as necessary).

9. Install oil pump and connecting lines.

10. Use new gasket, install cylinder head (Tighten to 45 - 50 lbs.).

11. Install carburetor and accelerator linkage.

12. Install radiator; connect hoses (Use Hudson Perfect Seal at all connections).

13. Continue with balance of cylinder head installing operations as outlined in "Cylinder Head Installing".

14. Check timing and install distributor and cap.

15. Install coil and coil bracket.

16. Install fuel pump and connect oil lines.

17. Install complete grille and baffles assembly and front bumper assembly by reversing procedure of removal.

18. Replace coolant and start engine.

19. Adjust tappets (engine hot). (See "Tappets & Valves").

20. Replace tappet covers and breather pipe.

NOTE: When tightening breather pipe attaching screw, do not bottom breather pipe against the inner wall of the valve cover as this will close off the venting action of the pipe and create high crankcase pressure.

21. Replace fender side dust shield and rear inspection shield. (Tie cord of boot to front suspension).

22. Install wheel and lower car.

23. Connect hood prop to hood and align hood.

CAMSHAFT

Removal - (6 Cylinder)

Perform operations under "8 cylinder Camshaft Removal items 1 to 9 and 12 to 16 inclusive.

Valve springs can be removed on the 6 cylinder engines by compressing the springs with a KMO-484 valve lifter and a suitable hook-type tool.

NOTE: Tappets should be raised and secured by the use of spring type wood clothes pins or some other practical means, sufficiently to allow removal of the camshaft.

Installation 6 Cylinder

To install, reverse procedure of removal.

Timing chain and sprockets should be installed with #1 Piston on top dead center in firing position with marks on sprockets 14 pitches or 7 full lengths apart, Figure 48.

Timing chain is not adjustable. NOTE: Refer to "Specification" Page 1 for "Engine Timing".
NOTE: To facilitate installation of two piece valve keepers, use Valve Keeper Installer 1 - 1953, Figure 46.

VALVE SYSTEM

Tappets and Guides
8 Cylinder

The tappets and guides can be removed without removing the cylinder head. However, it is recommended that the head be removed when more than two tappets are to be replaced.

Removal

1. Remove cylinder head
2. Remove R.H. front wheel and fender side dust shield.
3. Remove valve covers and breather pipe.
4. Use valve lifter and remove valve keepers, valves, and springs.
5. Remove tappet guide clamp bolts, washers, clamps and remove tappet and guide assemblies.

To install, reverse the order of removal. Observe the following points during reinstallation:

NOTE: Tappet guides must be accurately aligned with cams on camshaft. Position of guides is controlled by the guide clamps; the inner sides of which should be in full contact with matching flat surfaces on front face of each pair of tappet guides within .0015, Figure 44.

One method of obtaining alignment is to tighten clamp nuts just less than snugly, then bump outer face of clamps sharply inward using a wide piece of fiber or brass interposed between the hammer and the clamps. This will tend to jar the tappet guides into parallelism with clamps. When clamps are tightened, it should not be possible to insert .002 feeler blade at any point between inner edge of clamps and mating face of tappet guides.

Tappets and Guides
6 Cylinder

To remove valve tappets on the 6 cylinder engine, it is necessary to remove the oil pan and camshaft. Perform the operations under "Camshaft and Oil Pan Removal - 6 Cylinder"
Tappets for the 6 cylinder engines are furnished in standard, .002", .004" and .010" oversizes.

Valve Tappet Adjustment
(6 & 8 Cylinder)

1. Remove R. H. Front Wheel.
2. Remove fender side shield with side shield extension.
3. Remove valve covers and breather pipe.
   Adjust tappets as follows:
   6 Cylinder
   Intake - .008" hot
   Exhaust - .010" hot
   8 Cylinder
   Intake - .008" hot
   Exhaust - .010" hot

VALVES AND SEATS:

The valves seat directly in the cylinder block. (No valve inserts are used.)

To remove the valves proceed as follows:

1. Drain cooling system.
2. Remove cylinder head. See "Cylinder Head Removal", Pages 14 and 15.
3. Raise car and remove right front wheel and fender shield with extension.

4. Remove both valve covers and breather pipe.

5. Using KMO-484 Valve Spring Lifter compress the valve springs and remove spring keepers and retainers.

NOTE: Place corks or wood plugs in valve chamber oil return holes to prevent valve locks from dropping through these holes into the oil pan.

6. Remove valves from the engine and place them in a valve rack to protect them from any damage and to insure that the valves are returned to the same seats from which they are removed.

7. Check all valves for warpage and burning, replace any excessively burnt or warped valves.

8. Valves should be refaced on an accredited refacing machine.

NOTE: The following chart is used in conjunction with the letters and dimensional lines in Figure 49, should be used as a guide when performing any valve work.

<table>
<thead>
<tr>
<th></th>
<th>6 CYL</th>
<th>8 CYL</th>
<th>6 CYL</th>
<th>8 CYL</th>
</tr>
</thead>
<tbody>
<tr>
<td>A- 45°</td>
<td>45°</td>
<td>45°</td>
<td>45°</td>
<td>45°</td>
</tr>
<tr>
<td>B- 1.83&quot;</td>
<td>1.500&quot;</td>
<td>1.561&quot;</td>
<td>1.375&quot;</td>
<td></td>
</tr>
<tr>
<td>C- .1135&quot;</td>
<td>.1153&quot;</td>
<td>.1525&quot;</td>
<td>.1295&quot;</td>
<td></td>
</tr>
<tr>
<td>D- .0495&quot;</td>
<td>.036&quot;</td>
<td>.0496&quot;</td>
<td>.036&quot;</td>
<td></td>
</tr>
<tr>
<td>E- .083&quot;</td>
<td>.0765&quot;</td>
<td>.103&quot;</td>
<td>.0935&quot;</td>
<td></td>
</tr>
<tr>
<td>F- .016&quot;</td>
<td>.005&quot;</td>
<td>.008&quot;</td>
<td>.0045&quot;</td>
<td></td>
</tr>
<tr>
<td>G- .054&quot;</td>
<td>.0575&quot;</td>
<td>.075&quot;</td>
<td>.078&quot;</td>
<td></td>
</tr>
<tr>
<td>H- 1 - 11/16&quot;</td>
<td>1 - 3/8&quot;</td>
<td>1 - 3/8&quot;</td>
<td>1 - 7/32&quot;</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: Seat diameter of valve head must be concentric with valve stem within .002" total indicator reading. Valve stem end should be ground flat and square with axis within .002" total indicator reading.

A properly refaced valve will contact the valve seat throughout its entire circumference and the valve stem will "float" in the guide, free from valve stem friction.

NOTE: The best valve grinding and aligning job will go for naught if care is not used when tightening the cylinder head. Always use a torque wrench and tighten the cap screws or stud nuts in the sequence recommended to the following torque specifications 60-65 foot lbs. for both aluminum and cast iron heads 6 cylinder engines, 40-45 foot pounds for all 8 cylinder engines.

VALVE GUIDES:

Before reconditioning a valve seat it is important that the valve guides be checked for wear. Valve guides that are worn .003" more than the clearances recommended in the following chart they should be replaced.

<table>
<thead>
<tr>
<th></th>
<th>6 CYL</th>
<th>8 CYL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve Stem</td>
<td>.3407</td>
<td>.3417</td>
</tr>
<tr>
<td>Valve Guide</td>
<td>.3437</td>
<td>.3437</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>6 CYL</th>
<th>8 CYL</th>
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</thead>
<tbody>
<tr>
<td>Valve Stem</td>
<td>.3397</td>
<td>.3412</td>
</tr>
<tr>
<td>Valve Guide</td>
<td>.3437</td>
<td>.3437</td>
</tr>
</tbody>
</table>
Valve guides can be removed upward through the valve seat opening with a suitable puller.

Valve guides can be properly installed with the J-883 - A Valve Guide Installer. The installer consists of the driver handle, stop collar, and two pilots calibrated to insure that the guides are driven to the proper depth. On 8 cylinder engines the top of the valve guide should be 15/16" below the top face of the block for both intake and exhaust. See Figure 50.

For 6 cylinder engines use the Valve Guide Installer Handle part of J-883 - A, the J-883 - 7 Pilot Block, J-883 - 8 and J-883 - 9 Valve Guide Installer Pilots, Figure 51. Page3 - 43 to install the valve guides.

The installer pilots are fitted with collars to control the height of the valve guides when installing the exhaust guide should be 1 - 3/32" and the intake guide 1 - 7/16" from the top of the guide to the top face of the block, Figure 52.

To remove the varnish and carbon deposits found in valve guide bores use KMO-122 METAL BRUSH for cleaning the main bore of valve guides. To facilitate removal of stubborn varnish deposits, use lac-thinner and the KMO-122 Metal Brush.

NOTE: Always place clean rags below the valve guides to absorb any surplus draining of the thinner.

VALVE TIMING

6 Cylinder

Inlet open 7°-18° BUDC
Inlet closes 53°-42° ALDC
Exhaust opens 53°-18° BLDC
Exhaust closes 7°-42° AUDC

8 Cylinder

Inlet opens 10°-40°
BUDC Inlet closes 60°-0°
ALDC Exhaust opens 50°
BLDG Exhaust closes 18°-44° AUDC
To determine if valve timing is correct without dismantling the engine, the following procedure may be used.

1. Remove the front tappet cover and adjust the tappet clearance of No. 1 intake valve to .010 with engine hot or .012 with engine cold.

2. Insert a .002 feeler gauge in No. 1 intake tappet and rotate engine in direction of rotation until exhaust valve begins to close. (This is to determine proper stroke.) Continue to rotate engine very slowly until a light drag is felt on the feeler gauge.

3. At this point, inspect the timing marks on the flywheel through the opening in the rear engine support plate.

   The engine is correctly timed when the first of the four long timing marks is approximately 5/8" above the index of the timing hole.

   If the valve timing is incorrect, the above position of the first timing mark on the flywheel will be noticeably removed from the 5/8" position, one tooth out of time being roughly equivalent to 1 - 1/2" on the flywheel.

4. Reset intake tappet to recommend clearance of .008 hot or .010 cold and reinstall tappet cover, to complete check.

---

**VALVE MAINTENANCE**

If valve tappets, with proper clearance, are noisy the following points should be checked:

1. Tappets loose in their guides.
2. Tappets not properly rotating, causing uneven wear on tappet faces.
3. Weak valve springs.
4. Valve sticking in valve guides.
5. Valves loose in valve guides.
6. Valve springs cocked or not seating properly.
7. Warped valve.
8. Valve seat and guide not in alignment.

---

**CYLINDER BORING OR HONING**

Careful washing and careful protection before reconditioning the cylinder bores will save a great deal of expense later.

Crankshaft bearings, camshaft bearings, connecting rod bearing surfaces on the crankshaft, crankcase walls, in fact the entire part of the engine below the bottom of the cylinder bores must be protected from any particles of grit, chips, etc.

After reboring the cylinders or honing them, it is necessary that they be thoroughly washed.

All traces of abrasive material will have to be removed or extremely rapid wear of the new parts will result.

---

**REFERENCES**

<table>
<thead>
<tr>
<th>Source of Information</th>
<th>Date</th>
<th>Subject</th>
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</table>
## SECTION 4

### FUEL SYSTEM & EXHAUST

#### CARBURETOR WA-1

<table>
<thead>
<tr>
<th>SPECIFICATIONS:</th>
<th>Metering Rod Jet</th>
<th>Metering Rod Setting:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR MODEL:</td>
<td>4A</td>
<td>Use Gauge J-1265 Carter T-109-102</td>
</tr>
<tr>
<td>Make</td>
<td>Carter</td>
<td>Accelerator Pump:</td>
</tr>
<tr>
<td>Model</td>
<td>WA-1 -</td>
<td>Pressure type with adjustable stroke.</td>
</tr>
<tr>
<td>Model No.</td>
<td>749S</td>
<td>Intake ball check size No. 60 drill.</td>
</tr>
<tr>
<td>Type</td>
<td>Single Throat Down</td>
<td>Discharge ball check No. 32 drill.</td>
</tr>
<tr>
<td>Main Venturi</td>
<td>1 - 3/8&quot; I. D.</td>
<td>Relief passage (to outside) No. 42 drill.</td>
</tr>
<tr>
<td>Primary Venturi</td>
<td>11/32&quot; I. D.</td>
<td>Pump Adjustment - 16/64&quot; plunger travel, (full throttle position) short stroke.</td>
</tr>
<tr>
<td>Float Level</td>
<td>1/2&quot;</td>
<td>Choke heat suction hole, in body size No. 30 drill.</td>
</tr>
<tr>
<td>Idle Adjustment</td>
<td>1/2 to 1 - 1/2 turns open Pump Plunger Travel from Closed to Wide.</td>
<td></td>
</tr>
<tr>
<td>Low Speed Jet Tube</td>
<td>Jet size No. 65 drill.</td>
<td>Anti-Percolator Valve:</td>
</tr>
<tr>
<td></td>
<td>16/64&quot;</td>
<td>Saxophone Key</td>
</tr>
<tr>
<td>Vents:</td>
<td>Outside Only No. 10 drill.</td>
<td>Vacuum Spark Port:</td>
</tr>
<tr>
<td>Gasoline Intake:</td>
<td>Square vertical needle. Size No. 46 (.081&quot;) drill hole in needle seat.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 / 16 &quot; weatherhead nipple.</td>
<td></td>
</tr>
<tr>
<td>Idle Port:</td>
<td>Length .190&quot;, width .040&quot;.</td>
<td></td>
</tr>
<tr>
<td>Idle Port Opening:</td>
<td>136&quot; to 140&quot; above valve with valve closed.</td>
<td></td>
</tr>
<tr>
<td>Idle Screw Seat:</td>
<td>No. 46 drill.</td>
<td></td>
</tr>
<tr>
<td>Main Nozzle:</td>
<td>Slip nozzle, flush type, (angle tip) seats in primary venturi at 45° angle.</td>
<td></td>
</tr>
<tr>
<td>Carter No.-12 - 2805:</td>
<td>Discharge jet size .110&quot; dia. Inner nozzle (seats in slip nozzle) T. D. No. 31 drill (.120&quot;).</td>
<td></td>
</tr>
</tbody>
</table>
FIGURE 1

CLIMATIC CONTROL (CHOKE):

All model WA-1 Carburetors are equipped with Carter Climatic Control, Figure 1, which serves as an automatic choke. The Climatic Control closes the choke valve when the engine is cold. The Climatic Control is connected to the exhaust manifold by a tube (J) which allows exhaust gases to enter through the opening into the control housing and warm the thermostatic spring (C) and decreases the spring tension. A vacuum piston (D) is connected to the choke valve and operates from the vacuum of the intake manifold. The pull of the piston against the thermostatic spring opens the choke valve (H) as the engine becomes warm.

To prevent the thermostatic spring (C) from closing the choke valve if the throttle is opened on a cold engine, a lockout is provided in the choke linkage to hold the choke open on all wide open throttle operations.

A cam on the choke valve shaft is brought against an adjusting screw when the choke is closed. The screw is adjusted to hold the throttle open sufficiently to provide necessary engine speed (fast idle) during the warm-up period. As the choke valve opens, the fast idle cam moves away from the screw allowing the engine to run at normal idle speed.

An unloader is provided in the choke linkage to open the choke valve when the accelerator pedal is fully depressed. This allows the engine to clear itself of excess fuel if the engine is flooded during the starting period.

ANTI-PERCOLATOR VALVE:

When the car stands in extremely hot weather or after a hard run, fuel in the carburetor bowl may vaporize and set up pressure in the bowl. To prevent this pressure forcing the fuel out the high speed nozzle (percolating), an anti-percolator device vents the carburetor bowl to the atmosphere when the throttle is closed, relieving the pressure in the bowl.
An anti-percolating valve that opens too early will allow excess air to be drawn into the high speed circuit. If the valve fails to open, it will cause difficult starting when the engine is hot.

The WA-1 - 749S carburetor has one saxophone key type anti-percolator valve, Figure 2.

**ACCELERATING PUMP:**

The WA-1 carburetor, Figure 3, incorporates a throttle operated accelerating pump which discharges additional fuel into the carburetor throat when the throttle is opened. The discharge is prolonged by the pressure of the pump and the restriction of the pump jet. This discharge allows time for the high speed circuit to furnish necessary fuel.

**FAST IDLE:**

Provision is made on this carburetor for faster idle speed during the warm-up period. This is accomplished by a cam on the choke valve shaft which holds the throttle open slightly when the choke valve is closed. A soon as the engine becomes warm, the choke valve is opened and the fast idle cam moves away from the adjusting screw, allowing the throttle to close and engine to idle at normal speed.

**METERING RODS:**

The amount of fuel admitted to the carburetor throat through the high speed circuit is controlled by a stepped and tapered metering rod, Figure 3.

Opening the throttle raises the metering rod allowing more fuel to pass through the jet.

At top speed the smallest section of the metering rod is in the jet.

Under heavy load at part throttle and for acceleration at part throttle, a richer than normal air-fuel ratio is required. To provide this richer mixture, regardless of throttle position, the metering rod is connected to a vacuum piston. Under normal operating conditions the vacuum piston holds the metering rod down against the throttle link. When the engine vacuum drops, a spring under the vacuum piston raises the piston and metering rod, allowing more fuel to flow through the jet. As soon as the engine vacuum rises, the need for rich mixture passes and the vacuum piston returns the metering rod to normal position for mechanical operation through the throttle linkage.

**WA-1 CARBURETOR ADJUSTMENTS**

**PUMP TRAVEL:**

1. Remove the carburetor dust cover.
2. Back out throttle adjusting screw to seat throttle valve.
3. Pump connector link should be in the lower hole (short stroke), Figure 3.
4. Pump travel should be 16/64". Use Carter Universal Pump Stroke Gauge T-109-1175 if available.
5. Adjust pump travel by bending throttle connecting link at lower angle, Figure 3.
METERING ROD SETTING:

1. Remove air cleaner and dust cover.
2. Remove hairpin clip and disconnect spring from metering rod.
3. Remove metering rod and disk.
4. Insert metering rod gauge, J-1265 (Carter No. T-109-102). Hold gauge vertical and be sure gauge is seated in metering rod jet, Figure 4.
5. Press down on vacuum piston link directly over piston until it contacts the pump arm. Clearance between metering rod pin and shoulder of gauge should be less than .005" with throttle valve seated. Gauge must not drag on pin.
6. Adjust by bending lip on piston link at (A).
7. Remove gauge and install metering rod and disk.
8. Reconnect metering rod spring.

ANTI-PERCOLATOR ADJUSTMENT:

NOTE: Carburetor must be removed from engine.

1. Crack throttle valve .020" by placing gauge J-1633 (Carburetor No. T-109-29), between throttle valve and bore of carburetor on side opposite the idle port, Figure 5.

2. Clearance between percolator rocker arm lip and pump arm should be .005" to .015" at (B) Figures 4 and 6.

3. Adjust by bending the rocker arm at (A) Figure 4, using Bending Tool .1 - 1389 to obtain this clearance.
UNLOADER ADJUSTMENT:

1. Remove carburetor air cleaner.

2. Open throttle wide open and check between lower edge of choke valve and air horn (A), Figure 7. Clearance should be 7/16”.

3. Adjust by bending cam (B) on throttle lever using Bending Tool J-1137.

4. Clearance between lower edge of choke valve and air horn should be 5/8”, (A), Figure 7.

5. Adjust by bending fast idle link at offset portion (A), Figure 8.

FAST IDLE ADJUSTMENT:

1. Remove Carburetor air cleaner.

2. With fast idle cam in normal idle position, tighten throttle lever adjusting screw (A), Figure 8, until it just seats against the cam.

3. Hold throttle lever closed and pull cam back until low step is against but not on set screw (B), Figure 8

4. Normal setting is 1/2 to 1 - 1/2 turns open.

WA-1 CARBURETOR

REMOVAL:

1. Remove air cleaner. Loosen clamp at air horn.

2. Disconnect throttle linkage at carburetor.

3. Disconnect gas line from carburetor to fuel pump.
UNLOADER ADJUSTMENT:

1. Remove carburetor air cleaner.

2. Open throttle wide open and check between lower edge of choke valve and air horn (A), Figure 7. Clearance should be 7/16”.

3. Adjust by bending cam (B) on throttle lever using Bending Tool .1 - 1137.

4. Clearance between lower edge of choke valve and air horn should be 5/8”, (A), Figure 7.

5. Adjust by bending fast idle link at offset portion (A), Figure 8.

FAST IDLE ADJUSTMENT:

1. Remove Carburetor air cleaner.

2. With fast idle cam in normal idle position, tighten throttle lever adjusting screw (A), Figure 8, until it just seats against the cam.

3. Hold throttle lever closed and pull cam back until low step is against but not on set screw (B), Figure 8.

4. Normal setting is 1/2 to 1 - 1/2 turns open.

5. Disconnect gas line from carburetor to fuel pump.

IDLE ADJUSTMENT:

1. Start engine and allow engine to warm up.
2. See that choke valve is wide open.
3. Set idle adjustment screw to obtain smooth idle at 540 to 560 RPM.
4. Normal setting is 1/2 to 1 - 1/2 turns open.

WA-1 CARBURETOR

REMOVAL:

1. Remove air cleaner. Loosen clamp at air horn.
2. Disconnect throttle linkage at carburetor.
3. Disconnect gas line from carburetor to fuel pump.
6. Remove the low speed jet assembly, Figure 13.

7. Remove the pump jet plug and gasket assembly and pump jet, Figure 14.

8. Remove the pump discharge ball retainer and gasket, and check ball, Figure 15.

9. Remove nozzle passage plug, nozzle retainer plug and nozzle, Figure 16. (Be sure to remove small nozzle gasket from casting.)

10. Remove the pump strainer, and pump intake check ball, Figure 17.

11. Separate body from flange assembly, Figure 18, and remove body flange gasket.
12. Remove idle adjustment screw and spring, Figure 19. Check for groove on seating surface.

13. Remove idle port rivet plug, Figure 20.

14. Remove throttle valve screws, valve and throttle shaft and lever assembly, Figure 21. Check shaft for wear or loose lever and throttle rod hole in lever for wear.

15. Remove choke valve screws, choke valve, shaft and piston assembly from air horn. Do not remove the piston housing (attached to the air horn with rivets).

16. Remove all parts from the bowl cover.

ASSEMBLY:

1. Clean casting and metal parts thoroughly with a good commercial carburetor cleaning compound.
5. Install the needle, float and lever assembly, and float lever pin. Check float for dents and wear on lip, and float pin for wear. Check bowl cover for wear in counter-shaft hole. Set float level to 1/2" by bending lip that contacts the needle. Do not bend float Figure 24. Measure distance from projection on bowl cover to soldered seam of float, as shown.

6. Install throttle shaft and lever assembly and throttle valve. Small "C" in circle should be toward idle port facing manifold side of flange, Figure 25. Center the valve by tapping valve lightly before tightening screws.

NOTE: Back out throttle lever adjusting screw before installing shaft assembly.

7. Install idle port rivet plug, Figure 26.

8. Install idle adjustment screw and spring, Figure 27. Back out from seated position 1/2 to 1 - 1/2 turns. (Make final adjustment after installation.)

9. Assemble body and body flange assembly, Figure 28. Install screws and lock-washers. Pull screws down evenly.

10. Install low speed jet assembly, Figure 29. (Be sure jet seats firmly in casting.)

11. Install pump jet and pump jet passage plug and gasket assembly, Figure 30. (Be sure jet is clear of all restrictions and seats properly.)
12. Install pump check ball and pump discharge ball retainer and gasket, Figure 31.

13. Install pump intake check ball and pump strainer, Figure 32.

14. Install pump spring and pump plunger and rod assembly, Figure 33. Examine leather of plunger for damage. If leather is not in good condition, replace entire plunger assembly.

15. Install metering rod jet and gasket assembly, Figure 34. Examine for wear.

16. Install the bowl cover assembly, Figure 35. Pull the screws down evenly. Install idle passage plug and gasket assembly (center of bowl cover).

1. Install the anti-percolator cap and rocker arm assembly and spring, Figure 36. (Make certain that leather is in good condition and that pin is not worn.)
18. Install pump arm and countershaft assembly Figure 37. Install connector link on pump shaft in lower hole in pump arm.

19. Install the throttle shaft arm and screw assembly and throttle connector rod. Figure 38. Check throttle shaft arm for wear.

20. With throttle connector rod in place, adjust pump stroke. Use Carter universal pump travel gauge T-109-117S or machinist's scale, Figure 39, and set pump travel to 16/64". Adjust by bending throttle connector rod at lower angle.

21. Adjust metering rod after pump adjustment is made. (See Figure 4). Insert metering rod gauge J-1265 in place of metering rod, seating tapered end in jet. With throttle valve seated, press down lightly on piston link directly over piston. There should be less than .005" clearance between metering rod pin and shoulder of notch in gauge. Gauge must not drag on pin. Adjustment can be made by bending lip on piston link so that it contacts hump on pump arm. Remove gauge, install rod and disc, and connect spring.

22. Adjust anti-percolator, Figure 40, as outlined on Page 4 - 4, Figures 5 and 6.

41. Install nozzle, nozzle retainer plug and nozzle passage plug and gasket assembly, Figure 41.
24. Install air horn and piston housing assembly, Figure 42. Install screws and lock-washers. Tighten screws evenly.

25. With choke lever, screw and link assembly in place, install choke shaft and piston assembly, Figure 43. Check for loose lever on shaft.

26. Install choke valve, Figure 44. Center choke valve on shaft and in bore by tapping lightly. Hold in place with finger while tightening screws.

27. Install the piston housing and thermostatic coil assembly, Figure 45. Install coil housing assembly with indicator marks at bottom and rotate counter clockwise to center graduation.

28. Hold choke valve wide open, then tighten the choke lever screw as shown in Figure 46. Be sure that linkage does not bind in any position. Fast idle, unloader and lock out adjustments should be made as specified under "Carburetor Adjustments."

29. Install fast idle cam and pin assembly, Figure 47.
**SPECIFICATIONS:**

**CAR MODELS:** 5A, 6A, 7A, 8A  
Make Carter  
Model 6 Cyl. WGD 776-S  
Model 8 Cyl. WGD 773-S  
Type Dual Downdraft 1 - 1/4"  
Main Venturi 1 - 3/16" I. D.  
Primary Venturi 11/32" I. D.  
Secondary Venturi 21/32" I. D.  

**Float Level:** Distance from lowest part of float to bowl cover when needle is seated to be 3/16". (Use Gauge J-818-3)  

**Idle Adjustment:** 1/2 to 1 - 1/2 turns open, 6 cylinder. 1 to 1 - 1/2 turns open, 8 cylinder.  

**Low Speed Jet Tube:** Jet No. 66 Drill. Bypass No. 55 drill. Economy step, .068" diameter. Middle step tapers to .063" diameter. Power step, .048" diameter. Length 59/64".  

**Vents:** Outside only No. 10 drill.  

**Gasoline Intake:** Square vertical (push-pull) needle seat size No. 42 drill.  

**Idle Ports:** Upper port, slot type length .200" width .030".  

**Idle Port Opening:** .157" to .163" above upper edge of valve with valve closed tight.  

**Lower Port** (For idle Adjustment Screw). Size .0615" to .0655" Diameter.  

**Nozzle:** In primary venturi, round end type. Inside diameter No. 30 drill. Nozzle is installed permanently **DO NOT REMOVE.**  

**Accelerating Pump:** Pressure type delayed action plunger. Discharge jet (twin) No. 74 drill. Intake ball check, No. 40 drill. Discharge (Needle seat) No. 50 drill. Pump jet air bleed passage to outside 1/8" drill.  

**Choke** Climatic Control Butterfly type-offset valve. Set on index for (WGD-773 - S.) Set one point lean for (WGD-776-S.) Choke heat suction hole in body No. 36 drill.
Vacuum Spark Port: .039" to .041" diameter.
Top of port .015" to .025" above valve.

**CARBURETOR ADJUSTMENTS**
(WGD)

**FLOAT ADJUSTMENT:**

Holding the bowl cover inverted and gasket removed and with the float needle (A) Figure 48, seated, there should be 3/16" clearance between the top of float (B) and bowl cover (C). (Use gauge J-818-3 Carter No. T-109-28.) Measurement to be taken at lowest point of float. (approximately at center of float).

1. Back out throttle lever set screw until throttle valves (G) Figure 49, seat in bores (F) of carburetor and leave screw backed out until carburetor is installed on engine.

2. With the pump connector link in the outer hole (D) in pump arm (long stroke) the pump plunger should travel 5/16" from closed throttle to wide open throttle position.

3. Measurement can be made with suitable depth gauge.

4. If adjustment is necessary, bend the throttle connector rod at the upper angle (C).

**METERING ROD ADJUSTMENT:**

NOTE: The metering rods must be adjusted after the pump travel adjustment or when leaner than standard rods are installed. (No metering rod gauges are necessary for this adjustment).

1. With the throttle lever set screw backed out as in "Pump Adjustment", press down on vaccumeter link (1) Figure 50, until metering rods bottom.
2. With metering rods bottoming, revolve metering arm (K) until lip (H) (See insert) contacts vacuumer link (I). Hold arm (K) towards connector link side and carefully tighten the metering rod arm set screw.

**FAST IDLE ADJUSTMENT:**

1. With the thermostatic coil housing, gasket and baffle plate removed, open throttle valve (F) Figure 51, and hold choke valve closed by holding down on choke lever (L).

2. Then close throttle. There should now be .026" clearance (use gauge KMO-658, T-109-189) between the throttle valve and bore of carburetor (side opposite idle port).

   Adjust by bending the choke connector rod at lower angle (M).

**UNLOADER ADJUSTMENT:**

This adjustment must be made after making the fast idle adjustment.

1. Hold the throttle valve wide open and close the choke valve as far as possible without forcing.

2. Check clearance between upper edge of choke valve and inner wall of air horn; this should be 1/8" (use Tool J-818-5), Figure 52.

3. If adjustment is necessary, bend arm (N) on choke trip lever (Use Tool T-109-187).

**IDLE ADJUSTMENT:**

1. With carburetor installed on engine, start engine and allow engine to warm up.
2. See that choke valve is wide open.
3. Set idle adjustment screws to obtain smooth idle at 540 to 560 RPM. (If car is equipped with Drive-Master, set idle at 580 to 600 RPM).
4. On eight cylinder engines the normal screw setting is 1 to 1 - 1/2 turns open, on six cylinder engines 1/2 to 1 - 1/2 turns open.

**WGD CARBURETOR**

**REMOVAL:**

1. Remove the air cleaner. Loosen clamp at carburetor air horn.
2. Disconnect throttle linkage at carburetor.
3. Disconnect fuel line from carburetor to
fuel pump (at carburetor).
4. Disconnect vacuum line from carburetor to distributor.
5. Disconnect heat riser tube from exhaust manifold to carburetor.
6. Remove nuts and lock washers from the carburetor mounting studs and remove the carburetor assembly.

DISASSEMBLY:
1. Remove the dust cover screws, cover and gasket, Figure 53.

2. Remove the retainer clips and remove the throttle connector rod and choke connector rod, Figure 54.

NOTE: Check the throttle and choke connector rods at both ends for wear.

3. Remove bowl cover with all parts attached, Figure 55.

4. Remove the body flange screws and remove the body flange assembly and gasket, Figure 56.

5. Remove all parts from bowl cover, Figure 57.
6. Remove all parts from the carburetor body, except nozzles and other pressed in parts, Figure 58.

7. Remove all parts from the body flange assembly, Figure 59.

NOTE: Wash all parts in a good carburetor cleaning solution, except the thermostatic coil and housing assembly and the pump plunger.

CAUTION: DO NOT SOAK THE BOWL COVER ASSEMBLY FOR MORE THAN ONE-HALF HOUR.

NOTE: Carefully note slots in choke piston cylinder. If they are carbonized, remove the welsh plug by piercing center with a small pointed instrument and pry outward. Be careful not to damage the casting. Blow out all passages with compressed air and scrape worn or damaged parts and all gaskets.

After cleaning carburetor parts, group as follows:

1. Group all parts controlling gasoline level, Figure 60.

2. Group all parts controlling the idle operation, Figure 61.

3. Group all parts controlling the high speed operation, Figure 62.
4. Group all parts controlling pump operation, Figure 63.

5. Group all parts controlling choke operation, Figure 64.

NOTE: If welsh plug has been removed from the choke housing for cleaning, install a new plug.

ASSEMBLY:

1. Install all parts controlling IDLE OPERATION. Install throttle shaft and lever assembly, Figure 65. (Back out throttle lever adjusting screw.)

2. Install the throttle valves. Small "c" at (A) Figure 66, in circle should be toward idle part at (B) (when viewing casting from manifold side). Center throttle valves by tapping lightly and holding in place with fingers before tightening screws. (Always use new screws.)

3. With throttle closed, press shaft from lever side and install throttle centering washer at "C", Figure 67, prongs of washer extending outward. Press washer tight against carburetor casting.

4. Install idle part rivet plugs (D), Figure 68. Then install idle adjustment screws and springs (E). (Adjust to specifications as shown on page 4 - 15, "Idle Adjustment").
5. Install low speed jet assemblies, Figure 69. (No gaskets are used.)

6. Assemble body casting to flange, Figure 70. (Use new gasket.)

7. Install the intake ball check (G), Figure 71. Then install the retainer ring (H) and the strainer (I).

8. Install discharge check needle (J), Figure 72, gasket (K) and pump jet cluster (L) and screw. (Use new gasket.)

9. Install lower pump spring and plunger assembly, Figure 73.
10. Install bowl strainer gauge, nut and gasket assembly as indicated by arrow, Figure 74.

11. Install needle seat and gasket assembly (M), Figure 75.

12. Attach the intake needle and pull clip to float lip at (N), Figure 76, then lower needle into seat until float and lever line up with holes and install float lever pin. (Set float to specifications, Page 4 - 13 and install new bowl cover gaskets.)

13. Install metering rod jets, Figure 77. (No gaskets are used.)

14. Install vacumeister piston link and metering rod spring at (P), Figure 78, lip on link extending toward air horn.

15. Install vacumeister piston (Q), Figure 79, on link with pin extending away from float. (Install a new bowl gasket.)
16. Install vacumeter spring (R), Figure 80, in cylinder and assemble bowl cover on body. (Install bowl cover screws, tightening center screws first.)

17. Install pump connector link (S), Figure 81 in outer hole of pump arm and install hair pin clip. Insert the lower end of pump connector link in hole in plunger shaft. Hold arm (R) in place and press shaft through arm. Hold metering rod arm (U) with lip extending through slot in vacumeter piston link and press shaft in place. Tighten pump arm (T) screw and metering rod arm (U) screws.

18. Install the throttle shaft lever, washer and screw at (V), Figure 82. Install throttle connector rod and retainer clips.

19. Set pump stroke, Figure 83, (see Page 14, for pump stroke setting).
20. Install metering rods. Catch the metering rod spring loop with lower end of the metering rod as rods are inserted (W), Figure 84. Adjust metering rods in the following manner:
a. Back out the throttle lever adjusting screw so throttle valves seat.
b. Loosen metering rod arm set screw.
c. Press down on the vacumeter link until metering rods bottom in body casting.
d. With torque on arm touching lip (top of slot) of link, tighten metering rod arm set screw.
e. Install dust cover gasket, dust cover and screws.

21. Install fast idle cam and spring as indicated by arrow, Figure 85.

22. Install choke piston, lever, link and shaft, Figure 86.

23. Connect the fast idle cam spring to the choke piston lever at (X), Figure 87.

24. Install choke valve using new screws.
NOTE: Choke valve to be installed with the circled "C" visible from the top of the carburetor with valve in closed position as indicated by an arrow, Figure 88. Seat choke valve by tapping lightly; hold in place with fingers before tightening screws. Valve or shaft must not bind in any position.

25. Install the fast idle link, choke connector rod and retainer clip, Figure 89.

26. Install choke trip lever assembly, Figure 90.

27. With the choke valve tightly closed, adjust the fast idle by bending choke connector rod at the lower angle, Figure 91; to give proper clearance between the throttle valve and base of carburetor. See "Fast Idle Adjustment", Page 4-15.
30. Install the thermostatic coil and housing assembly, retainers and screws (Z), Figure 94. Install housing with index marks to bottom and revolve housing in direction of arrow, set index marks to specifications; see "Climatic Control Setting," Page 4 - 13. After making proper adjustment, tighten attaching screws.

![FIGURE 94]

**INSTALLATION OF WA-1 OR WGD CARBURETOR**

**NOTE:** Place four gaskets on each side of heat deflector, Figure 95. Replace all broken or damaged gaskets and straighten deflector if damaged.

![FIGURE 95]

I. Install carburetor and install nuts and lock washers on the carburetor mounting studs (E), Figures 96 and 97.

![FIGURE 96]

2. Connect vacuum line from distributor to carburetor, (F).

![FIGURE 97]

3. Connect gas line from fuel pump to carburetor, (G).

3. Connect heat riser line from exhaust manifold to carburetor (H).

3. Connect throttle linkage to carburetor; install clamp.

3. Adjust and test carburetor for maximum performance.

7. Install air cleaner.

**NOTE:** Do not tighten air cleaner clamp so tight that carburetor air horn may be distorted.
AIR CLEANER, DRY
(Oil Wetted Type)

The oil wetted type of air cleaner is used as standard equipment on all models. In this type cleaner the wire gauze is oil soaked. As the air passes through it, foreign particles are removed, permitting only clean air to enter the carburetor.

The air cleaner section should be cleaned at least every 2,000 miles, oftener if local conditions warrant.

This filter can be cleaned by removing the attaching wing nut and lifting out the unit. Clean off old oil and dirt by dipping in kerosene and blowing dry. Re-oil by dipping unit in engine oil (using the same grade as is used in the engine). Permit excess oil to drain off and reinstall unit in cleaner.

OIL BATH AIR CLEANER

The oil bath cleaner is available as an option. In this unit, dirt is precipitated from the air into the oil as the incoming air strikes the oil in the sump.

The oil bath type air cleaner should be serviced at 2,000 mile intervals, or more frequently during severe dust conditions, as follows:

1. Unscrew and remove wing bolt at top of cleaner.
2. Lift out filter element; clean in gasoline and drain.
3. Remove old oil, wash out base, and refill to level indicated with 50 S.A.E. oil for temperatures above 32°F and 20 S.A.E. for lower temperatures.

FUEL PUMP

Carter mechanical fuel pump M-729SZ, Figure 98 is used as standard on all 'A' series Hudsons. A combination fuel and vacuum pump, AC Type AT, Figure 99 is available as an option.

Operation of the fuel pumps is similar. The pump cam lever (A) fits under an eccentric on the camshaft. Rotation of the camshaft forces the cam lever down against the diaphragm spring (B), pressure, raising the diaphragm (C). Fuel is drawn into the fuel chamber through the inlet port (D), screen (E), and inlet valve (F). When the low side of the eccentric is against the cam lever, the diaphragm spring forces the diaphragm down, expelling fuel through the outlet valve (G) and outlet port (H) to the carburetor bowl.

Continued pump operation fills the carburetor bowl, and the float needle valve closes the carburetor inlet. Fuel pressure built up in the pump fuel chamber opposes the diaphragm spring, resulting in shorter strokes until the pump stops completely. Normal diaphragm stroke is about 1/64".

The vacuum section of the combination fuel and vacuum pump acts as a vacuum booster for the windshield wiper. The same eccentric and cam lever that operates the fuel pump operates the vacuum pump. The cam lever forces the
diaphragm (I) up against the diaphragm spring (J), expelling air through the outlet valve (K) and port (L) into the manifold.

With the cam lever on the low side of the eccentric, spring pressure forces the diaphragm down, drawing air from the windshield wiper through the inlet port (M) and valve (N). When the manifold vacuum increases, the diaphragm is drawn up against the spring and ceases to operate. The diaphragm operates only when manifold vacuum is insufficient for wiper operation.

**FUEL PUMP TEST:**

1. Remove and clean the fuel pump sediment bowl and screen.
2. Replace the screen if damaged.

NOTE: If the combination fuel and vacuum pump is used, remove and clean the air filter screen located under the cover at the top of the pump.

2. Make sure all connections and cover screws are tight after replacement.
3. Disconnect the fuel line at the carburetor and connect the fuel pump gauge.
4. Start the engine and run at 1800 RPM. Pressure should be 3 to 4 pounds with AC combination fuel and vacuum pump and 3 - 1/2 to 4 - 1/2 pounds with Carter M-729SZ. Stop engine and watch pressure gauge. Pressure should not fall perceptibly.
5. If pressure falls, leaking pump valves are indicated.
6. If pressure is below specifications, attach vacuum gauge to inlet port of pump and operate engine. Gauge should show 6" of mercury or higher for satisfactory operation.
7. If fuel pump pressure is low, but vacuum reading satisfactory, difficulty is in the gasoline tank or lines to the pump.
8. If pump pressure and vacuum are both low, pump should be repaired or replaced.

**VACUUM BOOSTER TEST:**

To check the action of the vacuum portion of the combination fuel and vacuum pump connect a vacuum gauge to the inlet port and disconnect outlet. Gauge should show 8-1/2" of mercury at 120 RPM and 12" at 1800 RPM. If vacuum is not within these limits, repair or replace pump.

**REMOVAL (8 Cylinder):**

1. Remove right front wheel.
2. Remove rear portion of fender dust shield.
3. Disconnect fuel lines from pump.
4. On combination pump, disconnect vacuum lines.
5. Remove cap screws, pump, and gasket pack.

**REMOVAL (6 Cylinder):**

1. Disconnect fuel lines from pump.
2. On combination pump disconnect vacuum lines.
3. Remove cap screws, pump, and gasket pack.

**INSTALLATION:**

Install in reverse of removal. Make sure flange gasket (A), Figure 100, mounting stud insulator bushings (C) and washers (E) are placed as indicated in exploded view.

**FUEL PUMP OVERHAUL**

NOTE: New diaphragms should be dipped in kerosene to soften them before assembly.

**FUEL PUMP DISASSEMBLY (CARTER):**

1. Mark pump body and valve housing with a file to insure correct reassembly.
2. Remove cam lever return spring (F), Figure 100.
3. Remove cam lever pin rivet plug (J) retainer (H), and pin (I).

4. Remove cam lever (B).

5. Remove six valve housing screws (P) and valve housing (M).

6. Remove two valve housing cover attaching screws (K), valve housing cover ®, outlet air dome diaphragm (Q) and strainer (O).

7. Remove diaphragm assembly (G).

8. Do not remove valve cage assemblies (L and N) unless they are to be replaced.

9. Clean all parts in gasoline. (Do not use strong solvent or cleaner on valve housing unless the valve cage assemblies have been removed.)

10. Inspect parts for wear and select repair kit. (One rebuilding kit is a gasket and diaphragm kit; the other contains all parts which are subject to wear.)

FUEL PUMP ASSEMBLY (CARTER):

1. Install new valve cage assemblies (L and N) if they have been removed.

2. Assemble strainer (O), outlet air dome diaphragm (G), valve housing cover (R) and attach to valve housing.

3. Install diaphragm assembly (G) in pump body with flat spaces on sides toward ports.

4. Align mark on pump body with mark on valve housing (M) and install housing, but DO NOT tighten screws.

5. Install cam lever, pin, and pin retainer.

6. Install new rivet plug M.

7. Flex diaphragm and hold in maximum down position and tighten valve housing attaching screws.

8. Install cam lever return spring.

FUEL PUMP DISASSEMBLY (AC):

CAUTION: Before taking a combination pump apart, read assembly instructions paragraphs No. 2, 13 and 15 for special equipment needed. These are AC tools No. Pt-8, and two 10-32 x 1 - 1/2' screws. If you do not have these tools, or equivalent, do not attempt to overhaul the pump.

1. Mark edges of fuel cover (25), Figure 101, and body diaphragm flanges with a file. The parts may then be reassembled in the same relative position.

2. Remove fuel cover screws (23) and lock-washers. Separate cover from body by jar-ring cover loose with a screwdriver handle. Remove diaphragm spring (28) and retainer (29). Remove valve cage retainer screw and remove retainer and cage assemblies (27) and gaskets (26).

3. Mark edges of vacuum cover (6) and body diaphragm flanges. The parts may then be reassembled in the same relative position.

4. Remove two screws from opposite sides of the vacuum cover, and substitute for them two No. 10-32 x 1 - 1/2 inch fillister head screws. Turn the two long screws all the way down, and then remove the balance of the regular cover screws. Alternately back off the two long screws, a few turns at a time, until the force of the heavy vacuum diaphragm spring is no longer effective. Remove the two long screws, the cover assembly, diaphragm spring (1), and spring retainer (12).

5. File riveted end of rocker arm pin (33) flush with steel washer, or drill of end with 3/8’ drill. Drive out rocker arm pin with a drift punch. Wiggle rocker arm (42) until links unhook from both diaphragms. Then remove rocker arm spring (40), rocker arm, and the link assembly.

6. Remove bushings (38) from rocker arm before removing rocker arm (42), two vacuum links (35 and 37), one fuel link (36), link spacer (41), and link washer (43).
7. Lift vacuum diaphragm (30) out of body, and remove lower oil seal retainer (34), by turning until slot lines up with flat of pull rod. Remove oil seal washer (32), upper oil seal retainer, and oil seal spring (31).

8. Remove fuel diaphragm (2) by pulling straight out. CAUTION: DO NOT TILT EXCESSIVELY OR STAKED-IN OIL SEAL WILL BE DAMAGED.

9. Remove valve cage retainer screw (3), and lift out retainer (4), two valve and cage assemblies (5) and two gaskets (13).

10. Remove bowl screw (11) and gasket (10). Then remove bowl (9), bowl gasket (8) and screen (7).

11. Remove cover plate screw (17) with gasket (18). Lift off the cover (19), cover gasket (20), screen retainer, (21), and screen (22).

12. Blow out all passages with compressed air.

INSPECTION:

Inspect pump parts as follows:

1. Top Cover and Pump Body - Make visual check for cracks and breakage. Inspect for diaphragm flange warpage by testing on a smooth flat surface. Examine all threaded holes for stripped or crossed threads. Broken, damaged, or severely warped castings must be replaced.

2. Valve and Cage Assemblies - Replace. Extent of wear cannot be determined visually.

3. Strainer Screen - Replace. Inspect new screen for damage or obstruction. Screen must fit snugly around inner edge.

4. Rocker Arm - Inspect for wear or scores at camshaft pad and at point of contact with link and pull rod.

5. Rocker Arm Pin and Washer - Replace bullet type pin with head type pin and washer.

6. Link - Replace because amount of wear cannot be determined visually.

7. Rocker Arm Spring - Replace. Spring may be weak from distortion or corrosion.

8. Diaphragm - Always replace.

9. Gaskets and Oil Seal - Always replace gaskets and oil seal to assure tight seals.

ASSEMBLY (AC):

1. Assemble link spacer (41) over fuel link (36). Place one vacuum link (35 and 37) on each side of the fuel link. The hook ends of the vacuum link should come together so that they surround the fuel link. All link hooks should point in the same direction. Place assembly of links and spacer between lobes of rocker arm with one spacer washer (43) on the outer side of each vacuum link. Slide rocker arm bushing (33) through holes in rocker arm, spacer washers, and links.

2. Stand the pump body (39) on the bench, fuel flange down. Set rocker arm spring in position with one end over cone cast into body. Slide rocker arm and link assembly into body. Outer end of all link hooks must point toward vacuum flange. Temporarily retain rocker arm and link assembly with AC tool PT-6 or a long straight pin or punch.

3. Turn the pump body over so the fuel diaphragm flange is up. Set the diaphragm spring (1) on the staked-in oil seal. Push diaphragm pull rod through retainer (12), spring and oil seal. Flat of pull rod must be at right angles to link. Hook diaphragm pull rod to fuel link. FUEL LINK IS THE SHORT, CENTER LINK. DO NOT TILT DIAPHRAGM PULL ROD EXCESSIVELY AS THIS MAY DAMAGE THE OIL SEAL.
4. Drive tool PT-6 out with permanent rocker arm pin (33). Place washer over small end of pin and spread pin end with ball peen hammer or round nose punch.

5. Place valve and cage gaskets (13) in recesses provided in fuel cover (6). Inlet valves must have three-legged spider facing out of cover, and outlet valve must have three-legged spider facing into cover. Secure valve assemblies with retainer (14), and screw (3).

6. Install strainer screen (7), bowl gasket (8), bowl (9), bowl screw gasket (10) and bowl screw (11) in the order named. Install air dome (14) in threaded hole in projection of casting for outlet.

7. Install fuel cover on body, making sure that file marks on cover and body line up. Push on rocker arm until diaphragm is flat across body flange. Install cover screws and lockwashers loosely until screws (16) just engage lockwashers. Pump the rocker arm three or four full strokes and tighten cover screws alternately until secure.

8. Diaphragm must be flexed before tightening cover screws, or pump will deliver too much pressure.

9. Place two gaskets (26) and two valve and cage assemblies (27) in cover (25). Inlet valve must have three-legged spider facing out of cover, and outlet valve must have three-legged spider facing into cover. Secure valve and cages with retainer and screw.

10. Turn cover over and set screen (22) in recess over valve hole. Set screen retainer (21) on screen. Place cover gasket (20), cover (19), cover screw gasket (18), and cover screw (17) in position in the order named and tighten cover screw.

11. Assemble oil seal on vacuum diaphragm pull rod in the following sequence: oil seal spring (31), upper retainer (34), oil seal washer (32), and lower retainer. Turn lower retainer 90 degrees to lock in position.

12. Lift the pump body above eye level, facing the vacuum diaphragm flange. The two vacuum links will swing down so that the diaphragm pull rod can be hooked to both links.

13. While holding vacuum diaphragm in position, the body should be clamped in a vise, vacuum side up. Clamp by one of the mounting flange ears. The vacuum diaphragm must be held level with body flange during the following operations by inserting a 3/32" piece of metal between rocker arm stop and body. This spacer can be made from piece of steel, 3/16" to 3/32" by 8 inches. Bend one end to form a right angle hook, 3/8" from bend to end. (This tool is available from your AC jobber as tool Pt-8.)

14. Place spring retainer (29) on riveted end of diaphragm pull rod, and place spring (28) on the retainer. Place vacuum cover and valve assembly over spring and align the file marks.

15. Insert two No. 10-32 x 1 - 1/2" screws in opposite holes in cover flange. Turn these long screws down as far as they will go without forcing, alternating a few turns on each. Insert regular screws with lock washers and tighten until screws just engage lockwashers. Replace two long screws with regular screws and lockwashers.

16. Remove 3/32" spacer from rocker arm position. This allows the heavy vacuum spring to push diaphragm into a flexed position. Tighten all cover screws alternately until secure.

17. Combination fuel and vacuum pump cannot be bench tested because of the heavy vacuum spring. Use a vacuum gauge and test pump while pump is assembled to engine.
The fuel level indicator is of the consistent voltage type. It consists of a voltage regulator, panel indicator and a tank level unit between connected by a single wire system between the units. Figure 102.

**VOLTAGE REGULATOR:**

Its function is to regulate the variable (input) voltage available from the car storage battery, or the charging system, to produce a constant 5.0 volt output to the gauges. This regulator is a simple device, operating with a heater bimetal in conjunction with a pair of contacts. It is temperature compensated to produce correct constant voltage for the gauge systems at all expected temperatures. It is mounted, near the panel indicators at approximately their same temperatures. The voltage regulator does not produce a steady DC voltage output, but rather a pulsating voltage at an effective constant average value of 5.0 volts. The input source can, therefore, be DC intermittent or interrupted DC, or AC, just so long as the average input voltage does not drop below 5.0 volts. Input voltage lower than 5.0 volts will result in proportionately low gauge indication. With the constant voltage regulator (with input voltage normally varying from 5.6 to 8.0 volts), input voltages in excess of 8.0 volts will not affect gauge indication accuracy, but will overload the regulator contacts and may result in premature wear.

**FUEL LEVEL GAUGE:**

With the tank empty, the float holds the slide rheostat (variable resistance) at maximum resistance causing the gauge to read empty (E). Figure 103.

With the tank full, the slide rheostat is moved to the minimum resistance point causing the gauge to read full (F) with the ignition switch on. The use of a bimetal in the fuel indicator provides stability of reading and eliminates pointer fluctuation incidental to surging in the tank and the float bobbing on the surface of the fuel, Figure 104.
GAUGE TROUBLE SHOOTING

GAUGE TESTING EQUIPMENT:

A. One new OK tank level unit (constant voltage).

B. Three ten-foot lengths of #16 insulated wire equipped with clip terminals at each end of wire.

C. One new OK panel fuel indicator gauge.

VOLTAGE REGULATOR:

The constant voltage regulator is common to both the fuel and temperature systems, that is, one regulator is used to operate both systems.

METHOD OF CHECKING:

1. If both gauges read considerably too high—for example, if the gas gauge reads up scale with an empty gas tank and the temperature gauge reads up scale with a cold engine, the constant voltage regulator is not working properly and should be replaced. (Check ground connections of the voltage regulator as grounding is essential to the proper functioning of the regulator.)

2. If both gauges read too low, either the input voltage to the C.V. regulator is below 5.0 volts or the voltage regulator is inoperative and should be replaced. Check battery voltage output before replacing regulator.

PANEL INDICATOR CHECK:

1. Disconnect lead wire at gas tank gauge unit.

2. Hook in a new tank unit. Ground tank unit. Place float in empty position, Figure 103. Turn on ignition switch. Panel gauge should read at (E) on dial.

3. Move float to full position, Figure 104. Panel gauge should read Full (F).

NOTE: If checks 2 and 3 are O.K., both panel gauge and lead wire are O.K. If checks 2 and 3 are not O.K., hook up a new tank unit to proper terminal of panel gauge and eliminate the lead wire from the panel indicator to the unit from the regular circuit. Repeat empty and full check. If now operating O.K., correct or replace bad wire between tank unit and panel gauge.

GASTANKUNIT:

If there is any question about the tank level unit being O.K., hook the tank unit up in series with a panel indicator and a constant voltage regulator known to be O.K. and a 6-volt battery, operate tank level unit by hand and see if panel indicator reads empty (E) with tank level unit float in bottom position, Figure 103 and read full (F) with level unit float in top position, Figure 104. If the panel indicator and lead wire function properly with a new O.K. tank unit, but did not function properly with the original unit, replace original unit.

NOTE: Be sure tank unit is properly grounded to gas tank and also that the tank is grounded to the frame.

GASOLINE TANK

REMOVAL:

1. Raise car and place stands jacks under frame.

2. Drain the gasoline tank and disconnect the fuel gauge wire and the fuel line.

3. Remove three Phillip head screws in rear compartment and remove the sponge rubber retainer.

4. Remove the rubber grommet and overflow drain hose at gas tank filler door.

5. Remove the two nuts and spacers attaching gas tank straps to body crossmember and remove the gas tank.

6. Remove the gas tank gauge unit.

7. Remove rubber shield from gas tank inlet pipe.

8. Remove gas tank outlet pipe.

INSTALLATION:

1. Install gas tank gauge unit (use new gasket).

2. Install gas tank outlet.

3. Install rubber shield to gas tank inlet elbow (use new clamps)
4. Install sponge rubber pad on gas tank inlet.

5. Install gas tank, use care when entering inlet pipe through floor and fender opening.

6. Install gas tank straps and draw tank up into position.

7. Install grommet and overflow drain hose at gas tank filler door opening.

8. Push sponge rubber against underbody panel and attach 3 retainer plates with phillip screws and speed nuts.


10. Connect gauge wire and fuel line.

INTAKE MANIFOLD
(8 Cylinder)

REMOVAL:

1. Remove air cleaner, loosen clamp at carburetor intake, loosen bracket from air cleaner to cylinder head.

2. Remove the distributor to spark plug wires and bracket from the intake manifold.

3. Remove distributor cap; remove coil wire to cap and fold up spark plug wires to top of cylinder head out of the way.

4. Remove the four nuts and lockwashers from the carburetor riser to the intake manifold.

5. Remove the eight nuts attaching intake manifold to block and remove coil, bracket, and manifold.

6. Remove all traces of old gasket material.

INSTALLATION:

Use new manifold gaskets and reverse procedure of removal.

EXHAUST MANIFOLD
(8 Cylinder)

REMOVAL:

1. Remove air cleaner, loosen clamp at intake, and loosen air cleaner bracket at opposite side of engine.

2. Disconnect throttle linkage at carburetor.

3. Disconnect gas line from carburetor to fuel pump.

4. Disconnect vacuum line from carburetor to distributor and heater tube from Climatic Control.

5. Remove the four nuts and lockwashers from the carburetor mounting studs and remove carburetor.

6. Remove locks and nuts from exhaust pipe to manifold flange.

7. Remove the ten nuts from the exhaust manifold outlet flanges.

8. Remove four bolts from the carburetor riser, connecting outlet and inlet manifolds.

NOTE: Use an air hose to blow away dirt particles before removing exhaust manifolds.

9. Remove weather control drain tube from clip and move to opposite side of engine.

10. Remove distributor cap, and spark plug wire bracket from cylinder head.

11. Remove exhaust manifold.

NOTE: Clean all old gasket material from manifold outlet ports.
MANIFOLD HEAT CONTROL
(8 Cylinder)

Exhaust and intake manifolds are separate castings bolted to the cylinder block and also to each other as there are interconnecting passages through which the exhaust gases flow to heat the fuel mixture. The amount of exhaust gases directed on to the walls of the inlet manifold and the duration of time during which these gases are so directed is controlled by a heat resistant valve set into the exhaust manifold. This valve is controlled according to the under hood temperature by a thermostatic coil spring.

HEAT CONTROL VALVE
(8 Cylinder)

REMOVAL:

NOTE: For removal, follow same procedure as exhaust manifold removal and, in addition, the following operations:

1. Disconnect spring from lever.
2. Remove cotter key from shaft and remove washer.
3. Remove heat control spring.
4. Remove the two nuts holding cover to manifold, and remove cover.
5. Remove springs from lower pin and shaft.
6. Use a drift to remove the tapered pin. This will allow removal of the shaft butterfly.

INSTALLATION:

Reverse procedure of removal.

EXHAUST AND INTAKE MANIFOLDS
(6 Cylinder)

Remove both manifolds as a single unit as follows:

REMOVAL:

1. Remove air cleaner by loosening the attaching screw at the carburetor air horn.
2. Remove the throttle connection from carburetor.
3. Remove the fuel line and vacuum line from carburetor.
4. Remove heat riser tube from the carburetor.
5. Remove the fourteen nuts and retainers attaching manifolds to block and remove manifolds with carburetor attached.
6. Clean off all traces of old gasket material.

INSTALLATION:

Reverse the procedure of removal.

HEAT CONTROL VALVE
(6 Cylinder)

REMOVAL:

For removal, follow same procedure as exhaust and intake manifold removal and, in addition, perform the following operations:

1. Remove exhaust manifold elbow from exhaust manifold.
2. Remove spring, retainer, cotter pin, and heat control spring.
3. Remove heat riser shaft. Use a hack saw blade to cut shaft at each side of butterfly. This will allow removal of shaft and butterfly as an assembly.

NOTE: Counterweight can be salvaged by driving out retaining pin (weight to shaft).

INSTALLATION:

1. Assemble new shaft with counterweight and butterfly.
2. Install heat control spring, retainer, anti-rattle spring and retainer and cotter pin.
3. Install exhaust manifold elbow to manifold.

NOTE: The butterfly should be centrally spaced on the shaft to eliminate any binding. After determining that fly is in the open position, securely weld the butterfly to shaft.
I. Install both manifolds and carburetor on engine.

FRONT EXHAUST PIPE
(8 Cylinder)

REMOVAL:

1. Raise car and place stand jacks under the front and rear.

2. Spread the locks and remove the two nuts attaching exhaust pipe flange to exhaust manifold.

3. Remove exhaust pipe bracket at clutch bell housing.

4. Remove oil pump heat shield attached to oil pan to gain more clearance for removal of pipe.

5. Remove oil check light wire and bakelite plug from oil check valve.

6. Remove gas line from carburetor to fuel pump.

7. Remove distributor cap and wire to coil. Remove distributor.

8. Remove exhaust pipe clamp at junction of front and rear exhaust pipes and disconnect from rear pipe.

9. Remove the front exhaust pipe by pulling forward and up over the radiator.

INSTALLATION:

1. Install the new front exhaust pipe and install clamp at junction with rear pipe. (Do not tighten bolts at this time.)

2. Install the two bolts, nuts, and locks through exhaust pipe flange to exhaust manifold. (Do not tighten bolts at this time.)

3. Install exhaust pipe bracket at clutch bell housing.

4. Now tighten bolts at connection to exhaust manifold and in clamp connecting front and rear pipes.

5. Install the oil pump heat shield and insert the two cap screws in oil pan.

6. Install oil check valve bakelite plug and connect oil check light wire.

7. Install the distributor, distributor cap, and coil wires.

8. Connect vacuum line from carburetor to distributor and check timing.

9. Connect gas line from carburetor to fuel pump.

10. Remove stand jacks and lower car.

FRONT EXHAUST PIPE
(6 Cylinder)

REMOVAL:

1. Raise car and place stand jacks under front and rear.

2. Remove the two bolts attaching exhaust pipe flange to exhaust manifold.

3. Remove bolt from bracket attaching exhaust pipe to engine support plate.

4. Remove exhaust pipe clamp at junction of front and rear exhaust pipes and disconnect from rear pipe.

5. Disconnect exhaust pipe and remove from under car.

INSTALLATION:

1. Install new front exhaust pipe from under car and connect at rear exhaust pipe, but do not tighten clamp.

2. Install clamp at engine support plate but do not tighten.

3. Connect exhaust pipe flange to exhaust manifold and tighten securely.

4. Tighten clamp at junction of front and rear exhaust pipes, also at engine support plate.
SECTION 5
COOLING SYSTEM

SPECIFICATIONS

Circulation
Water Pump
Drive Water
Pump Output
Water Pump Bearing
Lubrication
Fan Belt Adjustment
Fan Drive
Fan
Fan to Radiator Clearance

Cooling System Capacity:
6 or 8 Cylinder

6-Vane Impeller Pump
Fan V Belt
30 G.P.M. at 50 M.P.H.
Two Sealed Ball Bearings
Pre-Lubricated
Generator Mounting
Pump Shaft
4 Blade-18"
3/4 ± 1/8

18-1/2 Quarts
With Heater 19-1/2 Quarts

ANTI-FREEZE CHART

<table>
<thead>
<tr>
<th>Protection Temperature</th>
<th>Hudson Anti-Freeze Qts.</th>
<th>Methanol Qts.</th>
<th>Ethylene Glycol (Preston o Equivalent) Qts.</th>
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<td>±10</td>
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</tr>
<tr>
<td>-20</td>
<td>9</td>
<td>7-1/4</td>
<td>8</td>
</tr>
<tr>
<td>-30</td>
<td>11</td>
<td>8-1/4</td>
<td>9</td>
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</table>
DESCRIPTION AND OPERATION

The cooling system is of the pressure type and has a cellular tubular radiator, a centrifugal six vane impeller pump and a four blade radiator fan with the blades unevenly spaced to minimize noise.

Six cylinder engine blocks contain a brass water distributing tube with holes properly spaced to direct the flow of water around the exhaust valves for cooling purposes.

Eight cylinder engine blocks have a water jacket cover on the left side of the block.

By-pass thermostats are used to permit rapid engine warm-up by restricting circulation of the coolant through the radiator and by-passing it through the cylinder block until the coolant temperature rises sufficiently to open the thermostat. The temperature range of the thermostats is as follows -

- Starts to open 150° to 155.
- Fully open at 185°.

All models use a pressure type radiator cap which is designed to maintain a constant pressure in the cooling system under normal operating conditions.

A pressurized system provides advantages by protection against loss of coolant or antifreeze solutions by evaporation since the increased pressure of the system raises the boiling point of water from a normal 212° F at sea level to approximately 230° F with a 7 lb. pressure cap.

CAUTION: When removing pressure cap while the engine is hot, always turn cap slowly counterclockwise until the stop is reached. Keep the cap in this position until all pressure is dissipated; then turn cap fully and remove.

DRAINING SYSTEM

To drain the cooling system, open the radiator drain cock located at the lower right-hand corner and remove the drain plug in the cylinder block located at the rear left hand side and remove radiator cap.

RUST AND SCALE DEPOSITS

Scale or rust tends to obstruct the flow of coolant through the water passages of the cylinder block and radiator, and when such formation is excessive, it prevents proper heat dissipation and resultant overheating. This, in turn, causes loss in lubrication efficiency and accumulation of carbon, varnish and sludge.

If overheating exists due to clogging of the engine portion of the cooling system, the condition should be corrected by the use of a reputable solvent, instead of reverse flushing.

REVERSE FLUSHING

Reverse flushing of the cooling system is the forcing of water through the radiator using air pressure and flushing in a direction opposite to that of the normal flow of water.

Reverse flushing is necessary in order to get behind the deposits and force them out.

The procedure for reverse flushing is as follows:

1. Disconnect hoses from engine.

FIGURE 1
2. Install radiator cap and attach long hoses to radiator connections as shown in Figure 1. Insert the flushing gun as shown.

3. Connect water hose of gun to a pressure water source and air hose of gun to a pressure air source. Turn on the water, and when the radiator is full, turn on the air in short blasts. Allow the radiator to fill between the blasts of air. Continue this procedure until water from the lead-away hose runs clear.

**USE OF INHIBITOR**

The regular use of a cleaning and inhibiting fluid in the cooling system and periodic reverse flushing will greatly reduce the formation of rust, scale, and corrosion. The logical time for flushing and introduction of inhibitor is when the anti-freeze is installed in the fall and when it is removed in the spring.

A good combination inhibitor and cleaning solution should be kept in the cooling system at all times.

CAUTION: Care must be used in the selection of an inhibitor and cleaner as some of them contain strong acids or caustics that will react with the metal of the radiator core, eating holes through the metal and causing the radiator to leak.

The effectiveness of any inhibitor is limited to about six months after which the cooling system should be flushed, refilled, and new inhibitor added.

**ANTI-FREEZE SOLUTION**

There are several anti-freeze solutions available that are satisfactory for automobile cooling systems. Among these are denatured alcohol, methanol (synthetic wood alcohol) and ethylene glycol. It is recommended that the cooling system be cool before adding an anti-freeze solution. To facilitate accurate testing of freezing points, it is advisable not to mix different basic types of anti-freeze.

The alcohol anti-freeze solutions are subject to evaporation, especially on heavy runs, and should be tested at least once a week, and the necessary quantity of anti-freeze added to protect the cooling system for the lowest anticipated temperature.

CAUTION: These liquids, if spilled on the vehicle, should be washed off immediately with a generous quantity of water to prevent damage to lacquer or enamel.

When using ethylene glycol, it is necessary to clean the entire cooling system before putting in the anti-freeze solution.

It is also advisable to tighten or replace all hose connections. It is important that the cylinder head gasket be kept tight to prevent leakage.

If there are leaks in the system, they should be located and stopped. If evaporation occurs with the use of ethylene glycol, it is only necessary to add water to the solution; however, the cooling system should be watched closely for leaks, and should be tested when additional water is required.

CAUTION: Solutions containing salt, calcium chloride, soda, sugar, or mineral oils such as kerosene or engine oil should NEVER be used in the cooling system as they either clog the water passages or damage the hose connection and other parts.

**TESTING ANTI-FREEZE SOLUTION**

The freezing point of an anti-freeze solution maybe determined by using a hydrometer. When testing the solution, it should be tested at the temperature for which the hydrometer is calibrated, and the correct hydrometer for the solution should be employed in testing.
The water pump features a permanently lubricated ball bearing (18), Figure 3, for the pump shaft and non-adjustable packing (13). A permanent seal, which makes repacking unnecessary, consists of a graphite washer (14) adjacent to the impeller (12), backed with a neoprene seal (13) and brass spring and retainer (8) for maintaining constant contact on these two units. The graphite washer (14) is prevented from turning in the impeller (12) and housing by means of four ears which are retained by four corresponding slots in the impeller. The neoprene seal stops any fluid which might pass between the graphite washer and impeller.

A large drain hole at bottom side of pump body allows for drainage and acts as a vent to minimize moisture formation in the pump assembly.

The pump shaft is mounted in a permanently lubricated double row ball bearing with grooves in the shaft to furnish race-ways for the bearing balls and provide a means of taking end thrust of the fan and pump.

The bearing and shaft are retained in the pump housing by the shaft bearing retainer (6).

**WATER PUMP REMOVAL:**

1. Drain the cooling system by opening drain cock at lower right side of radiator and remove the pipe plug from left rear side of cylinder block.

NOTE: It is not necessary to remove the radiator to remove the pump; however, use care when removing and installing the pump.

2. Loosen the bolt in the fan belt and generator adjusting bracket and move generator in toward the cylinder block to remove the fan belt.

3. Disconnect hose from the water pump inlet.

4. Remove the bolt and nut from the generator adjusting bracket to cylinder block and remove bracket.

5. Remove the four bolts and lock washers attaching fan blades to fan pulley and hub, and remove the fan blades.

6. Remove bolts attaching water pump to block and remove the water pump.

**DISASSEMBLY:**

1. Remove the water pump shaft retainer (6), cover (2), and gasket (3), Figure 3.

2. Place the water pump assembly in "Water Pump Holding Fixture J-2778, and using shaft driver contained in the set, press out the pump shaft and bearing assembly (18) with water pump pulley hub (19) attached.

NOTE: The fixture is designed to support the water pump body on a level plane while removing the shaft from the impeller. The height of the support stud is controlled by adjusting nuts which are run up on the stud to level the water pump body. The large hole in the base
WATER PUMP -- 6 CYLINDER ENGINE

FIGURE 3

LEGEND

1. Cover bolt
2. Body cover
3. Body to cover gasket
4. Body
5. Body pipe plug
6. Bearing retainer
7. Body to block bolt
8. Shaft slinger
9. Pulley assembly
10. Fan blade assembly
11. Body cover gasket
12. Impeller
13. Shaft seal
14. Shaft seal washer
15. Body to cylinder block bolt
16. Body pipe plug
17. Body to cylinder block stud
18. Bearing and shaft assembly
19. Pulley hub
20. Fan blade bolt and lockwasher
plate provides clearance for the pulley hub. The slotted adaptor is placed between the body and the pulley hub to support the lower part of the body to eliminate spring-back and possible body fracture when removing the water pump shaft.

The bearing and shaft is serviced as an assembly only. The water pump pulley hub (19) is not part of the shaft and must be removed from the old shaft and installed on the new shaft. The adaptor included in 3-2778 Holding Fixture Kit can be used to remove the pulley hub.

3. Clean the bore in the pump body before re-assembly.

NOTE: Check the water pump body bore with an inside micrometer. If this dimension is greater than 1.1015, replace the water pump body.

Also check the pump body at the area of the impeller and if the impeller has been scraping the body, it indicates the excessive end thrust and complete pump should be replaced.

WATER PUMP SHAFT AND BEARING INSPECTION

1. Revolve bearing slowly by hand, using hand thrust load. If bearing does not drag or feel rough, it can be reused.

2. If steel seals at ends of bearing, outer races are loose so that they can be turned with the fingers, the bearing should be replaced.

3. Check shaft and if less than .6255", replace. Shafts with worn grooves should be replaced.

REASSEMBLY: - 6 Cylinder

1. Assemble the shaft and bearing in the water pump body.

NOTE: Bearing should be slight press fit into pump body, and assembled so that the groove on the outer race is aligned with the retainer wire slot in pump body bore.

CAUTION: When pressing bearing and shaft in housing, press against face of outer ring, not against shaft.

2. Lubricate shaft with castor oil and install the fan pulley hub (19). Support the flange of the hub and apply pressure on the impeller end of the shaft. Maintain proper pulley spacing. This dimension should be 5-5/32" from outside edge of hub to cover face of pump body. Figure 4.

NOTE: Pump body should be allowed to float during this operation.

FIGURE 4

Lubricate shaft with caster oil to facilitate assembly and assemble the seal (13) and carbon washer (14) and retainer (8) in the impeller and install impeller by supporting the assembly on the fan end of the shaft as shown in Figure 4.

NOTE: Impeller must protrude .007 to .017 beyond cover face of pump body.

4. Install the water pump shaft and bearing retainer (6), Figure 3.
WATER PUMP 8 CYLINDER ENGINE

FIGURE 5

LEGEND

1. Cover bolt
2. Body cover
3. Body to cover gasket
4. Body pipe plug
5. Body
6. Bearing retainer
7. Shaft slinger
8. Pulley assembly
9. Fan blade assembly
10. Body cover gasket
11. Impeller
12. Shaft seal
13. Shaft seal washer
14. Body to cylinder block bolt
15. Body to cylinder block stud
16. Bearing and shaft assembly
17. Pulley hub
18. Fan blade bolt and lockwasher
5. Use a new cover gasket (3) and install body cover (2).

6. Install fan hub (9), fan blades (10), lock-washers (20), and screws (21). Tighten screws to 12 to 15 lbs. Torque.

NOTE: Dimension from center line of fan pulley to outside face of cover should now be 3-13/16, Figure 4.

DISASSEMBLY: - 8 Cylinder

Follow the same procedure as outlined for 6 cylinder Disassembly and Assembly. Refer to Figure 5 for order of parts removal and installation.

WATER PUMP
8 CYLINDER ENGINE

INSTALLATION:

6 & 8 Cylinder

1. Remove all traces of the old pump to block gasket and install new gasket and pump to engine. Install attaching bolts.

NOTE: Clearance from outside edge of fan blade to radiator case should be 3/4 ± 1/8".

2. Install generator adjusting strap and fan belt.

3. Install hoses.

4. Install generator adjusting strap bolt in generator bracket and adjust fan belt.

5. Refill radiator.

FAN BELT ADJUSTMENT

NOTE: The fan belt must be operated with a definite amount of slack to prevent an overload being placed on the water pump and generator bearings.

Adjustment of the belt is obtained by swinging the generator on its mountings as follows:

1. Loosen the two generator bracket bolt nuts (D) and (E) and adjusting arm bolt (F), Figure 6.

THERMOSTATS

The temperature at which the thermostat opens is very important and it should be checked whenever the complete cooling system is being checked.

CAUTION: In cases of extreme overheating or freezing, check the thermostat, as the excessive temperature may have caused the bellows to take a set in the expanded position.

Place the thermostat in a pail of water with a thermometer and heat the water until the thermostat starts to open. The thermometer should show from 150° to 155° F, Figure 7.
Continue heating the water until the thermostat is wide open. The thermometer should show 185° F.

Discard thermostats that:

- Do not open completely.
- Open at too low a temperature.
- Open at too high a temperature.

A thermostat that opens too soon will cause the engine to operate at too low a temperature and if it opens too late or is sticking, it may cause the engine to overheat.

**WATER TEMPERATURE GAUGE**

A new type cylinder head sender unit is used in the temperature gauge which operates on an entirely different principal. The unit has no moving parts.

A comparatively new sintered material which has low resistance when hot and high resistance when cold is the heart of the unit.

The sintered material is enclosed in the extreme end of a sealed bulb which is installed in the cylinder head on the left hand side near the front.

When the coolant is cold the high resistance in the unit causes the instrument panel gauge to read at the cold end of the dial with ignition switch turned on.

When the coolant is hot the low resistance in the unit causes the instrument panel gauge to read at the hot side of the dial with ignition switch on. Refer to figure 8 and 9.

**SERVICE CHECKS**

If the temperature gauge reads up-scale when the engine is cold, check ground connection of the voltage regulator.

If the gauge shows a reading too low either the input to the regulator is low or the regulator is inoperative and should be replaced.

**NOTE:** Battery output should be checked before replacing regulator.

It is not advisable to attempt any repairs or adjustments to either unit of the gauge since they are factory calibrated and any attempt to repair is impractical.

**WATER JACKET PLUGS**

*(6 Cylinder)*

The water jacket plugs used in the left side of the six cylinder block are a drive fit and can be easily installed using Tool J-2793 as illustrated in Figure 10. Use a light coat of Hudson perfect seal paste to facilitate installation and improve the sealing.
The plug is started into place and then driven into the block with the installer until the shoulder of the installer contacts the block, Figure 10.

**RADIATOR**

The radiator is mounted in a "U" channel with attaching bolts mounted through rubber grommets attaching the sides of the radiator to the channel.

**REMOVAL:**

1. Drain radiator and disconnect hoses.
2. Remove two sheet metal screws attaching deflector shield to fender tie panel.
3. Disengage headlamp wiring from retaining clips at front of radiator.
4. Remove the four hexagon bolts attaching radiator to "U" channel and remove radiator.

**NOTE:** To install, reverse procedure of removal.

---

**COOLING SYSTEM DIAGNOSIS**

**Excessive Engine Temperature Causes:**

1. Ignition timing too late or too early
2. Fan Belt slipping.
3. Radiator or cylinder block clogged or restricted.
4. Radiator core outside surface covered by grille covers, ornaments, etc.
5. Outward air passages clogged with bugs or dirt accumulations.
6. Thermostat defective.
7. Collapsed water pump inlet hose.
8. Pump impeller loose on shaft or improper clearance of impeller in pump housing.
9. Engine fan blades not set at proper pitch.
10. High engine friction resulting from:
   a. Insufficient internal clearance
   b. Internal misalignment
   c. Use of heavy engine oil
   d. Inadequate oil circulation
11. Dragging brakes or tight wheel bearings.
12. Use of certain types of anti-freeze solutions in warm weather.
13. Slipping clutch.

**Water Pump Noise Causes:**

1. A squealing noise may indicate a tight fan belt.
2. A scraping noise indicates excessive end play of water pump shaft and impeller rubbing the water pump housing.
# SECTION 6

## ELECTRICAL SYSTEM

### SPECIFICATIONS

#### Models

| 4A-5A-6A-7A and 8A |

#### GENERATOR:

<table>
<thead>
<tr>
<th>Make and Model</th>
<th>Auto-Lite GDZ -6001B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type and Volts</td>
<td>Shunt--6 Volt</td>
</tr>
<tr>
<td>Control</td>
<td>Vibrating Type 3-unit regulator</td>
</tr>
<tr>
<td>Controlled Output</td>
<td>35 amperes</td>
</tr>
<tr>
<td>Poles</td>
<td>2</td>
</tr>
<tr>
<td>Brushes</td>
<td>2</td>
</tr>
<tr>
<td>Brush Spring Tension</td>
<td>35-53 oz. (with new brushes)</td>
</tr>
<tr>
<td>Bearings</td>
<td></td>
</tr>
<tr>
<td>Commutator End</td>
<td>Bronze</td>
</tr>
<tr>
<td>Drive End</td>
<td>Ball</td>
</tr>
<tr>
<td>Armature Shaft End Play</td>
<td>.003” to .010”</td>
</tr>
<tr>
<td>Ground Polarity</td>
<td>Positive</td>
</tr>
</tbody>
</table>

**Output Test:**

- **Cold**
  - 1.3 to 1.5 at 5.0 Volts (Measure from armature to field terminals)
  - 3.9 to 4.4 amperes at 5.0 Volts. Have field terminal grounded to the frame and measure from armature terminal to a ground on frame.

- **Hot**
  - 6.4 volts, 0 amperes at 870 to 970 RPM
  - 8.0 volts, 35 amperes at 1800 to 2000 RPM
  - 6.4 volts, 0 amperes at 950 to 1050 RPM
  - 8.0 volts, 35 amperes at 2150 to 2350 RPM

#### VOLTAGE REGULATOR:

<table>
<thead>
<tr>
<th>Make and Model</th>
<th>Auto-Lite-VRP-6101-A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volts</td>
<td>6</td>
</tr>
<tr>
<td>Ground Polarity</td>
<td>Positive</td>
</tr>
</tbody>
</table>

**Resistors:**

- R1
  - 34.5 to 42 ohms (Marked 38)
  - 6.5 to 8.0 ohms (Marked 7)

- R2
  - Resistance of voltage winding 29.8 to 33.0 ohms
  - 0.031” to .034”. Contacts should be open and the armature against the upper stop. Measure the gap with the gauge as near to the hinge as possible
  - .015” Minimum
  - 6.4 to 6.9 volts

**Cutout Relay**

- **Armature Air Gap**
  - 4.1 to 4.8 volts after a charge of 15 amperes
  - 4 to 6 amperes

- **Contact Point Gap**
  - Car speed for maximum charging rate 22 MPH
Current Regulator:

Armature Air Gap: .048" to .052". Contacts should be closed with the high limit gauge in place and open with the low limit gauge in place on the contact side and next to the brass armature stop pin.

Operating Amperage: 34.0 to 36.0 amperes
14-1/2 turns

Armature Spring

Voltage Regulator:

Armature Air Gap: .048" to .052" ohms, use same instructions outlined for "Current Regulator Air Gap.

Winding Resistance: 10.8 to 12.0 ohms
14-1/2 turns

Armature Spring

Operating Voltage: (at 10 ampere charging rate plus or minus .15 volts)

<table>
<thead>
<tr>
<th>STARTER MOTOR:</th>
<th>4A</th>
<th>6A-7A-8A</th>
<th>5A-6A-7A-8A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make and Model</td>
<td>Auto-Lite MZ-4164</td>
<td>MCH-6107</td>
<td>MCH-6109</td>
</tr>
<tr>
<td>Volts</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Poles</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Brushes</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Armature End Play</td>
<td>.005&quot; to .0625&quot;</td>
<td>.005&quot; to .0625&quot;</td>
<td>.005&quot; to .0625&quot;</td>
</tr>
<tr>
<td>Cranking Voltage</td>
<td>5 Volts</td>
<td>5 Volts</td>
<td>5 Volts</td>
</tr>
<tr>
<td>Cranking Amperage (Approx.)</td>
<td>160 amps. @ 120 RPM</td>
<td>160 amps. @ 120 RPM</td>
<td>160 amps. @ 120 RPM</td>
</tr>
</tbody>
</table>

Stall Test:

| Volts         | 2.0 | 2.0 | 2.0 |
| Amperes       | 280 Max. | 335 Max. | 335 Max. |
| Min. Ft. Lbs. | 4.4 | 6.0 | 6.0 |

<table>
<thead>
<tr>
<th>DISTRIBUTOR:</th>
<th>4A</th>
<th>5A-6A-7A</th>
<th>8A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Make</td>
<td>Auto-Lite</td>
<td>Auto-Lite</td>
<td>Auto-Lite</td>
</tr>
<tr>
<td>Model</td>
<td>IAT-4009</td>
<td>IAT-4009</td>
<td>IAT-4204B-1</td>
</tr>
<tr>
<td>Rotation</td>
<td>Clockwise</td>
<td>Clockwise</td>
<td>Clockwise</td>
</tr>
<tr>
<td>Drive</td>
<td>Oil Pump</td>
<td>Oil Pump</td>
<td>Camshaft</td>
</tr>
<tr>
<td>Point Gap</td>
<td>.020&quot;</td>
<td>.020&quot;</td>
<td>.017&quot;</td>
</tr>
<tr>
<td>Points Open</td>
<td>TDC</td>
<td>TDC</td>
<td>TDC</td>
</tr>
<tr>
<td>Cam Angle</td>
<td>39°</td>
<td>39°</td>
<td>27°</td>
</tr>
<tr>
<td>Arm Spring Tension</td>
<td>17-20 oz.</td>
<td>17-20 oz.</td>
<td>17-20 oz.</td>
</tr>
</tbody>
</table>
Firing Order
Shaft Bearings
Shaft Side Play
Shaft End Play
Timing Marks

<table>
<thead>
<tr>
<th>4A</th>
<th>5A-6A-7A</th>
<th>8A</th>
</tr>
</thead>
<tbody>
<tr>
<td>153624</td>
<td>153624</td>
<td>16258374</td>
</tr>
<tr>
<td>2-Bronze</td>
<td>2-Bronze</td>
<td>2-Bronze</td>
</tr>
<tr>
<td>.005&quot; max.</td>
<td>.005&quot; max.</td>
<td>.005&quot; max.</td>
</tr>
<tr>
<td>.003&quot; - .010&quot;</td>
<td>.003&quot; - .010&quot;</td>
<td>.003&quot; - .010&quot;</td>
</tr>
<tr>
<td>Flywheel</td>
<td>Flywheel</td>
<td>Flywheel</td>
</tr>
</tbody>
</table>

Centrifugal Governor

Advance (Distributor degrees and distributor RPM)

<table>
<thead>
<tr>
<th>RPM</th>
<th>300 0°</th>
<th>335 1°</th>
<th>400 3°</th>
<th>1090 9°</th>
<th>1200 10°</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>670</td>
<td>1175</td>
<td>1840</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>0°</td>
<td>1°</td>
<td>4°</td>
<td>8°</td>
<td>9°</td>
<td></td>
</tr>
</tbody>
</table>

Advance must follow on a smooth curve within 1° of above at all points.

Vacuum Advance (Distributor degrees and inches of mercury)

<table>
<thead>
<tr>
<th>Hq.</th>
<th>9-1/2&quot; 0°</th>
<th>13-3/8&quot; 0°</th>
<th>13-1/4&quot; 0°</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>14&quot; 1°</td>
<td>14&quot; 1°</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>14-3/4 2°</td>
<td>14-1/2 2°</td>
<td></td>
</tr>
<tr>
<td>11-1/2&quot;</td>
<td>15-3/8&quot; 3°</td>
<td>15-1/4&quot; 3°</td>
<td></td>
</tr>
<tr>
<td>12&quot;</td>
<td>16&quot; 3.75°</td>
<td>16&quot; 3.5°</td>
<td></td>
</tr>
</tbody>
</table>

Allowable variation from curve, plus or minus 1°.

COIL:

Make | Auto-Lite
Model | CE-6006-A

Amperage Draw:

<table>
<thead>
<tr>
<th>Engine Stopped</th>
<th>Engine Idling</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 5 amps. at 6.3 Volts</td>
<td>2 5 amps. at 6.3 Volts</td>
</tr>
</tbody>
</table>

SPARK PLUGS:

Make | Hudson Champion H-8 for cast iron and aluminum cylinder heads
Gap | .032"
Thread Size | 14 M.M.

BATTERY:

Make | National OE-2L-100
Capacity | 100 ampere hours at 20 hour rate
Number of Plates Per Cell | 17
ELECTRICAL SYSTEM

The 1951 "A" Series Hudsons use a positive grounded 6 volt electrical system employing a 6 volt, 100 ampere hour storage battery, an externally regulated shunt wound generator, and a three unit voltage regulator.

The starting system uses a 6 volt starter motor and left hand inboard type Bendix drive, on cars not equipped with the HydraMatic Drive, and a right hand outboard Bendix drive with cars equipped with the Hydra-Matic Drive. The starter motor is energized by the battery through a solenoid switch mounted on the left hand fender side shield. A dash mounted push button activates the solenoid.

The lighting system uses sealed beam headlamps and is protected by a circuit breaker on the light switch. A foot operated dimmer switch controls the headlamp beam.

Complete wiring diagram is shown in Figure 10.

BATTERY

The battery used is a National, Model OE-2L-100, 51 plate 6 volt, 100 ampere hour capacity storage battery.

Electrolyte level in the battery should be at the bottom of the square in filter cap opening. Only pure distilled water should be added to the battery. Electrolyte level should be checked at chassis lube periods and oftener during hot weather. Battery terminals should be kept free from corrosion and tight.

BATTERY TEST

HYDROMETER:

Under normal conditions a hydrometer reading of the specific gravity of each cell will determine the state of charge, Figure 1. A specific gravity of 1285 indicates a fully charged battery. A specific gravity of 1130 indicates a fully discharged battery. If specific gravity varies more than 25 points between cells, recharge and retest or test under load.

VOLTMETER:

If a battery fails to perform properly after charging, it should be tested with a volt-meter. Each cell should show two volts or over under no load, and the voltage across the posts should be 6 volts or over.

If these values cannot be obtained, battery should be replaced.

FIGURE 2

LOAD TEST:

A load test should be made to eliminate possibility of a weak cell. Use Battery-Starter tester, Figure 2, or a standard cell tester with
a heavy shunt across the terminals. With the cell tester the difference between cells should not be more than .15 volts, and each cell should test at least 1.5 volts. With the Battery-Starter tester, meter should show at least 4 volts at 300 amperes discharge.

If tester is not available, a voltmeter may be connected across the battery terminals while engine is cranked with the starter motor. Battery is serviceable if the starter cranks the engine at a good speed for 1/2 minute and the voltage does not fall below 4-1/2 volts. DO NOT CRANK MORE THAN 1/2 MINUTE WITHOUT ALLOWING STARTER MOTOR TO COOL. A slow cranking speed or voltage lower than 4-1/2 indicates a weak cell or high resistance connections to the starter, and the battery cables should be checked and load test repeated.

BATTERY CABLE CHECK:

1. Connect a negative voltmeter lead to the negative battery terminal and the positive lead to the starter motor terminal. Crank the motor with the starter. Voltage should not exceed .2 volts.

2. Connect the positive voltmeter lead to the battery ground post and connect the negative lead to car frame. Crank the motor with the starter. Voltage should not exceed .2 volts.

3. Connect positive voltmeter lead to car frame and negative lead to starter motor frame. Crank the motor with the starter. Voltage should not exceed .2 volts.

4. If voltage loss is greater than above, terminal posts, ground strap and connections, and starter solenoid should be checked for high resistance.

STARTING MOTOR

The starting motor is activated through a solenoid switch mounted on left hand front fender side dust shield. The solenoid is controlled by a push button on the instrument panel. Operation of the solenoid closes the circuit from the battery to the starting motor. The solenoid may be manually operated by removing the threaded cap on the rear of the solenoid cover and pushing the exposed plunger. The instrument panel push button will operate the solenoid only when the ignition switch is turned on.

Bearings on the starting motor are lifetime lubricated and require no oiling.

The starting motor cranks the engine through a left hand inboard type Bendix drive mounted on the armature shaft on cars not equipped with the Hydra-Matic Drive. Cars using the Hydra-Matic Drive use a right hand outboard Bendix.

CRANKING VOLTAGE TEST:

1. Connect the negative voltmeter lead of the starter motor tester to the starter switch terminal, Figure 3.

2. Connect the positive voltmeter lead to engine for a ground.
3. If a starter battery tester is used, turn the selector knob to the 15 volt position.

4. With ignition key off, engage the starter motor and note reading on the voltmeter. The cranking voltage should read 5 volts or more.

**CAUTION:** Crank engine intermittently (not more than 30 seconds) to prevent starter motor from overheating.

5. If the voltmeter reading is less than 5 volts, check the battery cables, ground straps and starter solenoid to determine the cause for the low reading. See "Engine Tune-Up", Section 2, Page 6.

6. After completing amperage draw test, turn control knob to "off" position.

7. Readings acquired by the above checks indicate the amount of current required to crank the engine.

The reading should be 140 to 160 amperes at 120 RPM, (Engine warm).

Excessively high readings will indicate a short in the starting motor circuit or an excessive drag on the motor due to a bent armature shaft or the field coils touching the armature.

Low readings indicate excessive resistance in the circuit caused by loose connections, worn brushes, or weak brush spring tension.

**STARTER SOLENOID TEST:**
1. Connect negative lead to "BAT" terminal of starter solenoid switch and positive lead to the starting motor terminal of starter solenoid switch, Figure 5.

2. Close the solenoid electrically to crank the engine; if the reading is more than 0.2 volts, replace the solenoid switch.

**STARTER REMOVAL:**

NOTE: On Drive-Master equipped cars it is
necessary to remove Drive-Master mounting bracket bolts, disconnect linkage, and pull bracket out and forward to allow removal of the starter motor.

1. Disconnect cable at battery negative terminal and remove cable at starting motor post.

2. Remove the two starter mounting stud nuts and remove starter motor assembly.

DISASSEMBLY:

1. On cars equipped with the outboard type starter, remove the two through bolts attaching the Bendix housing to starter frame and remove the Bendix housing.

2. On inboard type Bendix, remove lock spring from end of Bendix drive and remove spring and retainers.

3. On outboard type Bendix, drive out pin attaching adapter to shaft and remove adapter, sleeve and pinion.

4. Remove two countersunk screws attaching drive end head and remove head.

5. Remove commutator cover band and remove brushes from holders.

6. Remove commutator end head.

7. Remove armature.

FIGURE 6

3. If the lamp lights, the armature is grounded and should be replaced.

4. Place armature on a growler and hold a steel strip on the armature.

5. Rotate the armature, and if steel strip vibrates, armature is shorted and should be replaced.

6. If commutator is rough, it should be turned down on a lathe and finished with 00 sandpaper. DO NOT UNDERCUT THE MICA.

7. If bearing clearance exceeds .005", bearings should be replaced. (Soak bearings in engine oil and use correct arbor to install bearings.)

FIELD COILS:

1. Check field coils for grounds by touching one test probe to the frame and the other to each of the field coil terminals.

2. If the lamp lights, coil is shorted and should be replaced.

3. Check coils for open circuit by placing the test probes across each coil separately.

4. If lamp does not light, coil is open and should be replaced.

STARTER OVERHAUL

ARMATURE:

1. Check armature for grounds with a set of test probes in series with a lamp and a source of electricity.

2. Touch one probe to the armature core and touch the other to the end or shoulder of each commutator segment in turn.
BRUSHES:

1. Brushes should slide freely in their holders and make full contact with the commutator. Worn brushes should be replaced.

2. To replace brushes, unsolder the brush pigtail from the field or brush holder and open the loop. Insert new pigtail the full depth of loop and clinch and solder pigtail in loop.

3. Seat new brushes with sandpaper or brush seating stone. Wrap a strip of 00 sand-paper around the armature with sand side up and turn armature slowly in the direction of rotation. Blow sand and dust from commutator.

4. Check brush spring tension with a spring scale hooked on the brush end of the spring. Pull on a line parallel to the side of the brush and read scale just as spring leaves the brush. Tension should be 42 to 53 ounces.

5. Change spring tension by twisting the spring holder with long nosed pliers.

6. Check the two insulated brush holders for ground. Place one test probe on holder and one on end head. If lamp lights holder s grounded and end head should be replaced.

ASSEMBLY:

1. Replace armature in frame.

2. Install drive end head and attaching screws.

3. Install commutator end head and through bolts.

4. Pry up brush springs and insert brushes in holders.

5. Replace cover band.

6. Replace Bendix sleeve, pinion, spring retainers, spring, stop nut, pin and lock ring.

7. On Hydra-Matic Drive equipped cars, install all Bendix Drive Housing and through bolts.

INSTALLATION:

Reverse procedure of removal.

BENDIX DRIVE

The inboard Bendix drive is exposed and may be serviced without removal from the engine. On cars equipped with Drive-Master, the Bendix drive spring may be replaced with starting motor on the engine. On other cars it is more convenient to remove starter.

The Outboard Bendix drive is enclosed in the Hydra-Matic Flywheel housing and the starting motor will have to be removed for repairs.

Failure of Bendix drive pinion to mesh with the flywheel may be caused by gum, dirt or frost on the screw threads. Clean the Bendix drive with a brush dipped in kerosene. Operate the unit several times to loosen gum and dirt and remove excess kerosene. Lubricate the exposed portion of armature shaft with S.A.E. 10 engine oil. (DO NOT LUBRICATE SCREW THREADS). If proper operation cannot be secured by cleaning and lubrication, starter should be removed and checked for bent or damaged parts.

GENERATOR

All the 1951 Model Hudsons employ a shunt wound, externally controlled generator. The generator is mounted on the left side of the engine and is operated by the fan belt. Generator output is controlled by a three unit vibrating type current voltage regulator. A signal system incorporated in the regulator operates the signal light on the dash. The signal light is when the ignition switch is turned on and remains on until the generator starts to charge the battery.

The voltage regulator holds the generator output at 35 amperes or below, depending on the load requirements. The generator should not be operated at over 35 amperes for any length of time.
The generator armature is carried on a bronze bearing at the commutator end and on a roller bearing at the drive end. The bearing should be lubricated with 3 to 5 drops of engine oil at each chassis lubrication. At generator overhaul the ball bearing should be packed 1/2 full of high temperature, non-fibre grease; the bronze bearing should be soaked in engine oil and the commutator end grease pocket filled with high temperature grease.

The Hudson electrical system is positive grounded and whenever a generator is installed or re-installed on the engine it should be polarized with the battery to prevent burning of regulator contact points and damage to the units.

To polarize the generator, ground the field terminal to the frame and touch the armature lead briefly to negative terminal of the battery.

Failure of charging system to maintain the battery charge under normal operating conditions may be caused by a faulty condition of the generator, the voltage regulator or connecting wires.

**WIRING CHECK:**

Before removing either the generator or voltage regulator for overhaul or replacement wiring of the charging circuit should be checked for high resistance connections, short or open circuits. These circuits can be tested by checking the voltage drop between the connections.

1. Remove the battery lead from the "B" terminal of the voltage regulator and connect a reliable ammeter between the terminal and the lead.

2. Run the engine and turn on lights or accessories until a 10 ampere charge shows on the ammeter.

3. With a 10 volt voltmeter check the voltage reading between the following points:

| MAX. VOLTS | a. Generator frame to battery ground post | .3 |
|           | b. Battery ground post to regulator base | .3 |
|           | c. Battery negative post to regulator "B" terminal | .1 |
|           | d. Generator armature terminal to regulator "A" terminal | .1 |
|           | e. Generator field terminal to regulator "F" terminal | .5 |
|           | f. Regulator base to generator frame | .3 |

4. Higher readings indicate frayed or broken wires or poor connections.

**GENERATOR TOTAL OUTPUT CHECK:**

1. Disconnect the armature (A) lead and the battery (B) lead from the regulator and connect a reliable ammeter between these two leads, Figure 7, connecting the positive lead to the (B) leadwire. Start engine, (IMPORTANT) then connect the tester negative lead to the (A) lead wire.

2. Connect a jumper from generator field (F) to a ground.

3. Operate the generator at idle speed and ground the field lead to the regulator base.

4. Watch the ammeter and increase the speed slowly. At 2500 generator RPM, 1250 engine RPM, output should be 50 amp. DO NOT INCREASE GENERATOR OUTPUT ABOVE 50 AMPERES.

---

**FIGURE 7**

- Connect a jumper from generator field (F) to a ground.
- Operate the generator at idle speed and ground the field lead to the regulator base.
- Watch the ammeter and increase the speed slowly. At 2500 generator RPM, 1250 engine RPM, output should be 50 amp. DO NOT INCREASE GENERATOR OUTPUT ABOVE 50 AMPERES.
FIGURE 8

A. Cover Band  
B. Armature Terminal Stud  
C. Field Terminal Stud  
D. Ground Screw  
E. Pole Shoe Screw  
F. Oilier  
G. Bearing Retainer  
H. Bearing Retainer Gasket  
I. Bearing  
J. Washer Retainer  
K. Felt Washer  
L. Woodruff Key  
M. Through Bolts

N. Brush Spring  
O. Brush  
P. Brush Lead  
Q. Commutator End Head  
R. Armature  
S. Frame  
T. Snap Ring  
U. Felt Washer  
V. Bearing Retainer Screw  
W. Drive End Head  
X. Lockwasher  
Y. Armature Shaft Nut  
Z. Drive Pulley

**CAUTION:** The engine MUST NOT be run for more than a few seconds while making the above test, due to the danger of burning out the generator.  
**NOTE:** If the above test is made with a resistor type tester, the resistance knob must be turned to the out position.

5. If generator fails to build up, remove generator for overhaul.  

**DISASSEMBLY:**

1. Remove cover band.  

2. Disconnect brush leads and remove brushes.  

3. Remove through bolts and remove commutator end head.  

4. Remove armature and drive end head. (If necessary, tap drive head end lightly with a soft hammer.)  

5. Remove shaft nut and lockwasher.
6. Remove drive pulley and Woodruff key.
7. Remove armature from drive head end.
8. Remove bearing retainer screws and remove retainer, felt washers, gasket and bearing.

**NOTE:** The following generator checks, pages 6-11 to 6-16 can be made on a suitable test stand by an experienced operator.

**FIELD COIL GROUND TESTS:**

1. Make sure no leads are touching frame.

2. Using a set of test probes in series with a lamp and a source of electricity, touch one probe to the field terminal stud and ground the other probe to the generator frame.

3. If lamp lights, coils are grounded.

4. If ground is present, remove nuts and washers from armature and field terminals and press terminals from frame.

5. Repeat ground test. If lamp does not light on this test, faulty terminal post insulation is indicated.

6. If coils still test grounded, unsolder connection between coils.

7. Test each coil separately and replace grounded coil.

**FIELD COIL OPEN CIRCUIT TEST:**

1. Touch one test probe to armature terminal stud and one to field terminal stud.

2. If lamp does not light, an open circuit is present.

3. To determine which coil is open, hold one test probe on the connection between the coils and touch the field coil terminal and then the armature terminal with the other probe. If lamp lights, coil on that side is good.

4. Replace open circuited coil.

**FIELD COIL SHORT CIRCUIT TEST:**

1. Connect ammeter, battery and variable resistor in series with the field coil terminals, (Figure 9).

2. Connect a voltmeter across the terminals.

3. Adjust voltage to 5 volts and read ammeter.

4. If current is not 1.3 to 1.5 amperes, a short exists in the field coil.

5. If a short is present, check each coil separately and replace shorted coil.

**FIELD COIL REMOVAL:**

1. If a field coil tests open, short or grounded, unsolder connection between the coils and disconnect faulty coil from terminal post.

2. Mark pole shoe position in frame to assure replacement in correct position.

3. Remove pole shoe screw. (Use a pole shoe removing tool if available.)

4. Remove pole shoe and remove coil.
FIELD COIL: REPLACEMENT:

1. Solder terminal post to new coil. (Use rosin core solder.)

2. Assemble coil on pole shoe and install in frame. (Make sure pole shoe is in position marked before removing from frame.)

3. Coat pole shoe screw with boiled linseed oil and install in frame.

4. As screw is tightened, strike the frame several sharp blows with a soft hammer to align shoe.

5. Twist and solder connection between the two field coils and assemble terminal stud in frame.

6. Test field coil draw (short circuit test).

ARMATURE GROUND TEST:

1. Place armature on V-block or growler and touch one test probe to armature core.

2. Touch other test probe to each commutator segment in turn. (Touch probes to ends or shoulders of segment - not to brush or bearing surfaces.)

3. If lamp lights, armature is grounded and should be replaced.

ARMATURE OPEN CIRCUIT TEST:

1. With armature on V-block or growler, touch test probes to each pair of adjacent commutator segments. (Do not touch brush surfaces.)

2. If lamp does not light at any pair of segments, an open circuit exists, and armature should be replaced.

ARMATURE SHORT CIRCUIT TEST:

1. Place armature on a growler and hold a thin strip of steel or hack saw blade on the armature core.

2. Rotate armature slowly.

3. Steel strip will vibrate if armature is shorted.

4. If short is present, replace armature.

ARMATURE COMMUTATOR REPAIR:

1. Place armature on V-blocks and check commutator runout with dial indicator.

2. If total runout exceeds .003”, commutator should be turned down.

3. If commutator diameter after turning is less than 1.60 inches, replace armature.

4. Remove burrs from commutator with 00 sandpaper.

5. Undercut mica between armature segments to a depth of 1/32”. (Mica may be undercut with a hack saw blade if set of teeth is ground to the exact width of the cut.)

BRUSH HOLDERS:

1. Touch one test probe to insulated brush holder and ground the other probe to the end head. If lamp lights, brush holder is grounded.

2. Place armature in soft jawed vise and install commutator end head and brushes. Brushes should slide freely in the holders and be in perfect alignment with commutator segments.

3. Hook a spring scale in the hole in the end of the brush arm. Pull the scale on a line parallel to the face of the brush. Scale should indicate 35 to 53 ounces (with new brushes) just as the arm leaves the brush.

4. Adjust spring tension by bending springs.
REPLACEMENT:

Generator brushes may be replaced without disassembling generator. Brushes should be replaced if they are oil soaked or worn to less than 1/2 inch.

1. Remove cover band.
2. Disconnect brush leads.
3. Lift brush arms and remove brushes.
4. Install new brushes inholders and connect brush leads.
5. Cut a strip of 00 sandpaper the exact width of commutator.
6. Lift brush and slide sandpaper under brush with sanded side against brush.
7. Pull sandpaper so that brush is forced against holder. Once or twice is sufficient. (Brush seating stone may be used to seat new brushes.)
8. Blow sand and carbon dust out of generator.
9. Run generator under load to obtain perfect brush seating.
10. Reinstall cover.

GENERATOR ASSEMBLY:

1. Pack ball bearing one-half full of high temperature, non-fiber grease.
2. Soak felt washers in engine oil before assembly.
3. Install felt washer, retainers and bearing in drive head end.
4. Install bearing retainer gasket, felt washer, and bearing retainer.
5. Install snap ring on armature and assemble on drive head end.
6. Install armature in frame so that dowel pin enters hole in head.
7. Soak bronze bearing in commutator end head in engine oil and pack grease pocket with high temperature grease.
8. Assemble commutator end head on armature.
9. Install through bolts - make sure lower bolt passes under field connection insulation.
10. As through bolts are tightened, strike the generator frame a sharp blow with a fiber hammer to align armature shaft and bearing.
11. Install brushes and attach brush leads. (Brushes should be seated on commutator with 00 sandpaper or brush seating stone.)
12. Install Woodruff key, drive pulley, lock-washer and shaft nut.

ARMATURE SHAFT END PLAY:

1. Mount dial indicator on drive head end with plunger in line with and touching end of shaft.
2. Move to both extreme positions and read end play.
3. If end play is not within .003 to .010 inches, improper assembly is indicated.
GENERATOR MOTORIZING DRAW:

After generator is assembled and brushes properly fitted, the motorizing draw should be checked to assure proper assembly and alignment.

1. Connect an ammeter and battery in series with the armature terminal and frame, Figure 11.
2. Ground the field terminal to the frame.
3. Connect a variable resistor in series with the battery and generator.
4. Connect a voltmeter from the armature to the frame.
5. Generator should operate as a motor with the armature turning slowly.
6. Adjust voltage to 5 volts and read ammeter.
7. Motorizing draw should be 3.9 to 4.4 amperes. If motorizing draw is higher, or armature does not turn, worn bearings, incorrect bearing alignment, short circuits, or improper assembly is indicated.

GENERATOR CIRCUIT RESISTANCE CHECK:

1. Disconnect battery lead at voltage regulator "B" terminal; connect the ammeter negative lead to the regulator "B" terminal and the positive lead to the wire disconnected from the regulator, Figure 13.
2. Install the negative voltmeter lead to the generator "A" terminal and the positive voltmeter lead to the battery negative terminal.
3. Connect a jumper between the generator "F" terminal and a ground.
4. Run the engine at 2000 RPM or 20 amperes. The voltmeter should read not over .8 (tenths) or less.
5. If the resistance is more than .8, make the following checks with the ammeter connected as in paragraph 1.
   A. Remove the positive voltmeter lead from the battery and install to the "A" terminal at the voltage regulator. Ammeter should show less than .1 (tenth).
   B. Connect the voltmeter negative lead to the regulator "A" terminal and the voltmeter positive lead to the regulator "B" terminal. Ammeter should not show more than .3 (tenths).
   C. Next, connect the voltmeter positive lead to the battery negative terminal, negative lead to "B" terminal on regulator. Ammeter should not show more than .5 (tenths).
   D. Connect the voltmeter positive leads to engine ground, negative wire to base of regulator. Ammeter should show .2 (tenths) or less.

VOLTAGE REGULATOR

The generator regulator is a three unit, vibrating type current-voltage regulator consisting of a cutout relay, a current limiting regulator, and a voltage regulator.

The cutout relay closes the circuit from the generator to the battery when the generator voltage reaches 6.7 to 6.9 volts. The cutout relay opens the circuit when the generator voltage falls below 0 to 5 amperes reverse current.

The voltage regulator unit operates when the generated voltage rises above the value for which it is set. (See "Specifications"). The voltage regulator controls the generator output by inserting resistance in the field circuit. The voltage regulator contact points open and close at high frequencies and hold the voltage at a constant value as long as the resistance of the circuit is high enough to keep it operating.

The current limiting regulator operates in the same manner as the voltage regulator and holds the generator output to the maximum safe value.

The voltage regulator should be removed for overhaul or replacement only after other possible causes of the trouble have been eliminated.
1. Inspect wiring between voltage regulator and generator. (See "Wiring Check", page 9.)
2. Make sure generator operates correctly without the regulator in the circuit. (See "Generator Check".)
3. Check battery specific gravity and terminal voltage. If battery is not up to specifications, substitute a fully charged battery of the same type and capacity for test purposes.

**CIRCUIT BREAKER CHECK:**

To determine whether the circuit breaker points are closing at the proper generator voltage and also whether they will open upon deceleration by amperage from the battery proceed as follows:
1. Disconnect the battery wire at the voltage regulator "B" terminal and connect the ammeter between the voltage regulator "B" terminal and the wire disconnected, Figure 14.
2. Connect voltmeter positive lead to base of regulator and negative voltmeter lead to the generator "A" terminal.
3. Set carburetor throttle lever adjusting screw so engine will idle at approximately 400 RPM.
4. Increase engine RPM by carefully rotating the accelerator bellcrank while watching the voltmeter gauge.

**NOTE:** When the voltmeter reads 4 to 6 amperes, negative side of zero, the circuit breaker should open and the ammeter needle will return to zero. Perform operations 4 and 5 several times until you are sure your readings are correct.
5. Next slowly reduce the engine speed and watch the ammeter.

**CIRCUIT BREAKER ADJUSTMENT:**

1. To adjust the closing voltage, remove cover and change the armature spring tension by bending the lower spring hanger. Increasing the tension raises the opening voltage; decreasing the tension lowers the opening voltage.
2. To adjust the opening voltage, raise or lower the stationary contact by expanding or contracting the bracket, keeping the points perfectly aligned. Increasing the gap lowers the opening voltage; decreasing the gap raises the opening voltage. (Contact gap must not be less than 0.015”.)
3. Replace cover and recheck.

**VOLTAGE REGULATOR CHECK:**

1. Disconnect the battery wire at the voltage regulator "B" terminal and connect the test ammeter between the voltage regulator "B" terminal and the wire disconnected.
2. Connect the voltmeter positive lead to the regulator base and the negative lead to the regulator "B" terminal, Figure 15.

**NOTE:** When the voltmeter reads at any point between 6.4 to 7 volts the circuit breaker points should close and the ammeter will now show that the generator is charging.
3. Run engine at approximately 2000 RPM.
4. Turn resistor knob in until ammeter reads 10 to 15 amperes and then check the voltmeter which should be 7.2 to 7.5 volts.

**NOTE:** If car is out of warranty the voltage regulator can be set by bending the spring hanger to get this necessary reading. The unit must be final-checked with the voltage regulator cap in place as generally it will change the reading from .1 to .2 of a volt and must be compensated for in making this adjustment.

5. Stop engine, disconnect battery negative terminal and then proceed to remove the tester leads from the voltage regulator and install the wires back onto the "B" terminal of the regulator.
6. Install the voltage regulator cover.

**VOLTAGE REGULATOR ADJUSTMENT:**

1. To adjust operating voltage remove cover and change the armature spring tension by bending the lower spring hanger. Increasing the tension raises the operating voltage; decreasing the tension lowers it.
2. Replace cover and recheck.
3. After each adjustment stop the engine and restart it. Bring engine up to speed and adjust current to 10 to 15 amperes before taking a reading.

**CURRENT REGULATOR CHECK:**

1. Disconnect the battery wire at the voltage regulator "B" terminal and connect the test ammeter between the voltage regulator "B" terminal and the wire disconnected, Figure 16.
2. Connect a starter battery tester directly across the battery and set load to 50 amperes, or use the equivalent in seal beam lamps.
3. Run engine to approximately 2000 RPM; amperage reading should be 36 amperes. If it is not within a tolerance of one to two amperes of this reading, the regulator should be removed and taken to an authorized Auto-Lite dealer for replacement.

**CURRENT REGULATOR ADJUSTMENT:**

1. To adjust operating amperage, remove cover and change armature spring tension by bending the lower spring hanger. Increasing tension raises the operating amperage; decreasing the tension lowers it.
2. Replace cover and recheck. Stop engine and restart after each adjustment. Take readings with cover in place.

**REGULATOR CONTACT POINTS:**

In normal use the contact points on all three regulator units will become grayed. If the contacts are burned, dirty, or rough, the points should be filed just enough to secure a smooth surface. File parallel with and lengthwise to the armature. Clean the points with a piece of linen or lintless bond tape dipped in carbon tetrachloride and follow with dry tape. Use clean tape for each set of contacts.
The distributor for the 6 and 8 cylinder engines rotate in a clockwise direction. The lower end of the 8 cylinder distributor is provided with a spiral gear which meshes with a similar gear on the camshaft. Six cylinder distributor shafts have an offset tongue end which fits into a slot at the end of the oil pump shaft gear.

Incorporated in the distributor in an automatic centrifugal advance and vacuum advance control.

The automatic centrifugal advance provides the proper ignition timing in relation to engine speed.

The vacuum advance control provides additional spark advance over the centrifugal advance through the engine vacuum. When the engine is running under light load and engine vacuum is high, the breaker plate is rotated to the maximum advanced position. However, under heavy load conditions, as when the throttle is opened for additional acceleration or hill climbing, and engine vacuum is low, the breaker plate is rotated to the retarded position to prevent fuel detonation or pinging.

Correct spark setting is obtained with the number one cylinder at top dead center on compression stroke, rotor facing No. 1 terminal of distributor cap, distributor set in mid-position the quadrant, and contact points just opening.

**BREAKER POINT ADJUSTMENT:**

Breaker points may be adjusted with distributor installed on car as follows:

1. Remove distributor cap and rotor.

2. Crank engine until the fibre block on the contact arm rests on the highest point of the cam lobe.

3. Loosen the contact support lock screw (B), Figure 17, and turn the eccentric adjusting...
screw (D) until the correct gap is obtained. Distributor point gap is .017" on eight cylinder engines and .020" on six cylinder engines.

4. Tighten contact support lock screw and re-check point gap.

5. If necessary bend stationary contact to secure correct alignment.

BREAKER POINT RENEWAL:

1. Remove distributor cap and rotor.
2. Remove hair pin clip at (F), Figure 17.
3. Remove screws (G) attaching vacuum control unit to distributor housing and remove vacuum control unit.
4. Remove the two screws at (C) and the two nuts, washers and insulators at (H).
5. Disconnect breaker point wires at (E) and (H) and remove complete contact support plate and contacts with condenser attached for bench disassembly.
6. Remove screw and clip (A) attaching breaker arm spring and remove breaker arm.
7. Remove lock screw (B) attaching stationary contact and remove the contact.
8. Install a new breaker arm and attach primary and condenser lead wires to breaker spring clip and install clip and screw (A).
9. Install a new stationary contact, but do not tighten lock screw; connect wires at (E) and (H) and install condenser.
10. Install complete contact support plate and stationary contact as an assembly, and install screws (C) and nuts (H).
11. Check alignment of contact points. Bend the stationary contact arm if necessary to secure proper alignment and contact. DO NOT bend breaker arm.
12. Tighten screw (D).
13. Adjust breaker point gap.
14. Check breaker arm spring tension. Hook a spring scale to the arm at the contact and pull at a right angle to the contact surface. Tension should be 17 to 20 ounces just as the contact separate.
15. Adjust spring tension by loosening screw at (A), attaching breaker arm spring to plate, and move end of spring in or out of clip as necessary.

FIGURE 18

DISTRIBUTOR REMOVAL:

1. Remove wires from distributor cap and remove cap.
2. Disconnect vacuum line (C), Figure 18 and distributor primary wire (B).
3. Remove lock plate, hold down screw (A), attaching distributor quadrant to engine and remove distributor from engine.

DISASSEMBLY:

1. Remove rotor.

NOTE: On 6 cylinder models, remove stationary contact support with condenser, stationary contact and breaker arm as an assembly. See Operations 2 through 5, under "Breaker Point Renewal". On 8 cylinder cars, proceed as follows:

2. Remove screw and clip (A), Figure 17, attaching breaker arm spring, primary lead, and condenser lead to breaker plate and remove breaker arm.
3. Remove condenser.
4. Remove stationary contact lock screw (B), and remove contact.
5. Remove vacuum control unit by removing hairpin clip (F) and screws (G), Figure 17.
6. Remove breaker plate screws (C) and bearing retainer clips, and lift out breaker plate.

   Items 7 through 10 apply to both 6 and 8 cylinder engines.

7. Remove oil wick from cam and remove hairpin retainer from oilwell.

8. Pull cam off shaft.

9. Remove centrifugal weights and springs.

   NOTE: Use care to prevent distortion of springs.

10. Drive pin from collar or gear on shaft below distributor housing and remove shaft from top of distributor.

**ASSEMBLY, 6 and 8 CYLINDER:**

1. Install new shaft and bushings in distributor base if clearance between shaft and bushings is greater than .005". Soak bushings in engine oil for 15 minutes before installing shaft.

2. Install distributor shaft, thrust washer, collar or gear and pin.

3. Check distributor shaft end play for minimum of .010".

4. Install centrifugal weights and springs.

5. Install cam, hairpin retainer, and oil wick. Apply a drop of engine oil to centrifugal weight pivots and cam slots.

6. Pack breaker plate bearing 1/2 full of high melting point grease and install breaker plate, bearing retainers and breaker plate screws. On 6 cylinder Models, install breaker points and condenser on breaker plate before installing plate. Install plate and distributor cap clips and screws and install primary lead screw. (Do not allow wire from breaker arm to primary terminal to ground on breaker plate.)

7. Install vacuum control unit.

8. Replace stationary contact, breaker arm, and condenser and adjust point gap.

9. Attach primary and condenser leads to clip on breaker arm spring and check spring tension.

   NOTE: Make sure ground wire (E), Figure 17, is securely attached to upper and lower sections of breaker plate and that condenser lead and mounting are tight.

10. Coat cam lobes lightly with water pump grease and soak the oil wick with engine oil. Place a drop of light engine oil on the breaker arm pivot.

11. Replace rotor.

---

**FIGURE 19**
INSTALLATION:

Line up the first line before the UDC mark on the flywheel with the pointer on the flywheel housing, Figure 21, with No. 1 cylinder on compression stroke.

1. Set distributor rotor to point to No. 1 contact in the distributor cap, Figure 20.

2. Insert and engage distributor shaft.

3. Insert lock plate; hold down screw attaching distributor quadrant to engine. Set distributor midway on the quadrant.

4. Replace distributor cap, secondary wire and spark plug wires, Figure 20.

5. Place three to five drops of engine oil in shaft oiler and adjust timing.

For distributor testing, see Engine Tune-Up section, pages 2-9 through 2-11.

The timing is advanced by rotating the distributor counter-clockwise. Clockwise rotation of the distributor retards the spark.

Ignition timing may be accurately set by using a neon timing light. Connect the timing light as recommended by manufacturer. Mark the long line on the flywheel (Figure 21) with white chalk and loosen the screw attaching distributor quadrant to engine. Operate the engine at idle speed with the timing light aimed at the flywheel opening and rotate the distributor until chalk mark lines up with the pointer. Tighten the quadrant screw and accelerate the engine. Chalk mark should move to the left of pointer as centrifugal governor advances the spark.

To set the timing without a timing light, remove No. 1 spark plug and crank engine until No. 1 piston starts up on compression stroke. Continue cranking until long line on flywheel lines up with pointer. Loosen distributor quadrant screw and rotate distributor clockwise to the limit of the slot in the quadrant. Remove secondary wire from center of distributor cap and hold bare end of wire about 1/8" from the cylinder head. With ignition switch on, slowly rotate the distributor counter-clockwise just until a spark jumps from the wire to the cylinder head; then tighten quadrant screw.

IGNITION TIMING

For average operating conditions both 8 and 6 cylinder engines Should be set to fire at top dead center of the compression stroke at cranking speed. When the long mark before the UDC on the flywheel is lined up with the pointer, No. 1 piston is at top dead center.
Correct ignition timing is indicated by a slight "ping" at about 15 MPH when accelerating at full throttle from 10 MPH in high gear. If no ping is heard, timing should be advanced one quadrant graduation mark at a time until the ping is heard. Under no circumstances should the pointer at the flywheel opening be more than one inch (first short mark) before the UDC mark when the spark occurs, Figure 19.

If too much ping occurs or if the engine pings at higher speeds, timing should be retarded by rotating the distributor clockwise one graduation at a time.

NOTE: When a change is made from one grade of gasoline to another, or when the altitude at which the car is operated is changed considerably, ignition timing should be adjusted for efficient operation. With premium grade fuels or for high altitude operation, a more advanced spark setting may be used.

SPARK PLUGS

Spark plugs used on all models are Hudson Champion H-8, 14 mm plugs. Gap on plugs should be set at .032". Check gap with a wire feeler gauge and adjust by bending the ground (side) electrode, Figure 22.

When replacing spark plugs always use new gaskets to assure correct seal. Seat the plug with the fingers and use a torque wrench to tighten. Recommended torque is 25 to 30 foot pounds. If a torque wrench is not available, seat the plug finger tight (on a new gasket) and tighten 3/4 of a turn with a wrench.

Spark plug condition often indicates other engine trouble according to the nature and color of the deposit on the firing end of the plug as shown in the following table:

<table>
<thead>
<tr>
<th>DEPOSIT</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown-Powdery</td>
<td>Normal Operation with</td>
</tr>
<tr>
<td>Tan-Powdery</td>
<td>regular fuel.</td>
</tr>
<tr>
<td>White-Powdery</td>
<td>Normal Operation with</td>
</tr>
<tr>
<td>Yellow-Powdery</td>
<td>leaded fuel.</td>
</tr>
<tr>
<td>Black-Wet</td>
<td>Oil Fouled Oil pumping or</td>
</tr>
<tr>
<td>Black-Fluffy</td>
<td>plug too cold.</td>
</tr>
<tr>
<td>White-Blistered</td>
<td>Gas Fouled Air-fuel mixture</td>
</tr>
<tr>
<td>White-Blistered</td>
<td>too rich or plug too cold</td>
</tr>
<tr>
<td>White-Blistered</td>
<td>Burned Electrodes Air-fuel</td>
</tr>
<tr>
<td>White-Blistered</td>
<td>mixture too lean, incorrect</td>
</tr>
<tr>
<td>White-Blistered</td>
<td>ignition timing, leaking</td>
</tr>
<tr>
<td>White-Blistered</td>
<td>valves, or plug too hot.</td>
</tr>
</tbody>
</table>

HOT AND COLD PLUGS:

Spark plugs specified above are for average operating conditions. If the car is operated under conditions resulting in consistently high engine temperatures, a colder plug should be used. If the car operates under conditions resulting in consistently low engine temperatures, a hotter plug may be indicated.
The heat range of a spark plug is determined by the distance from the tip of the insulator to the internal gasket through which the heat passes from the plug to the head. Plug A, Figure 23, is a hot plug; plug B, with a shorter heat transfer path, is a cold plug.

**CONDENSER**

A six volt condenser is used in conjunction with the distributor breaker points to prevent arcing at the contacts. .20 to .25 microfarad condenser is used.

The condenser is mounted in the distributor, and the condenser lead is connected to the breaker arm spring by the same clip attaching the primary lead. The condenser body is grounded to the breaker plate by the mounting screw.

Contact pitting will result if a condenser of incorrect capacity is used. The breaker contact should be examined, and if the pit mark is on the breaker arm (negative), the condenser is under capacity. If the pit is on the stationary, contact (positive), the condenser is over capacity.

**CONDENSER TEST**

1. Block distributor points open with a piece of fiber. Disconnect the primary lead wire at the distributor.
2. Check condenser lead to see that it is not frayed or broken and is connected securely to breaker arm clip. Condenser mounting screw must make tight ground to breaker plate. Ground wire from breaker plate to subplate must be securely connected.
3. Connect the two condenser test leads together.
4. Turn the condenser control knob to the "Microhm" position and allow the tester to warm up for one minute. Then turn the control knob to read on the set line.
5. Connect the red lead to the distributor primary terminal and connect the black lead to the condenser shell, Figure 24, page 2-9, Engine Tune-Up.
6. With the control knob turned to the "Microhm" position, the meter should read in the blue bar marked "MIC" at the right side for satisfactory condenser circuit resistance.
7. Turn the condenser switch to the "Microfarad". The meter should read 20 to 25 microfarads for both six and eight cylinder engines.
8. Turn the condenser switch to the "Megohm" position. Meter should now read in the blue bar at left side marked "MEG" for satisfactory condenser insulation. If the meter reads in the red bar or over to the extreme
right, replace the condenser.

NOTE: When making the above checks, the condenser should be at operating temperatures.

**COIL**

The ignition coil used is Auto-Lite CR-6012-A; the coil provides a means of stepping up the six volt primary current to high voltage necessary to jump the spark plug gap. The primary winding of the coil is connected to the battery through the distributor contact points. The secondary winding of the coil is connected to the spark plug through the rotor and distributor cap.

**COIL TEST:**

1. Connect leads of coil breaker unit as shown in Figure 17, page 2-11, Engine Tune-Up.
2. Turn on ignition switch.
3. Turn on master control switch on Sun Tester.
4. Turn the switch to "Coil Set" and adjust coil set regulator until the meter reads on set line. (NOTE: Line one for Auto-Lite coils).
5. Turn switch to coil test position, the meter reading must be within the "good coil" band and hold steady to denote a good coil.
   
   A reading outside the "good coil" area or an erratic reading of 3 to 5 division inside "good coil" band indicates bad coil.
6. Turn ignition switch off.
7. Turn the tester control knob to the milli-amp position.

NOTE: If the coil meter does not read in the "good coil" band, remove the coil cap and connect test leads directly to the primary connections.

After making direct connections to the coil, retest, and if the meter does not read in the "good coil" band, replace the coil.

**COIL SECONDARY RESISTANCE CHECK:**

1. Connect ground (Blue) and positive primary (red insulator) test leads together.
2. Turn master switch "On".
3. Turn tester switch to Dwell-Ohm position, and adjust Dwell-Ohm Regulator until meter reads on "Set" line.
4. Separate the positive primary and ground test leads, connect the positive primary lead to the primary ignition wire which was removed from the distributor, Figure 18, Section 2, page 12, Engine Tune-Up.
5. Insert the short test lead into the high tension post of the coil and connect the ground lead directly to the short test lead.
6. Meter should read from 2,000 to 10,000 OHM's resistance. If the meter reads outside this range, replace coil.

NOTE: If a coil tester is not available, a coil may be checked by comparing the length of the spark with the spark from a standard coil of the same make and type. The coil should be checked both hot and cold.

To heat the coils, connect the primary of the coil to be checked in series with the standard coil across a 12 volt battery. Ground the secondary windings and heat both coils at about 5 amperes for 5 minutes.

To check the spark length, hold the secondary leads a short distance from the ground and make and break the primary connection to the battery.

Internal repairs cannot be made to the coils; in case of a defective coil, it is necessary to replace the complete coil.

**HEADLAMPS**

The headlamps are the "Sealed Beam" type, designed so that the bulb, reflector, lens, and the gasket are assembled in one securely sealed unit making them dust and moisture free, Figure 25.
When the filament burns out or the lens breaks, the entire unit is discarded and a new one installed, thereby assuring maximum lighting efficiency through the life of the car.

The Sealed Beam reflector unit (A) Figure 26, is held to a sub-body (B) by the retainer (C) and three screws. The sub-body (B) forms a ball and socket joint with the lamp housing (D) and is held to the housing by four coil springs (E) plus the vertical adjustment screw (F) and the horizontal adjustment screw (G).

The three locating lugs (H) are located so that the reflector unit can be mounted in only one position.

The Sealed Beam units are interchangeable right and left.

**SEALED BEAM UNIT**

**REPLACEMENT:**

1. Remove headlamp lens rim by taking out the three screws.

2. Loosen, but do not remove, the three screws (B) and (D), Figure 27, holding the retainer. Do not disturb the aiming screws (A) and (C) at the top and left side of the unit.
3. Remove retainer by rotating counterclock-wise, allowing the Sealed Beam unit to be removed.

4. Remove the reflector plug from the unit as shown in Figure 28.

5. Install new unit by reversing above operations.

**HEADLAMP AIMING**

Place the car on a level surface with a light colored vertical screen 25 feet ahead of headlamp lens.

![FIGURE 29](image)

Draw a horizontal line on this surface at the level of a point 3" below the headlamp center, as shown in Figure 29. This line is 26-3/4" above the floor line. If, however, your state requires a loading allowance, draw this horizontal line below the above line by whatever a mount that is required in your state.

Locate center of car by sighting through the center of the rear window along the right and then along left of windshield center bar and mark these two points on the horizontal line. The point midway between these two lines is the center of the car which should be temporarily located on the screen.

Draw vertical lines (B-B) and (C-C), on the screen to the right and left of the center line at a distance equal to one-half of the center to center distance (28 inches) between the two lamps.

Place dimmer switch in position which produces highway (upper) beam on screen.

Remove headlamp lens rim.

Move the light beam to the right or left by turning the horizontal adjustment screw (C), Figure 29. Raise or lower the beam by turning the vertical adjustment screw (A).

Cover one lamp to obscure the beam of light and then adjust the beam from the other lamp so that the center of the zone of highest intensity falls on the intersection of the horizontal line A-A, Figure 29, 3" below the headlamp center, and the vertical line directly ahead of the lamp.

Repeat the operation for the other lamp. No further adjustment is needed for the traffic (lower) beam.

**FIGURE 30**

DIMMER SWITCH

The headlamp beam is controlled by a foot operated dimmer switch mounted in the floor panel. Dimmer switches have two single terminals and a double terminal, Figure 30. The single terminals connect to the battery and the headlamp lower (dim) beam. The double terminal connects to the headlamp upper beam (bright) and to the beam indicator lamp on the instrument panel.

**DIMMER SWITCH CHECK:**

1. Disconnect all wires from the dimmer switch.

2. With the light switch on, connect the dimmer switch battery wire to a test lamp and ground the other lamp terminal, Figure 31.
3. Correct the circuit to the dimmer switch if lamp does not light.

4. If lamp lights, replace the switch battery wire and touch one lamp lead to the doable connector and ground the other lead.

5. Operate the dimmer switch. Lamp should light in one switch position and not in the other. Repeat with lamp connected to the lower beam terminal. If switch fails to turn the lamp on and off from each terminal, replace switch.

**CIRCUIT BREAKERS & FUSES**

The main circuit breaker is incorporated in the car headlight switch and is connected to an auxiliary circuit breaker by a jumper wire.

The auxiliary circuit breaker is located on the steering column brace under the dash panel.

**NOTE: WHEN ACCESSORY ITEMS SUCH AS CLOCK OR CIGAR LIGHTER ARE INSTALLED, THEY MUST BE CONNECTED AS SHOWN IN THE WIRING DIAGRAM**

Fuses are used for the protection of optional equipment as follows:

- Electric Clock - Three ampere fuse in a fuse case at back of clock.
- Weather Control - Fourteen ampere fuse in a fuse case on left side of weather control housing.
- Radio - Fourteen ampere fuse incorporated in the radio "A" lead wire.
- Drive-master - Ten ampere fuse in the drive-master control switch on the instrument panel.
- Direction Indicator - Ten ampere fuse attached to the flasher unit lead wire.

**Horns**

Two electric air horns are standard equipment on all models.

The horn is operated by a magnetic type motor which consists of a field, armature, and a set of breaker points which interrupt the flow of current in the coil.

The armature is securely attached to the diaphragm.

Interruption of the current in the coil causes the diaphragm to vibrate which produces the sound.

The twin horns are constructed in such a manner as to produce different tone frequencies and the frequencies of each horn are synchronized to produce a harmonious tone when the horns are sounded together.

The major items that govern the frequencies of tone are as follows:

1. The form and thickness of diaphragm.
2. The weight attached to diaphragm.
3. The length of the air column.
4. The air gap setting between field and armature.
If an adjustment of tone is desired, proceed as follows:

1. Remove cover (J) by inserting a screw driver in opening provided at edge of cover.
2. With car engine running at proper RPM to deliver the maximum charging rate, loosen the lock nut and turn the adjusting nut (H) up or down until the desired tone is obtained.

**NOTE:** It is advisable to have only one horn connected when the following adjustment is being made. Remove the wire at the horn relay from the horn not being adjusted. Proceed in this manner with each horn, and after each horn has been tested, connect both to relay and sound together, then replace cover Figure 32.

3. After adjustment is made, be sure to tighten lock nut against the adjusting nut (H).

The air gap between field "A" and the armature "B" should be .027" to .029" on the high horn, .032" to .034" on the low horn.

The armature (B) is threaded on to diaphragm stud (C) which is attached to diaphragm (D). Armature (B) is locked in the desired position by lock nut (E). Therefore, to set air gap between field (A) and armature (B) loosen lock nut (E) and turn armature (B) in a clockwise direction to decrease air gap and counter-clockwise to increase air gap. Tighten lock nut (E) securely before checking gap. The armature (B) should be approximately parallel with the field (A).

After the air gap has been properly adjusted, it is necessary to readjust nut (H) to obtain maximum volume and the best tone.

If for any reason the front housing and air column assembly has been removed, care should be taken when replacing it to see that the gasket between the diaphragm, front housing, and air column assembly is in good condition.

A new gasket is recommended as any air leak in the air column reduces the volume and quality of tone.

The short air column is used in conjunction with the thick diaphragm for the high horn. The long air column is used in conjunction with the thin diaphragm for the low horn.

**DIRECTION INDICATOR**

The direction indicator switch is operated by a lever located on the steering column and this lever is turned manually in the same direction that the steering wheel is to be turned (up for right or down for left turn). The switch turns off automatically as the turn is being made. If the lever is turned to signal for one direction but the turn is made in the opposite direction, the switch will be turned off automatically as the turn is made.

A jeweled light on the left end of the instrument panel flashed to indicate unit is operating.

**INDICATOR LAMPS AND WIRE HARNESS (REAR)**

**INSTALLATION:**

1. Assemble the direction indicator light sockets to tail lamps by plugging into the provided opening shown at K, Figure 33, according to their identification (Right side wire - yellow, Left side wire - blue).

2. Clip rear indicator wires to deck opening trough by existing clips and follow the trough to the left corner of deck opening as shown in Figure 33.
3. Remove left rear door scuff plate on sedan or left door scuff plate on broughams and coupes.
4. Starting from in front of rear door lock pillar between frame and rocker panel, insert a fish wire at point A, Figure 34, which is between the rear pillar and fender and above the fender to frame seal. Guide the fish wire upward and back between the wheelhouse and fender to project into the rear compartment. Attach the rear wire harness to the fish wire and withdraw the fish wire.
5. Install loom over wire harness to protect wires at base of pillar shown at A, Figure 34.
6. At the left front fender wheel opening, lift the lower outside corner of the rubber stone guard and insert a fish wire between the rocker panel and frame at a point shown at B, Figure 34. Guide fish wire back through to where scuff plate has been removed. Attach wire harness to fish wire; then withdraw fish wire.
7. From the engine compartment, enter a fish wire through the opening between dash panel and stone guard (C), Figure 34; guide the fish wire down till engaged with the wire harness. Then withdraw the fish wire, bringing the wire harness out through opening shown at C, Figure 34.
8. Enter the rear wire harness through the existing grommet in the dash panel shown at D, Figure 34, and pull wire through from inside the car.
9. Wrap a strip of electrical friction tape around the rear wire harness and lay the tap across the top of frame at a location centered with the scuff plate attaching holes shown at E and install scuff plate.
10. Reinstall scuff plate.
WIRE ROUTING FOR TURN INDICATOR

TO TURN INDICATORS

FIGURE 34
INDICATOR LAMPS AND WIRE HARNESS (FRONT)

INSTALLATION:
1. Remove the front fender parking light lens and bezel assemblies by extracting the two screws on face of bezel, Figure 33.
2. Remove the socket bracket and wire assemblies by extracting the screw on the back face of the lamp housing and disconnecting the wire terminal at junction block. Then pull the wire out through the rubber grommet in lamp.
3. Install the socket bracket and wire assemblies to parking lamp housings and tighten the socket bracket retaining screw securely. Then attach the white insulated wire to the parking light terminal of junction block.
4. Install bulbs in sockets and reassemble the lens and bezel assemblies.
5. Install a connector to each of the direction indicator wires from the parking lights.
6. To the right hand connector attach the terminal of the yellow jumper wire and clip with the existing clips used for the headlamp wires in the path followed to the left hand junction block. Then attach a connector to the terminal of the yellow jumper wire.
7. To the connector of the yellow jumper wire insert the terminal of the yellow wire of the front indicator wire harness. To the left hand indicator light wire (blue) connector, insert the blue wire terminal of the front indicator wire harness.
8. Attach the front wire harness to the existing clips used for the headlight wires on the left front fender side dust shield.
9. Enter the wire harness through the existing grommet shown at D, Figure 34. Then pull wires through from inside of car.

3. Install direction indicator steering column switch and conduit assemblies to the upper gear shift support.

NOTE: Indicator switch case and cover assembly replaces the upper control lever tube bracket.

4. Insert rubber part No. 301852 between the steering column and switch wires under the conduit. See (A), Figure 34.
5. Install the steering column bracket cap over the conduit.
6. Tighten the steering column bracket bolts securely.
7. Clamp wires from steering column switch with clamp attached to the steering column brace as shown in Figure 34.
8. Install flasher switch in the hole located at the rear of auxiliary circuit breaker in the steering column brace. Flasher switch contacts should face toward front of car.
9. Use a letter F drill and drill a .257” diameter hole through the instrument panel for the jeweled light. Locate hole 3 inches from left end of instrument panel and 5/8” down below instrument panel upper bead.
10. Assemble the jewel light and retainer to instrument panel.
11. Drive the two tapered switch trip pins into the holes in the steering wheel hub. Install the steering wheel.

JACKET TUBE AND SWITCHES

INSTALLATION:
1. Remove steering wheel and jacket tube.
2. Install jacket tube and bearing assembly contained in direction indicator kit.
3. Insert the yellow wire terminals of the front and rear harnesses and the yellow switch wire into a double connector.

STEERING COLUMN AND FLASHER SWITCHES

WIRING INSTRUCTIONS:
1. Insert the yellow wire terminals of the front and rear harnesses and the yellow switch wire into a double connector.
2. Insert the blue wire terminals of the front and rear harnesses and the blue switch wire into a double connector.

3. Assemble a single connector to the black wire of the flasher switch and join to the black wire of the steering column switch.

4. Plug flasher light into the jewel retainer.

5. Connect the white wire from the positive post of the flasher switch to the battery side of the temperature gauge.

NOTE: For complete illustration of wiring, see Figure 35.

DIRECTION INDICATOR SWITCH

ELECTRICAL CHECK:

1. Disconnect switch wires from connectors under instrument panel.

2. Connect black wire to hot side of circuit breaker.

3. Connect one lead of test lamp to blue switch wire and ground the other lamp lead. Move switch lever down and lamp should light.

4. Connect one lead of test lamp to yellow switch wire and ground the other lamp lead. Move switch lever up and lamp should light.

5. If lamp fails to light in either position, switch should be replaced.

MECHANICAL CHECK:

NOTE: For proper operation of direction indicator, steering wheel must be properly installed in straight ahead position on steering column.

1. Remove switch case cover and check cancelling pawls (A), Figure 36, to see that they slide freely. Apply a small amount of vaseline to slot in each pawl.

2. Move switch lever up and turn steering wheel 1/2 turn right. Cancelling pin it steering wheel hub should strike and pass left pawl without moving switch. The pawl spring (B) should return the pawl to extended position when the pin clears.

3. If cancelling pawls do not return to extended position, pawl may be binding on paw lever. Examine spring attaching loop or pawl and see that open end of loop is bent up - not down. If pawl still fails to return pawl spring may be weak. Spring may be removed and shortened.

4. Return wheel to straight ahead position Canceling pin should strike pawl and disengage switch.

5. Repeat test with switch lever down and turn wheel left.
6. If switch fails to operate properly, cancelling pin in wheel hub may be too short or bent.

7. Move switch lever up and turn wheel 1/4 turn left. Pin should strike left pawl and disengage switch.

8. Repeat with switch lever down and turn wheel right. Pin should strike right pawl and disengage switch.

9. If pin fails to strike pawl, pin may be too short or bent.

NOTE: Switch lever must NOT be held in position while steering wheel is turned. If lever is held, cancelling pawl may be locked on the trip lever and switch will cancel in one direction only. The additional tension on the cancelling lever spring may cause the switch to change to the opposite direction when cancelled.

REMOVAL:
1. Remove three switch wires from clip under instrument panel and disconnect wires at connectors.

2. Remove two Phillips head screws attaching switch case to control lever tube bracket.

3. Loosen steering column bracket cap at instrument panel and remove switch wire cover.

4. Remove switch case and wire assembly.

INSTALLATION:
Reverse procedure of removal. Connect switch wires to harness wires of same color.

DIRECTION INDICATOR FLASHER UNIT

The direction indicator flasher unit is mounted under the instrument panel forward of the circuit breaker. The flasher unit contains two sets of breaker points. One set makes and breaks the circuit to the pilot light on the instrument panel to indicate that the unit is operating. Pilot lamp flashes only when both lamps in either left or right circuit are operating. The other set of points alternately inserts and removes resistance in the circuit to the direction indicator lamps, flashing the lights.

FLASHER UNIT CHECK:

1. Remove clamp attaching flasher unit to brace and remove Essex plug from flasher.

2. Connect a six volt battery to terminal marked "X", Figure 37.

3. Connect two 21 C.P. test lamps in parallel to terminal marked "L" (Lamps) and to the battery. Lamps should flash on and off. With above lamps connected, connect a 2 C.P. test lamp to terminal marked "P" (pilot) and to the battery. All lamps should flash on and off.

4. With above lamps connected, connect a 2 C.P. test lamp to terminal marked “P” (pilot) and to the battery. All lamps should flash on and off.

5. Disconnect one 21 C.P. test lamp. Pilot test lamp should go out and remaining 21 C.P. lamp flash rapidly.

6. Replace flasher unit if defective.

NOTE: If direction indicator lights flash too rapidly, the front indicator lamp is reversed, placing the parking filament in the indicator circuit and increasing the circuit resistance, or only one lamp is operating.
RADIO ANTENNA

INSTALLATION:

1. Insert tube and rod assembly (A) into arm (B) of control assembly (C) and lock securely in place with set screw (D).

2. To mount stop (E), drill a No. 31 (.120) hole (F) in the windshield center bar 4" from the cowl panel. Mount the stop with screw as shown.

3. On centerline ridge of roof panel, drill a 1-1/8" diameter hole 2" above windshield center bar for control assembly. Inside the car, remove mirror and locate a 1/4" diameter hole (K) which can be felt through the upholstery in the bottom tab of the front dome lamp bracket. Pierce the upholstery at this point with a pencil.
To mount control assembly, first assemble rubber insulator pad (L) over the bakelite insulator of the control assembly. Note the word "Top" on the underside of the pad for correct positioning. Tie a piece of string approximately 12" long onto the contact (M) on the control assembly. Thread the string through the roof panel, front end panel and into the interior of the car by way of the hole previously pierced in the upholstery. With the tube and rod assembly in a line parallel to the windshield center bar, push the control assembly through the 1-1/8" diameter hole in the roof panel. Where the assembly pushes against the upholstery on the inside of the car, make a slit approximately 5/8" long. Pull the assembly through, making sure that the rubber insulator pad (L) is in correct position.

5. Assemble bushing (N) over the threaded sleeve so that it fits into hole in front dome lamp bracket as shown. Slip flat washer and lock washer over the sleeve secure with hex nut (P). Tighten assembly in place so that the tube and rod assembly rests in the stop as shown.

6. Position the escutcheon plate (Q) so that it comes flush with the upholstery and secure with flat washer, lock washer and hex nut (R). Do not tighten the hex nut too much or the plastic escutcheon plate may distort or crack.

7. Place knob (S) on end of shaft. The arrow will point in the direction of the tube and rod assembly. Fasten the knob to the shaft with set screw (T).

NOTE: The tube rod, when in "down" position, must rest in the stop. If it does not seat completely, lift the arm about 90° from the windshield remove the screw (U) from the under-side using the Bristol wrench. Thread screw into the hole diagonally opposite in the arm. If the mast rests too heavily in the stop, the screw in its original position can be backed slightly out of its hole to raise the mast from the stop.

Remove joint cover (G) from instrument panel by taking out screw (H). Drill a 7/16" diameter hole in joint cover as indicated in view "A". Position spacer (S) on instrument panel re-install joint cover. Leave the screw a little loose.

9. To mount lead rod (V), first pull contact (M) through upholstery insert the upper end of the lead rod. Push contact back through upholstery through the bracket, pressing the bushing (W) firmly into the 1/4" diameter hole in the front dome lamp bracket.

10. Insert the threaded sleeve of the lead rod through the 7/16" diameter hole in joint cover, spacer instrument panel. From the under-side of the dash board, assembly the lock washer hex nut (X). Tighten securely. Finally tighten the screw in the upper face of the joint cover. Replace the mirror.

11. Assemble the lead-in cable assembly (Y) by screwing the coupling nut on to the sleeve of the lead rod. Make certain that the male pin is directed straight into the female contact in the lead rod. Insert cable plug into socket in radio.
SECTION 7
CLUTCH
SPECIFICATIONS

Driving plate Diameter
10" Used on 4-A, With Overdrive, Drive- Master or Super-Matic Drive

Engaging Springs:
Inner
Outer

ALL MODELS:
Engaging Spring Tension
(Compressed to 1-5/8"):
Inner 75 to 80 lbs.
Outer 130 to 140 lbs.

Engaging Fingers 3
Clutch Pedal Travel 1-1/4" - 1-3/4"
Throwout Bearing Ball

CONSTRUCTION

All Hudson cars except those equipped with Hydra-Matic Drive use a single plate, cork insert, oil cushioned type clutch.

Details of the clutch may be seen in Figure 3. Engagement and disengagement of the clutch is controlled by the clutch foot pedal which is connected by linkage to the shifter yoke (16). When the clutch pedal is depressed, the yoke moves forward carrying with it the throwout bearing (13) which bears against the 3 throwout fingers (3) which react against the retainers (5) to move the pressure plate away from the driving plate and flywheel against the pressure of the engaging springs (7). This action disconnects the driving plate (1) and drive gear (15) from the flywheel.

CLUTCH PEDAL ADJUSTMENT

To assure full disengagement of the clutch to prevent clashing when shifting gears and also to prevent the clutch pedal from riding against the floor board, 1-1/2" clearance must be maintained between the floor board and rear face of pedal, Figure 2.

This can be adjusted by loosening lock nut (A), Figure 3, removing cotter pin and clevis pin (C) and turning yoke (B) to increase or decrease the clearance as required. Replace clevis pin and cotter pin and tighten lock nut securely.

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<th>Single Plate in Oil</th>
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<tbody>
<tr>
<td>Type Fluid</td>
<td>Hudsonite</td>
</tr>
<tr>
<td>Quantity</td>
<td>1/3 Pint</td>
</tr>
<tr>
<td>Filler Plugs (2)</td>
<td>Front of Flywheel</td>
</tr>
<tr>
<td>Plate Facing</td>
<td>Cork Inserts</td>
</tr>
<tr>
<td>Number of Corks</td>
<td>90</td>
</tr>
<tr>
<td>Pilot Bearing</td>
<td>Ball</td>
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</tbody>
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4-A  5A-6A-7A-8A
9"  10" All Models
6  3
9  12

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</table>
DRAIN AND REFILL CLUTCH

The clutch assembly should be drained and refilled with Hudsonite Clutch Compound every 5000 miles as follows:

1. Remove plug (A), Figure 4, using socket wrench J-472.

2. Crank engine slowly until the star on flywheel is aligned with the timing pointer the timing inspection hole. This will bring the drain hole to the bottom of flywheel and allow complete drainage.

3. Crank engine until the drain hole again appears at the timing inspection hole and insert 1/3 of a pint of Hudsonite Clutch Compound using J-485 Clutch Filler Gun.

4. Install plug (A).

The measuring cup J-486 is calibrated and should be used for measuring the clutch compound unless the "one shot" 1/3 pint can used.

NOTE: Cars equipped with Hudson Drive-Master can be lubricated by raising car and removing flywheel dust cover. Crank engine until plug appears at bottom of flywheel, remove plug and drain.

Crank engine until plug has moved upward approximately 3 inches from drain position and insert Hudsonite Clutch Compound using gun J-485.

Replace plug and flywheel dust cover.

CLUTCH GRABS OR STICKS

Drain Hudsonite Clutch Compound, flush clutch using 1/3 pint solution of 80% carbon-tetrachloride and 20% acetone.

Run engine at idle speed for 10 minutes, operate clutch pedal at least 50 times during flushing period to assist cleansing action of the solvent solution.

Drain flushing solution completely, then 1/3 pint of Hudsonite Clutch Compound. Replace drain plug.

CLUTCH REMOVAL FROM CAR

1. Remove front seat cushion.

2. Remove the four bolts attaching the bottom of front seat frame to seat track, remove two screws attaching seat adjusting lever to seat frame, and remove seat back and base from car.

3. Disconnect accelerator pedal at accelerator rod.

4. Remove foot brake pedal rod from brake lever using tool J-2795, Figure 5.

5. Pull the steering column hole rubber cover up out of the way.

6. Remove the floor mat.
7. Remove Hudson Weather Control unit held by 4 screws, (2 each side). Remove Bowden wire at weather control valve.

8. Remove the floor opening cover, (held by 5 screws at cowl kick pad, 12 screws along floor and 1 bolt and nut at steering gear floor opening cover.)

9. Disconnect the propeller shaft at transmission companion flange. Remove screws attaching propeller shaft center support bracket and move propeller shaft rearward to clear transmission companion flange.

NOTE: Use a wire or rubber band to prevent the trunnions from slipping off the "U" joint spider.

10. Unhook the clutch pedal lever return spring.

11. Remove the two clutch cross shaft bracket bolts, remove clutch cross shaft bracket.

12. Remove the clutch control link clevis pin and unhook clevis.

13. Remove shifter shaft outer lever nut and washer, this will disconnect the linkage connecting the Handy Shift to the transmission.

14. Remove 2 screws and remove flywheel guard from bottom of clutch housing.

15. Remove the two engine rear mounting bolts and nuts at third crossmember.

16. Jack up rear end of engine about 1/2" off the frame.

CAUTION: Place a block of wood under head of jack to prevent damage to the oil pan.

17. Disconnect speedometer cable at transmission and install wood plug.

18. Remove two top screws holding clutch housing to engine endplate and install two headless screws J-2969 to support the transmission until the balance of the screws are removed.

19. Remove breather pipe bracket from clutch housing, and bolt attaching breather pipe and rear tappet cover.

20. Pull transmission and clutch housing back towards the rear and up through the floor opening. Hoist J-1502 will be helpful in handling the assembly.

NOTE: See "Overdrive Section" on cars equipped with Overdrive.

21. Loosen all clutch-cover-to-flywheel screws slightly to release the tension of clutch engaging springs. Remove the screws and lift off the clutch assembly and driven disc.

DISASSEMBLY AND INSPECTION

DRIVING PLATE

1. A black glaze on surfaces of corks generally indicates the use of unsuitable clutch fluid or that unit was operated with insufficient fluid. If corks are blackened but not burned, soak the plate in Hudsonite Compound to clean the corks. If soaking does not remove the black coating, replace the plate assembly. Clean cork surfaces are necessary for smooth soft operation of clutch.

2. Driving plate should run true at cork faces within .010" when rotated on Vee blocks with mandrel inserted in hub spline.

3. Hub splines must be free of burrs and nicks and must slide freely on splines of main drive gear (clutch shaft) without appreciable backlash.

4. Examine spring loaded hub for broken springs or stampings. Spring cages should retain the hub in the plate without appreciable angular backlash or sidewise lost motion and springs should be a tight fit with no clearance between ground ends of springs and clutch inner driven disc to insure proper frictional load between inner and outer driving plates. Plates that do not meet above specifications should be replaced.
PRELIMINARY COVER CHECK

Before proceeding with disassembly of cover and pressure plate assembly, check for general condition of cover, fingers and retainers. This test should be made regardless of whether the pressure plate appears to be in good or bad condition.

1. Mount the pressure plate and cover assembly on base plate or on a standard fly-wheel with a standard driving plate and ONE standard gasket interposed.

2. Bring cover into firm contact with flywheel or base plate using an arbor press or other means, then install and tighten 8 of the 16 cover-to-flywheel cap screws.

The measurements described in the next paragraph should always be made with the cover held to base plate or flywheel at the front flange, not at the hub or rear wall of the cover.

3. Using a machinists combination square or depth micrometer, measure the distance from clutch throwout bearing contacting surface of lowest finger to top of cover hub (A) as shown in Figure 6. On a clutch in good condition, the distance should be 1-1/4" to 1-1/2" when the interposed driving plate is .200" to .213" and the gaskets are .028" to .032" uncompressed thickness.

If distance is greater than 1-1/2" the throwout fingers and/or retainers are excessively worn or the cover is distorted inwardly. The assembly should be disassembled for inspection of its component parts.

If distance is less than 1-1/4", it can be assumed that the fingers, cover and retainer are not excessively worn and further disassembly is optional except for testing the pressure of the engaging springs or replacing the pressure plate. It can be assumed as satisfactory, providing fingers clear hub of cover by at least 1/8".

PRESSURE PLATE

NOTE: Before proceeding with disassembly of the cover and pressure plate assembly, look for the correlation punch mark near the outer edge of the pressure plate and a corresponding mark near it on the cover flange. These marks indicate the relative position of the parts when the assembly was balanced at the factory and the marks should be kept together to maintain the original balance.

Pressure plate should be free of cracks, burns or scores and should be true within .010". Scrape all gummed oil from pressure plate. Warpage may be
readily checked by laying pressure plate on a surface plate. If a .010" feeler can be inserted at any point between surface plate and pressure plate, the pressure plate should be replaced. If a surface plate is not available, use a new pressure plate or flywheel to serve as a surface plate.

**ENGAGING SPRINGS**

If clutch pressure plate shows signs of overheating, it is likely that the engaging springs will require replacement. Inner and outer springs should be checked for tension at each overhaul using the Valve Spring Tester Tool KMO-607 and checking against the tension data as follows:

- Inner all @ 1-5/8" -- 75 to 85 lbs.
- Outer all @ 1-5/8" -- 130 to 140 lbs.

**THROWOUT FINGERS**

Visually check the fingers for wear and uneven surfaces at the points where the fingers contact the throwout bearing and retainers, also check the retaining pin bores. Replace fingers that show noticeable wear.

**RETAINERS AND WASHERS**

Check retainers for wear at slot where they contact the lobed surface of the fingers. The bearing surface on the retainers is practically a line contact. If bearing area of retainer is grooved deeper than .005" replace the retainer. If, however, there is only one such groove, the retainer may be safely continued in service by rotating it 180 degrees from former position when it is being installed. Changing the retainer position by half a turn will bring unworn portion into contact with finger fulcrum lobe.

NOTE: The plain copper washers interposed between retainers and cover function as oil seals. Top and bottom faces of these washers must be flat and free of scores, otherwise they should be replaced.

**CLUTCH COVER**

Inner surface of cover must be flat and free from scores adjacent to the holes for the finger retainers. Cover must be flat within .005" when front face is checked on a surface plate.

Distance from front face of cover where it contacts the flywheel gasket, to points on front wall of cover where retainer sealing washers fit (B) Figure 6, should not be less than 2.350" and not more than 2.370" measured 1/8" from edge of each of the 3-finger retainer holes. Variation in distance at any of the 3 holes should not exceed .008". Covers that are not within these limits should be replaced unless equipment and skill is available for doing an accurate job of straightening.

Cover hub bore (C) against which the throw-out collar oil seal contacts, must be smooth and free from nicks and burrs.

If cover hub bore (C) shows considerable wear and scoring, it is an almost certain indication of misalignment. Whenever this condition is encountered, be sure to thoroughly check the engine rear support plate, flywheel and clutch bell housing, for shaft concentricity and face alignment in both planes.

**THROWOUT BEARING AND SEALS**

In the removal of clutch from engine, the throwout bearing (13), Figure 1, grease retainer (17) and clutch oil seal (14) will be removed as a single unit with the collar (12).

Leather element of seal must be free of glaze and cuts or cracks and must be firmly attached to the stamped steel element. Leather must not rotate in relation to the stamping and the seal assembly must be stationary on the clutch collar. Check to see that coil spring is intact and not loose.

Replacement of the oil seal necessitates removal of the throwout bearing from the clutch collar. Use care when pressing new seal onto collar, apply a steady pressure to the (INNER) metal edge. As the seal assembly can be quickly made ineffective by careless installation, it is important to use
ation, it is important to use a close fitting pressing sleeve so as to confine all the load to the inner edge.

The throwout bearing should be free from roughness or lumpiness when rotated after cleaning and oiling, otherwise it should be replaced. If both the throwout bearing and the oil seal require replacement, it is usually as economical to install a new collar assembly.

When installing throwout bearing to collar, do so with a press having a ram adaptor large enough to cover the entire front face of the bearing. DO NOT drive the bearing into place on the collar as such action is likely to mark or brinnell the races causing subsequent noise in operation.

NOTE: When assembling throwout bearing to collar, do not fail to install a new grease retainer (17) Figure 1, to annular recess in the bearing. Make sure that the washer is fully seated in recess.

Grease retainer (17) and oil seal assembly should be soaked in engine oil for at least 30 minutes before they are installed.

PILOT BEARING

The main drive gear pilot ball bearing in flywheel should run freely. If lumpy or rusty or badly worn replace bearing. Inertia type expanding jaw puller J-877 facilitates removal of bearing from flywheel, Figure 8.

FLYWHEEL

Check flywheel for smoothness and flatness. If burned or warped more than .010”, it should be replaced. Make sure that flywheel attaching bolt nuts are tightened to 40-45 foot pounds torque.

REAR SUPPORT PLATE AND CLUTCH BELL HOUSING

Check cylinder block rear support plate very carefully for tightness and alignment. This is especially important in cases where car has been subject to chronic clutch trouble. Make a similar check of clutch bell housing. In lieu of highly precise equipment, use a steel straight-edge to check steel rear support plate and a surface plate or other flat surface to check the front face of clutch bell housing. Both units should be flat and in plane within

REASSEMBLY

1. Install the throwout fingers to pressure plate. (DO NOT FORGET TO INSTALL THE COTTER PINS.) Place a finger retainer over each finger with threaded end of retainers facing up.

NOTE: Retainers may be rotated 180 degrees to present a new bearing surface to fingers.

2. Lay the pressure plate with fingers and retainers installed, on base plate of fixture, J-298-H.

3. Assemble the previously tested engaging springs into seats on pressure plate, spacing inner spring arrangement equally to insure proper balance.

4. Check position of correlation marks on cover and pressure plate, align the marks then lower the cover onto the pressure plate while guiding each of the 3 finger retainers into their respective holes in cover.

5. Using clutch assembly fixture Figure 7, or other suitable means, pull cover into place by compressing engaging springs. Install lockwasher and nut on each finger retainer and draw nuts up to 40-45 foot pounds torque after cover is pressed all the way down.
6. Remove assembly from fixture. Using a suitable heavy duty end wrench engage flat portion of retainers and turn same until all fingers are centered sideways in retainer slots. THIS IS AN IMPORTANT PART OF THE JOB. Make sure that shoulder of each retainer is fully seated on wall of cover.

7. Reinstall clutch cover and pressure plate assembly to flywheel or base plate of fixture after having first placed a driving plate and ONE gasket underneath.

8. Install and tighten 8 of the 16 cover to flywheel cap screws.

9. Using a scale or adjusting gauge J-774, measure from lowest finger at contact end to top of cover hub. If measurement is within limits of 1-1/4" to 1-1/2" synchronize the fingers as outlined in next paragraph. If measurement is greater than 1-1/2", the cover is probably distorted and same should be checked as outlined under "Disassembly and Inspection Clutch Cover Check".

10. Using finger setting gauge J-774, as shown in Figure 9, check should be same for each finger within .010". If any finger is higher than another by not more than .029", it should be brought to height of others (lowered) by striking the nut end of its retainer sharply with a soft hammer.

If any finger is more than .030" higher than another, it should be lowered to level of other fingers by installing a thin (about .005" thick) washer between clutch cover and retainer of the high finger.

11. Remove assembly from fixture.

**INSTALLATION OF CLUTCH ASSEMBLY TO ENGINE**

1. Install ONE new clutch cover gasket and shellac it in place on front face of cover flange.

**NOTE:** If clutch has been properly reconditioned only one gasket of 1/32" free thickness is required to give correct release and engagement. Avoid the installation of two or more gaskets as each added gasket reduces the effective pressure of engaging springs by an amount equal to the thickness of each additional gasket.

2. Place driving plate on pressure plate then insert the aligning arbor J-449, Figure 10, through cover and splines of driving plate and into pilot bearing in flywheel. Push the assembly up into place on the flywheel and
secure with the cap screws. Keep the arbor in position so as to keep the driving plate centered. This will assist installation of the transmission.

3. Tighten the cap screws gradually drawing down opposite screws instead of in rotation so that a good gasket seal is insured. Using a torque wrench, tighten all cover screws to 20-25 foot pounds. Withdraw the arbor.

4. Insert 1/3 of a pint of Hudsonite into clutch via the cover hub opening.

5. Install clutch collar and throwout bearing assembly to clutch cover hub bore after spreading a thin coat of engine oil over bore wall. Care must be exercised to prevent damaging the lip of the oil seal or curling it over in the bore.

6. Center the throwout bearing grease retainer leather washer (17), Figure 1, (not the oil seal) by temporarily inserting the aligning arbor through it. Rotate collar and throwout bearing to position for proper alignment with throwout yoke on transmission.

7. Tighten all rear engine support plate screws.

8. Install two headless screws J-2969 in engine endplate to assist in supporting transmission at installation.

9. Bring the transmission assembly to position where main drive gear (clutch shaft) is aligned with bore of throwout collar, then carefully push forward to enter drive gear through grease retainer leather washer, splines of driving plate and into pilot bearing. During this operation the main drive gear must be relieved of the overhanging weight of the transmission until the bell housing engages the dowels.

NOTE: Before transmission assembly is moved up against rear support plate, make a last inspection to verify that the end face of throwout collar in clutch is properly aligned with the throwout yoke on transmission and that oil seal lip has not turned under.

CAUTION: Alignment of bell housing with engine is controlled by the sleeve dowel in the upper left location of the bell housing attaching bolt circle and by the dowel bolt at the lower right location viewed from rear of car. Make sure that the former is in place and entered in bell housing hole before tightening bolts. Install lower right bolt (dowel bolt) first. NEVER grind or otherwise reduce the diameter of the dowel bolt to facilitate installation.

10. Remove the two headless screws or guide studs.

11. Install remaining clutch housing attaching bolts and tighten to 40-45 foot pounds.

12. Complete installation by reversing the order of removal of the remaining parts.

**CLUTCH PEDAL LEVER, HOUSING AND BUSHING REMOVAL:**

1. Remove the nuts and washers from clutch and brake pedal rod and lever.

2. Using puller tool J-2795 remove clutch and brake pedal rods.

3. Disconnect clutch pedal lever return spring.

4. Remove clutch overcenter spring using tool J-2956, Figure 11.
5. Remove cotter key and pin from clevis to clutch cross shaft lever.

6. Remove cotter key and pin from clevis attaching brake lever to master cylinder push rod.

7. Remove the two stop light wires and two brake line connections from rear of master cylinder.

8. Remove the bolt from the rear of master cylinder bracket which will allow the master cylinder and bracket assembly to swing down.

9. Remove the lock screw and Woodruff key from the clutch cross shaft lever and slide the clutch pedal lever and cross shaft out of the frame.

10. Remove the two bolts from the pedal lever housing and bushing assembly to frame and remove the master cylinder and bracket assembly, the brake pedal lever and the pedal lever housing and bushing assembly as one unit and disassemble on a bench.

11. Remove lock ring from the pedal lever and housing assembly and remove the master cylinder and bracket assembly and brake pedal.

INSTALLATION

Reverse procedure of removal.

NOTE: Check adjustment of clutch pedal after assembly.

TROUBLE SHOOTING

CHATTERING
Improper clutch adjustment
Binding drive plate hub
Unequal contact of pressure plate face
Uneven spring pressure
Improper alignment of transmission
Worn splines on transmission main drive gear
Binding pressure on fingers or fulcrums

GRABBING
Improper clutch adjustment Uneven spring pressures

Binding on release levers or fulcrum studs.
Sticking clutch pedal
Worn rubber engine mountings
Improper alignment of transmission with clutch and rear engine plate

SLIPPING
Improper lubricant
Excessive lubricant
Worn or glazed driving plate
Improper clutch adjustment
Warped driving plate
Binding pressure on fingers
Binding clutch pedal
Insufficient free pedal travel
Improper alignment of clutch, engine and transmission.

DRAGGING
Improper clutch adjustment
Improper pedal adjustment
Bent clutch driving plate
Worn or burnt corks
Clutch driving plate hub binding on main drive gear splines
Sticking release sleeve
Binding pilot bearing
Improper alignment

RATTLING
Worn parts in release assembly
Worn splines on clutch shaft or in plate hub
Worn release bearing
Worn pilot bearing
Unequal clutch finger setting
Worn fulcrum pins
Excessive backlash in transmission or propeller shaft
Worn transmission main drive gear bearing
Improper alignment

VIBRATING
Improper balance of clutch assembly
Bent clutch shaft
Improper alignment with transmission
Loose engine mountings
Loose flywheel or flywheel out of balance
Worn transmission rear bearing
Defective vibration dampener
Worn Universal joints
SECTION 8
SYNCHRO-MESH TRANSMISSIONS
SPECIFICATIONS

BEARINGS AND BUSHINGS

Main Drive Gear ......................... Ball
Mainshaft Pilot ......................... Needle Brg.
Mainshaft Rear .......................... Ball
Reverse Idler ........................... Steel Back
Countershaft Gear ........................ Tin base

RATIO - All Series with or without D/M - O/D or S/M Drive
Low Gear........................................2.88 to 1
Second Gear.....................................1.82 to 1
High Gear.......................................1 to 1
Reverse Gear .............................. 3.5 to 1

END PLAY

Countershaft Gear ..................... .006 to .016
Mainshaft Intermediate Gear and Synchronizer ........ .003 to .016
Reverse Idler Gear .................... .003 to .010

NUMBER OF GEAR TEETH

Countershaft Drive.......................... 26
Countershaft Intermediate ................. 21
Countershaft Low............................ 17
Countershaft Reverse ..................... 14
Main Drive Gear............................ 17

SPEEDOMETER PINIONS

<table>
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<tr>
<th>PART NO.</th>
<th>TEETH</th>
<th>AXLE RATIO</th>
<th>TIRE SIZE</th>
<th>STEWART WARNER PART NO.</th>
<th>MODELS</th>
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<tr>
<td>304703</td>
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<td>4-1/10</td>
<td>7.10 or 7.60</td>
<td>22719-AG</td>
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<td>16</td>
<td>4-1/10</td>
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<tr>
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SPEEDOMETER DRIVE GEARS

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<td>4-A with Drive-Master *</td>
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GOVERNOR PINIONS

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<th>MODELS</th>
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<td>7.10 x 15</td>
<td>448022</td>
<td>4-A with Drive-Master *</td>
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<tr>
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<td>7.10 or 7.60</td>
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<td>All with O/D, D/M or S/M*</td>
</tr>
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* O/D - Overdrive
* D/M - Drive-Master
* S/M - Supermatic Drive
FIGURE 2

1. Gear Pilot Bearing  
2. Main Drive Gear  
3. Gear Bearing Retainer  
4. Gear Oil Seal  
5. Retainer Locating Pin  
6. Clutch Housing  
7. Washer Pin Front  
8. Gear Bearing  
9. Shaft Pilot Bearing  
11. Shift Hub Lock Ring  
12. Synchronizer Shift Sleeve Hub  
13. Synchronizer Spring (2 places)  
14. Synchronizer Shift Plate  
15. Synchronizer Shift Sleeve  
16. Synchronizer Ring (2 places)  
17. Shaft Intermediate Gear  
18. Main Shaft  
19. Shaft Lower and Reverse Gear  
20. Gear Housing Gasket  
21. Speedometer Gear Housing Washer  
22. Gear Housing Bolt (3 places)  
23. Shaft Rear Bearing  
24. Speedometer Gear  
25. Speedometer Gear Housing  
26. Gear Housing Oil Seal  
27. Companion Flange  
28. Flange Washer  
29. Flange Nut  
30. Gear Lock Ring  
31. Retainer Gasket  
32. Case Gasket  
33. Washer Pin Front  
34. Main Shaft Snap Ring  
35. Cluster Thrust Washer  
36. Cluster Steel Washer  
37. Case  
38. Governor Gear OD HDM  
39. Governor Gear Ring OD HDM  
40. Cluster Bushing Front  
41. Countershaft Gear Cluster  
42. Main Drive Gear (clutch gear)  
43. Countershaft  
44. Drain Plug  
45. Cluster Bushing Rear  
46. Speedometer Cable  
47. Speedometer Pinion  
48. Speedometer Cable screw  
49. Filler Plug  
50. Selector Lever Outer  
51. Selector Shaft Nut  
52. Rail Lock Ball (2 places)  
53. Rail Lock Spring Low and Reverse  
54. Cover Screw  
55. Transmission Cover  
56. Cover Gasket  
57. Low and Reverse Shift Rail  
58. Bushing Set Screw  
59. Shift Selector Lever  
60. Shift Rail Interlock  
61. Selector Shaft Bushing  
62. Breather  
63. High and Second Shift Rail  
64. High and Second Ball Spring  
65. Clutch Throw Out Lever  
66. High and Second Rail Stop Screw  
67. Low and Reverse Shifter  
68. Low and Reverse Shifter Set Screw  
69. High and Second Shift Fork  
70. Shift Lever Outer  
71. Shift Shaft Nut  
72. Shift Shaft Seal  
73. Shift Shaft  
74. Shift Shaft Pin  
75. Shifter Control Wire Bracket Screw  
76. Shift Lever, Inner  
77. Low and Reverse Fork Set Screw  
78. Low and Reverse Shift Fork Set Screw  
79. Case Stud  
80. Expansion Plug  
81. Washer Pin Rear  
82. Counter Shaft Lock Plate  
83. Lock Plate Screw  
84. Idler Gear Bushing  
85. Idler Gear Shaft  
86. Reverse Idler Gear
LUBRICATION

When transmission and gears are free of all lubricant, 2-1/4 pints are required to bring level up to full. When drained and refilled, 2 pints are required. The correct lubricant is an S.A.E. 90 E.P. for summer or temperatures above 32°F. and an S.A.E. 80 E.P. for winter--or temperatures below 32°F.

TRANSMISSION REMOVAL FROM CAR

1. Remove front seat cushion, and remove the four bolts attaching the bottom of front seat frame to seat track. Remove two screws attaching seat adjusting lever to seat frame and remove seat back from car.
2. Disconnect accelerator pedal at accelerator rod and remove foot brake pedal rod from brake lever.
3. Pull the steering column hole rubber grommet up out of the way and remove the floor mat.
4. Remove Hudson Weather Control blower unit held by 4 screws (2 each side). Remove Bowden wire at weather control valve at cylinder head and remove the floor opening cover over the transmission.
5. Disconnect the front universal joint at transmission. Remove screws attaching center bearing support bracket and move propeller shaft rearward to clear transmission companion flange.

NOTE: Use a "C" Clamp or rubber band to hold needle bearings in position.

6. Disconnect the clutch pedal lever return spring and remove the two clutch cross shaft bracket.
7. Remove the clutch control link clevis pin and unhook clevis.
8. Remove shifter shaft outer lever, nut and washer; this will disconnect the linkage connecting the Gear Shift to the transmission.
9. Remove 2 screws and remove flywheel guard from bottom of clutch housing and remove the two engine rear mounting bolts and nuts at #3 crossmember.
10. Jack up rear end of engine about 1/2" off the frame.

CAUTION: Place a block of wood under head of jack to prevent damage to the oil pan.

11. Disconnect speedometer cable at transmission and install wood plug.
12. Remove the two top screws holding clutch housing to engine and plate and install two headless screws or studs to support the transmission until the balance of the screws are removed.
13. Remove breather pipe bracket from clutch housing and bolt attaching breather pipe and rear tappet cover.
14. Pull transmission and clutch housing back towards the rear and up through the floor opening. Hoist J-1502 will be helpful in handling the assembly.

DISASSEMBLY OF TRANSMISSION

NOTE: Refer to the Overdrive Section for removal of overdrive unit on cars so equipped. Unless otherwise specified, all reference numbers in text are illustrated in Figures 1 and 2.

1. Remove the six screws that hold clutch housing to the transmission case and detach the clutch housing and attached clutch throwout shaft, yoke, sleeve and bearing assembly from the transmission.

2. Remove drain plug at bottom of case and drain lubricant. Place case assembly in Holding Fixture J-1584 and bolt securely at front end of case with two clutch housing cap screws, Figure 3.

FIGURE 3
3. Remove governor at speedometer gear housing on cars equipped with Over-drive, Drive Master or Vacumotive Drive.

4. Remove universal joint companion flange nut and companion flange from mainshaft.

**DO NOT HAMMER:** Use Universal Joint Companion Flange Puller, Tool No. J-820, to remove a tight flange from mainshaft, Figure 3.

5. Remove four screws and lockwashers and lift transmission cover off cautiously to prevent the shift rail lock spring from jumping out. Remove the spring and lock ball.

6. Flush out and thoroughly clean inside of case and gears.

7. Remove speedometer gear housing cap screws and speedometer gear housing using care to prevent damaging the housing oil seal. Remove the speedometer drive gear.

8. Remove 2nd and high shift rail stop screw.

9. Remove lock screw from low speed shifter fork and lock screw from the low speed shifter, Figure 4.

**NOTE:** To remove these special self-locking screws, use a screw-driver having a straight blade or a blade with a slightly reverse taper that will enter to bottom of screw slot. "DO NOT USE A TAPERED BLADE SCREW DRIVER."

10. Slide low and reverse shift rail out of front of case, then remove shift fork and shifter, also the shift rail interlock.

11. Remove the set screw from 2nd and high shift fork, then slide the shift rail out of front of case. Remove the lock ball and spring from

12. Remove screw and countershaft and reverse idler gear shaft lock plate, Figure 5.

13. Drive countershaft out of rear end of case with Bronze Driver J-1574, Figure 6. Countershaft gear can now be lowered to bottom of case.
14. Pull main shaft rearward by hand far enough to provide clearance for bearing puller jaws behind bearing or bearing retainer snap ring. If shaft does not move rearward easily, temporarily reinstall the companion flange and with a soft hammer tap the flange carefully rearward until above clearance is obtained.

15. Pull bearing from main shaft with puller J-1134-H, Figure 7.

16. Pull main shaft rearward and main drive gear forward until main shaft is fully withdrawn from needle roller pilot bearing in rear end of main drive gear. Move synchronizer shift sleeve into 2nd speed position and low reverse sliding gear as far rearward as it will go, then lift main shaft assembly out through cover opening in case, Figure 8.

   a. Disassemble main shaft assembly on the bench by first sliding the low reverse gear off the shaft.

   b. Remove shift sleeve hub lock ring with special pliers, KMO-630, Figure 9.

17. Pull main drive gear forward far enough to clear bearing retainer snap ring. Remove snap ring, then bump the drive gear forward and lift out through cover opening in case.

   a. To remove the bearing from main drive gear, remove the main drive gear lock ring, Figure 10.
b: Remove main drive gear bearing using Puller J-1134-H with cup type, adaptor on puller screw, Figure 11.

18. Remove shift shaft inner lever.

19. Remove countershaft gear cluster, one thick steel thrust washer, and two bronze thrust washers through cover opening, Figure 12.

20. Working through mainshaft bearing hole in front face of case drive-out reverse idler gear shaft with Driver J-1574, Figure 13. When shaft is driven all the way out, lift reverse idler gear from case.

21. Remove shift selector shaft nut and washers, lift off selector outer lever.

22. Remove shift selector shaft set screw, Figure 14.
23. Remove shift selector shaft from inside of case. Remove steel bushing by pulling upward, Figure 15.

24. Remove shift shaft outer lever after removing nut and washers.

25. Remove shift shaft tapered pin, Figure 16, with pin punch and then withdraw shift shaft and shaft seal.

27. With retainer removed from case, insert the two seal engaging jaws of Oil Seal Remover J-1576, one at a time between metal portion of seal and retainer. Place the drift (part of remover set) between the jaws and drive out seal assembly, Figure 18.

28. Install new oil seal by pressing into place with tool J-1569, Figure 19.

REPLACING MAIN DRIVE GEAR OIL SEAL

26. Remove main drive gear bearing retainer by bumping it rearward out of housing, Figure 17.

INSPECTION AND REPAIR TRANSMISSION CASE BREATHER

When transmission has been completely disassembled, always wash and blow out the interior free from any grit or metallic particles. Carefully
inspect particles. Carefully inspect the breather for being open, clean and the top sufficiently loose so that it may be rotated. The breather must be installed so that the holes in the side of the body are fore and aft, and extend entirely through the top wall of the case, as shown in the illustration below, Figure 20.

![Figure 20](image)

**FIGURE 20**

**COVER BAFFLE:**

The baffle plate welded to the transmission cover should be so arranged as to almost touch the case boss when cover screws are installed. Bend baffle to obtain this position.

**TRANSMISSION BALL BEARINGS:**

DO NOT place bearings where dirt is liable to mix with the lubricant in the bearing.

Bearings should be washed in clean gasoline or kerosene. DO NOT SPIN the bearings and particularly do not spin bearings with an air hose. Spinning a bearing at high speeds will almost certainly do considerable damage. After washing the bearings, blow them out with clean, dry air. Direct the flow of air into the open face of the bearing while holding the inner race and slowly rotate the outer race by hand. DO NOT ALLOW the air to spin the bearing.

a. Inspect the bearings for cracks, chipped balls, race and cone.

b. Lubricate the bearing with clean, new engine oil, rotating the bearings by hand in order to spread the lubricant over all surfaces.

Transmission mainshaft bearings are built originally with end play and because they may feel quite loose, it does not necessarily indicate that they are worn and unfit for use.

**COUNTERSHAFT GEAR CLUSTER ASSEMBLY:**

Inspect all gears on cluster for damaged teeth. Remove any and all raised edges from teeth surfaces by hand stoning. Recommended diametrical clearance between countershaft and bore of cluster bushing is .001" to .0025". Replace bushings if clearance is greater than .005". Bushings can be removed with any suitable arbor press and driver.

Should a new cluster gear be installed, be sure that large gear (at driven end) has 26 teeth which is of the correct ratio and matches the 17 tooth Main Drive Gear.

To replace cluster bushings, place both bushings in position in the gear cluster, being sure that the annular groove in each bushing is nearest the adjacent end of shaft. Install with Bushing Replacer J-1572, Figure 20, and turn until both bushings are drawn into gear toe within .015" beyond each end of gear thrust face.

Insert loose pilot guide of Reamer KMO-338 in one end of gear cluster and ream bushing to .865", Figure 22. Insert removable pilot inbore of reamed bushings and ream remaining bushing from opposite end of gear.
REVERSE IDLER GEAR:

Recommended diametrical clearance between idler shaft and bore of idler gear bushings is .001" to .0025". Replace bushing if clearance is in excess of .005".

Start new bushing into gear bore, then pull bushing into position with Bushing Replacer J-1572. Ream bushing to .865" using Reamer KMO-338 with pilot, Figure 23.

SELECTOR AND SHIFT SHAFTS

Recommended clearance between selector shaft and bushing is .001" to .0035", but clearance of twice this amount if not accompanied by oil leakage is permissible.

If a new shift shaft seal is installed, make sure that it does not interfere with rotation of the shift shaft.

SPEEDOMETER GEAR HOUSING SEAL

If the seal is hard, cracked, or glazed or if signs of oil leakage are apparent at disassembly, install a new seal.

REASSEMBLY OF TRANSMISSION

SELECTOR AND SHIFT SHAFT LEVERS

1. Make sure the transmission case is thoroughly clean inside and outside.

2. From inside the case, install the shift selector shaft bushing. Apply a few drops of oil on shaft, then insert the shaft in the bushing. Install set screw.

3. Place outer selector lever in position (pointing toward left of case), install plain washer, shakeproof washer and nut and tighten securely.

4. Apply a few drops of oil to shift-shaft, then insert shaft in case and lock in position with shift-shaft pin, Figure 15. Install the rubber sealing washer, outer shift lever, plain washer, shakeproof washer, and nut and tighten securely. If more than a slight drag is felt when rotating shaft, check oil seal for interference.

5. Install shift shaft inner lever on the splined shift shaft with the lever in straight up position.

REVERSE IDLER GEAR AND GEAR CLUSTER

Place reverse idler gear in position inside of case after applying a few drops of oil to gear bushing. Insert one end of idler shaft with countershaft lock plate into slot in shaft. Sight through hole in lock plate and when same is centered over hole for lock screw, start reverse idler shaft into hole in case. Holding shaft in this position, bump shaft into case. When shaft is well started, apply a coat of red lead or other suitable sealer to exposed portion of shaft and drive shaft into final position with a soft hammer.

Coat the two thin countershaft gear cluster thrust washers with viscous grease, then install these washers on the retaining pins and install in case with the bronze surface of washer.
towards gear thrust face.

Install steel washer on rear face of cluster gear with lug on washer engaging slot in end of cluster gear. Apply light oil to bushings in cluster gear. Then place cluster gear and steel washer unit into transmission case, being careful not to dislodge the thrust washers.

NOTE: Replace scored or worn washers in order to maintain proper clearance.

DO NOT install the countershaft at this time.

MAIN DRIVE GEAR:

Install bearing to main drive gear using Bearing Replacer J-1570. Note position of retainer ring groove. DO NOT INSTALL RETAINER RING AT THIS TIME.

Insert gear and bearing assembly through cover opening into front opening of case far enough to expose the ring retainer groove, then install the snap ring into groove.

Apply a coating of viscous grease to recess in end of main drive gear and insert the 16 individual rollers comprising the pilot bearing.

If necessary to replace the stop ring proceed as follows:
1. Straighten the eight locking ears of the stop ring.
2. Remove lock ring and ring center (die case).
3. Insert the new stop ring and ring centers and turn ring center in the stop ring 1/4 turn to line up recesses in the ring center with the 8 locking ears on the stop ring.
4. Install wire lock ring and bend all locking ears in recesses as shown in the preceding illustration.

NOTE: Use a small drift and a light hammer for this operation.

MAIN SHAFT ASSEMBLY:

1. Install the low reverse gear to main shaft splines with oil holes in gear registered over shaft spline oil channels. Shift fork flange on gear should be toward front of shaft.

NOTE: Four of the helical splines are provided with an oil channel at the front end of the splines.

2. Slide intermediate gear over front end of shaft with ground tapered hub toward front of shaft.

ASSEMBLY OF SYNCHRONIZER:

1. Place the 3 synchronizer shift plates in the shift sleeve hub. Install the two synchronizer springs so that one end of each spring rests in the same groove of shift plate with the free ends running in opposite directions, Figure 25.

2. Assemble the synchronizer hub, plates and springs into shift sleeve.

NOTE: Undercut on hub and shifter fork groove in sleeve should point toward rear of transmission.
Assemble the two bronze synchronizer rings to the shift sleeve hub with the 3 plate end slots engaging the shift plates.

6. Install the synchronizer unit on the main shaft with the tapered side of the shift sleeve toward the front of the transmission.

7. Install synchronizer shift sleeve hub lock ring on end of main shaft using Pliers, T-1575. USE A NEW LOCK RING. The lock ring is available in only one thickness .087" and must be carefully fitted into shaft groove to eliminate all end play.

8. Move the synchronizer shift sleeve towards rear of main shaft (2nd gear position), then carefully insert mainshaft and gears assembly through cover opening of case with threaded end of main shaft towards rear of case. Carefully enter the front end of main shaft into pilot bearing mounted in end of main drive gear.

9. Install the speedometer gear housing over the main shaft bearing and with 3 bolts 1/2" longer than the standard bolts removed, draw the bearing on the shaft carefully with even pressure until speedometer gear housing contacts the transmission case. Remove the speedometer gear housing.

10. Install the speedometer drive gear to rear end of main shaft.

11. Install speedometer gear housing assembly and new gasket to end of case.

12. Install the companion flange being careful to prevent injury to the oil seal. Install plain washer and self-locking nut. Tighten to 90-100 foot pounds using a torque wrench. THIS NUT MUST BE KEPT TIGHT.

COUNTERSHAFT

Insert Countershaft Driver J-1574 into countershaft cluster gear through hole in front end of case. Raise cluster gear up into align-

SHIFTER RAILS AND FORKS

1. Install the shift rail lock ball spring and lock ball into hole in case.

<table>
<thead>
<tr>
<th></th>
<th>LOW AND REVERSE RAIL</th>
<th>2ND AND HIGH RAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>STANDARD TRANSMISSION</td>
<td>9 lbs.</td>
<td>9 lbs.</td>
</tr>
<tr>
<td>WITH OVERDRIVE</td>
<td>30 lbs.</td>
<td>19 lbs.</td>
</tr>
<tr>
<td>WITH HDM</td>
<td>19 lbs.</td>
<td>19 lbs.</td>
</tr>
<tr>
<td>WITH OVERDRIVE AND HDM</td>
<td>30 lbs.</td>
<td>19 lbs.</td>
</tr>
</tbody>
</table>

NOTE: Low and Reverse and Second and High lock ball springs are of equal tension with standard transmission. The above chart should be referred to for Overdrive and HDM as these transmissions are equipped with heavier springs in both Low and Reverse and Second and High shift rails.
2. Place second and high shift fork in groove of synchronizer shift sleeve and while holding the fork in this position, insert the shift rail into case through hole in fork. Figure 27.

Install and tighten slotted set screw using a straight blade screwdriver. Install rail stop screw and lock washer.

NOTE: The rail stop screw must not bottom on shift rail.

CAUTION: Make sure at this time that the previously installed inner shift shaft lever is correctly positioned. Inner shift lever and milled end of shift shaft should be in a true vertical position.

3. Install shift rail interlock plunger.

4. Start the low and reverse shift rail into transmission case. Install low and reverse shifter in position and slide shift rail into shifter, Figure 28.

5. Place low and reverse shift fork in groove of low and reverse sliding gear and slide shift rail through hole in fork and into hole at end of case.

6. Install slotted head lock screw into shifter and tighten securely. Follow the same procedure on shift fork and lock screw.

7. Shift transmission into all 4 gear positions successively and also into neutral. If operation is satisfactory install the remaining shift rail lock ball and lock spring.

8. Install transmission cover using a new gasket.

FIGURE 27

FIGURE 28

INSTALLING TRANSMISSION

1. Install two headless screws or studs in engine end plate to assist in supporting the transmission at installation.

NOTE: Before installing transmission to engine rear support plate, check cylinder block rear support plate very carefully for tightness and alignment. This is especially important in cases where the car has been subject to chronic transmission trouble, noisy and jumping out of gear. Make a similar check of transmission clutch bell housing.

In lieu of highly precise equipment, use a steel straightedge to check steel rear support plate and a surface plate or other flat surface to check the front face of clutch bell housing. Both units should be flat and in plane within .005".

Be sure to check position of clutch driving plate and see that it is perfectly centralized within the clutch assembly. This can be done by using the J-449 aligning arbor or with a standard main drive gear if arbor is not available. If this precaution is not taken, difficulty will be encountered when installing the transmission and the front end of the...
gear shaft and pilot bearing in the flywheel will be damaged.

2. Rotate clutch collar and throwout bearing to position for proper alignment with throw-out yoke on transmission.

3. Tighten all rear engine support plate to block screws.

4. Bring the transmission assembly to position where the main drive gear (clutch shaft) is aligned with bore of clutch throwout collar, then carefully push transmission forward to enter drive gear splined shaft through grease retainer leather washer, splines of clutch driving plate and into pilot bearing in flywheel.

NOTE: During this operation the main drive gear must be relieved of all over hanging weight of the transmission until the bell housing engages the dowels on engine rear support plate. Before transmission assembly is moved up against rear support plate make a last inspection to verify that end face of throwout collar in clutch is properly aligned with throwout yoke on transmission and that oil seal lip has not turned under.

CAUTION: Alignment of bell housing with engine is controlled by the sleeve dowel in the upper left location of the bell housing attaching bolt circle and by the dowel bolt at the lower right location viewed from rear of car. Make sure that the former is in place and entered in bell housing hole before tightening bolts. Install lower right bolt (dowel bolt) first. NEVER grind or otherwise reduce the diameter of the dowel bolt to facilitate installation.

5. Remove the two headless screws or guide studs, J-2969.

6. Install remaining clutch bell housing bolts and screws and tighten with a torque wrench to 40-45 foot pounds.

7. Complete remainder of installation by reversing the order of removal of the remaining parts.

TROUBLE SHOOTING
SERVICING THE TRANSMISSION
JUMPING OUT OF GEAR

Jumping out of gear is likely to be caused by one of the following conditions:

1. Misalignment of the transmission with the engine (chips, dirt, buckled gasket) between the clutch bell housing and transmission may cause jumping out of high gear.

2. Engine mountings improperly adjusted may cause jumping out of high gear.

3. Mainshaft or countershaft end play is excessive, might cause jumping out of high or second.

4. Synchronizing unit worn or damaged.

5. Loose fitting bearings or bushings.

6. Failure to move gearshift lever far enough to complete engagement.

7. Low and reverse shift rail lock ball spring lacks sufficient tension (should have 19 pound load) at 11/16” for standard transmission and 30 pounds at 13/16” with Overdrive.

NOTE: If transmission has jumped out of gear many times while under load, it may be necessary to replace the mating gears because the gear teeth may have become beveled.

NOISE IN GEAR

Misalignment of transmission
Worn, scored countershaft bushings
Worn, rough reverse idler gear
Eccentric countershaft gear assembly
Sprung or worn countershaft
Excessive backlash in constant mesh gear
Excessive end play in countershaft or reverse idler gear
Worn mainshaft pilot bearing
Scuffed gear tooth contact surface
Insufficient lubrication
Incorrect grade of lubricant
Worn, rough mainshaft rear bearing  Sliding
gear teeth rough, chipped, tapered  Excessive
second speed mainshaft end play  Noisy
speedometer gears

Noise may occur in neutral or in any one or
more speeds. Some gear noise is to be expected
in all except high speed. Trace the gears that are
under load and examine them for damage,
checking the bearings and amount of end play.
Noise in neutral or the from of a constant regular
click indicates a nicked gear of faulty bearing.

End play on countershaft to be not less than
.006" nor more than .016". If a check shows end
play of more than .016" it indicates worn thrust
washers that should be replaced. End play on
mainshaft intermediate gear and synchronizer
shift sleeve to be from .003" to .006" and if more
than .016" it indicates a worn synchronizer shift
tooth hub lock ring that needs replacing. End
play on the reverse idler gear is from .003" to
.010" and any end play in excess of .010" re-
quires replacement of gear.

OTHER NOISE CAUSES
Out-of-balance fan
Defective torsional damper
Out-of-balance flywheel
Unbalanced clutch assembly
Loose transmission mounting
Loose engine mountings
Worn universal joints
U-joints improperly installed
Misaligned or sprung propeller shaft
Incorrect driveshaft assembly

STICKING IN GEAR
Improperly operating clutch
Insufficient chamfer of sliding gear teeth
Sliding gear tight on mainshaft splines
Misaligned mainshaft
Improper linkage adjustment

SLIPPING OUT OF FIRST GEAR
First and reverse sliding gear loose on main-
shaft splines
Sliding gear teeth worn or tapered
Worn, misaligned mainshaft splines
Worn countershaft first speed gear

Excessive end play of reverse idler In-
sufficient gear mesh
Too much chamfer on shift rail ball notch
Improper linkage adjustment

LOSS OF LUBRICANT

Lubricant level too high
Damaged or improperly installed gaskets
Damaged or defective oil seals
Loose drain plug, transmission cover
Cracked transmission housing
Use of excessively foaming lubricant
Stopped up transmission breather
Worn mainshaft bearings

HARD SHIFTING
Improperly operating clutch Sliding
gear tight on shaft splines
Insufficient chamfer of sliding gear teeth
Burred mainshaft splines
Misaligned mainshaft
Damaged synchronizing unit
Worn shifter rails
Worn or sprung shifter fork
Improper adjustment of shifting linkage

Difficult gear shifting, especially into second
gear, is often caused by the improper adjustment
of the cross-shift control wire or by looseness of
the cable anchor clip which secures it to the bell
housing. This results in insufficient movement
being imparted to the transmission inner shift
lever to allow it to fully engage the shift
forks. In cases of hard shifting the "Gear Shift"
lever and cross shift control cable should be
adjusted if necessary as follows:

A. Place "Gear Shift" Control Lever, Figure 29
in the extreme upper position.

B. Loosen control wire casing anchor bracket
bolt. Pull upper anchor bracket (18) up until
all slack is out of casing and the shift shaft
inner lever is fully over into the low and reverse
shifter. (Check this in transmission). Tighten
anchor bracket bolt (35) Figure 30. The control
wire anchor should have clearance at top and
bottom.
<table>
<thead>
<tr>
<th>Number</th>
<th>Component Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control lever</td>
</tr>
<tr>
<td>2</td>
<td>Control lever knob</td>
</tr>
<tr>
<td>3</td>
<td>Control lever anti-rattle washer</td>
</tr>
<tr>
<td>4</td>
<td>Control lever fulcrum screw</td>
</tr>
<tr>
<td>5</td>
<td>Control lever fulcrum bracket</td>
</tr>
<tr>
<td>6</td>
<td>Control lever fulcrum bracket ring</td>
</tr>
<tr>
<td>7</td>
<td>Lever tube and fulcrum bracket</td>
</tr>
<tr>
<td>8</td>
<td>Control lever compression spring</td>
</tr>
<tr>
<td>9</td>
<td>Compression spring seat</td>
</tr>
<tr>
<td>10</td>
<td>Control lever tube bracket - upper</td>
</tr>
<tr>
<td>11</td>
<td>Control lever tube bracket - lower</td>
</tr>
<tr>
<td>12</td>
<td>Control lever push rod</td>
</tr>
<tr>
<td>13</td>
<td>Push rod end - upper</td>
</tr>
<tr>
<td>14</td>
<td>Push rod end - lower</td>
</tr>
<tr>
<td>15</td>
<td>Push rod upper compression spring</td>
</tr>
<tr>
<td>16</td>
<td>Push rod spring seat</td>
</tr>
<tr>
<td>17</td>
<td>Control wire, casing and bracket</td>
</tr>
<tr>
<td>18</td>
<td>Control wire anchor bracket - upper</td>
</tr>
<tr>
<td>19</td>
<td>Control wire anchor bracket - lower</td>
</tr>
<tr>
<td>20</td>
<td>Control wire dust boot (steering end)</td>
</tr>
<tr>
<td>21</td>
<td>Control wire dust boot (trans. end)</td>
</tr>
<tr>
<td>22</td>
<td>Control wire anchor</td>
</tr>
<tr>
<td>23</td>
<td>Control wire anchor hairpin clip</td>
</tr>
<tr>
<td>24</td>
<td>Transmission shift shalt outer lever</td>
</tr>
<tr>
<td>25</td>
<td>Shift shaft outer lever pin</td>
</tr>
<tr>
<td>26</td>
<td>Trans. shift selector lever, outer</td>
</tr>
<tr>
<td>27</td>
<td>Trans. lever to bell crank rod</td>
</tr>
<tr>
<td>28</td>
<td>Bell crank rod grommet</td>
</tr>
<tr>
<td>29</td>
<td>Bell crank rod washer</td>
</tr>
<tr>
<td>30</td>
<td>Bell crank rod clevis</td>
</tr>
<tr>
<td>31</td>
<td>Control tube upper bracket set screw</td>
</tr>
<tr>
<td>32</td>
<td>Bell crank rod locknut</td>
</tr>
<tr>
<td>33</td>
<td>Push rod end key</td>
</tr>
<tr>
<td>34</td>
<td>Push rod lower compression spring</td>
</tr>
<tr>
<td>35</td>
<td>Control wire anchor clamp bolt</td>
</tr>
<tr>
<td>36</td>
<td>Control tube upper bracket clamp bolt</td>
</tr>
<tr>
<td>37</td>
<td>Steering jacket tube clamp</td>
</tr>
<tr>
<td>38</td>
<td>Control lever to bell crank rod</td>
</tr>
<tr>
<td>39</td>
<td>Control crank (at steering gear)</td>
</tr>
<tr>
<td>40</td>
<td>Jacket tube lower clamp</td>
</tr>
</tbody>
</table>
NOTE: Check shift selector lever (26) Figure 30 to which cross shift control wire is attached, to be sure the lever is tight on its shaft. Check bracket (19) to be sure it is tight on the transmission case.

Increased viscosity of the transmission lubricant during cold weather is another factor to be considered when dealing with hard shifting, as the thickening of the lubricant is apt to interfere with the action of the synchronizing mechanism.

During cold weather operating, it is recommended that the lubricant be thinned by the addition of kerosene when hard shifting is encountered. Add approximately 2 ounces of kerosene after draining a like quantity of lubricant.

C. The "Gear Shift" control should be inspected and if the gear control lever (1) Figure 30, is not in a true crosswise position when in neutral, it should be adjusted by removing the cotter pin and clevis pin at the front end of the control tube to transmission rod (27). Loosen lock nut (32) and turn clevis (30) in the rod. When properly adjusted (transmission in neutral and Handy Shift control lever exactly crosswise), the clevis pin hole in the clevis (30) will line up with the hole in lever (39).

GEAR SHIFT

The gear shifting mechanism is operated from a control lever pivoted in a housing attached to the steering gear jacket tube just below the steering wheel.

The backward and forward movement of the gearshift lever (1) Figure 30 imparts a rotary motion to the tube and lever (7). This rotary motion moves the control lever to bell crank rod (38), bell crank to shift shaft outer lever rod (27) and outer shift shaft lever (24) back and forth. The lever (24) is attached to the transmission shift shaft, an inner lever mounted on the shift shaft moves the gear into the desired positions.

ADJUSTMENT

Place the gear shift lever (1) in neutral position, remove the cotter pin and clevis pin from rod (27) at bell crank (39).

The transmission shift lever (24) and the gear shift lever (1) must be in the neutral position. Loosen rod lock nut (32) on rod (27) and turn clevis (30) in or out until the clevis pin will drop into bell crank hole (39).

GEAR SHIFT LEVER TUBE AND FULCRUM BRACKET

REMOVAL

1. Remove horn ring and steering wheel. See Steering Gear Section.

1. Raise carpet sufficiently to clear area of steering gear.

1. Remove steering gear floor opening metal and rubber dust cover.

1. Remove set screw (31) and clamp bolt (36) and remove gear shift upper bracket from jacket tube.

NOTE: Check condition of lever fulcrum bracket spacer ring and replace if less than .025 thick.

2. Remove retainer plate at instrument panel.

2. Remove steering jacket tube clamp (37) at instrument panel.

7. Remove hair pin clip (23) attaching gear shift control cable (17) to lever (7) and remove cable anchor bracket clamp bolt (35).

NOTE: When-re-installing bracket (18) and cable (17) to lever tube bracket (7) the gear shift lever (1) must be in the extreme up position, (between the low and reverse positions). Pull bracket (5) and tube (7) upward until all slack is out of the casing and control wire and that the shift lever at the transmission is completely over to the low and reverse side. (To be checked at transmission). Before tightening bolt (35) assure that anchor (22) in control wire (17) has clearance at the top and bottom of travel.
8. Disconnect rod (38) at control lever (7).
9. Remove spring (8) and flat washer (9).
9. Control tube can now be removed.

NOTE: If Steering Gear Jacket Tube is to be removed with control tube attached proceed as follows:

a. Loosen steering gear housing mounting bolts to allow steering gear to drop sufficiently to allow clearance for jacket tube removal.

b. Loosen jacket tube clamp (40) at steering gear housing and lift jacket tube by swinging the lever up and to the right and out through opening at floor cover.

To Install, reverse procedure of removal.

**GEAR SHIFT CONTROL LEVER PUSH ROD**

**REMOVAL**

1. Remove steering wheel.
2. Remove upper bracket (5) and ring (6).
3. Remove gear shift lever fulcrum screw (4), lever (1), and anti-rattle spring washer (9).
4. Remove hairpin clip anchor (22) at lower end of control tube and disconnect cable (17).
5. Remove bolt (35) attaching anchor bracket to lower support bracket.
6. Pull lower push rod end (14) down far enough to remove the key attaching push rod (12) to push rod end (13).
7. Remove push rod upper end (13).
8. Remove upper compression spring (15) and seat (16) with a wire hook.

**INSTALLATION**

Install the upper compression spring seat (16) and spring (15) on the push rod (12) and install in control tube (17).

NOTE: Apply a coat of viscous chassis lubricant to the push rod ends when assembling them in the control tube.

Reverse procedure of removal on remaining parts.
SECTION 9
DRIVE-MASTER

DRIVE-MASTER OPERATION

Models 4A and 5A equipped with Drive-Master have the same controls as the conventional car and can be driven in exactly the same manner. The owner has the choice of either automatic or manual shifting. Pushing the instrument panel switch "HDM" button in provides automatic clutch operation and automatic gear shifting in second and high gear. If the car owner desires to shift gears manually he merely presses the "OFF" button on the instrument panel switch and the car immediately reverts back to conventional drive.

TO START engine, turn on ignition switch depress the clutch pedal and press the instrument panel starter control button.

TO START the car moving place the gear shift lever in high gear position, depress the accelerator pedal and the car will move forward in pick-up gear (second gear). When the car has reached the speed at which the driver desires to shift into high gear, he simply releases the accelerator pedal momentarily and the shift is made quickly and automatically into high gear. When coming to a stop, the transmission is automatically shifted from high to pick-up gear and the car is ready to move as soon as the accelerator is depressed.

DRIVE-MASTER UNITS

Drive-Master comprises the following units:

- Instrument Panel Control Switch
- Clutch Control Unit and Throttle Lock
- Accelerator Switch
- Transmission Shift Rail Switch
- Transmission Power Shift Unit
- Governor Switch
- Transmission Control Switch

INSTRUMENT PANEL CONTROL SWITCH

The instrument panel control switch, Figure 1, mounted in the center of the instrument panel controls Drive-Master operation.

FIGURE 1

A 15 ampere fuse enclosed in a round fuse holder, located in the wiring circuit 6" from the control switch protects the Drive-Master units.

CLUTCH CONTROL UNIT

The clutch power unit, Figure 3, is mounted on the left side at the top of the engine. A vacuum line connects to the engine intake manifold to provide the power for operation.

The power is transmitted from the vacuum cylinder piston through a rod direct to the clutch throwout yoke shaft, so that the clutch is disengaged when the piston is moved forward. When the piston moves toward the rear, the clutch is engaged.

The movement of the piston is controlled through linkage by the power unit valve to the accelerator pedal.

When the accelerator pedal is depressed, the valve is moved to equalize the pressure on both sides of the piston and the clutch is engaged by the pressure of the clutch springs on the pressure plate.

When the accelerator is in its released position, full manifold vacuum is obtained on the front of the power cylinder piston and atmospheric pressure on the rear of the piston moves it forward and the clutch is disengaged.
1. Power Unit Air Intake Pipe Assy.
2. Power Unit Vacuum Pipe Assy.
3. Power Unit Mounting Bracket Studs
4. Clutch Unit Bellcrank Bracket Assy.
5. Accelerator Switch to Cross Shaft Rod
6. Power Unit to Air Cleaner Pipe Assy.
7. Accelerator Switch
8. Clutch Power Cylinder Tension Spring
9. Clutch Power Unit Mounting Bracket
10. Clutch Unit Compensator Trip Lever
11. Clutch Unit Compensator Trip Lever Spring
12. Clutch Unit Solenoid Valve Assy.
15. Clutch Power Unit Solenoid Gasket
17. Clutch Power Unit Cylinder Assembly
18. Throttle Lock Diaphragm Cylinder Assy.
19. Throttle Lock Solenoid to Diaphragm Tube Assy.
20. Clutch Unit Compensator Trip Lever Shaft
21. Clutch Power Unit Piston Rod Guard
22. Clutch Power Unit Piston Rod Assy.
23. Clutch Unit Piston Rod Pivot Bolt
24. Clutch Unit Piston Valve and Rod Link Pin
25. Clutch Unit Piston Valve and Rod Link
26. Clutch Unit Piston Valve and Rod Assy.
27. Clutch Power Unit Valve Lever Eccentric Bushing
28. Clutch Unit Bellcrank and Compensator Assy.
29. Valve Lever Cam
30. Bellcrank to Clutch Coupling Lever Rod
31. Accelerator Pedal to Bellcrank Rod Assy.
32. Threaded Sleeve Rod Swivel
33. Threaded Sleeve Rod Assy.
34. Control Lever to Bellcrank Rod Ball Joint Assy.
35. Accelerator Pedal Link Bellcrank Bracket Stop
36. Accelerator Pedal Link Bellcrank Bracket
37. Throttle Lock Diaphragm Rod Check Nut
38. Bellcrank Rod and Ball Joint Assy.
39. Valve Lever Cam Adjusting Screw Nut
40. Transfer Diaphragm Solenoids
41. Solenoids to Power Cylinder Tube Assy.
42. Power Cylinder Assembly
43. Transfer Diaphragm Assembly
44. Power Cylinder Mounting Stud, Nut, Spacer and Ferrule
45. Power Cylinder Piston Guard
46. Transfer Diaphragm and Rod Assy.
47. Transfer Rod Lock Nut
48. Transfer Diaphragm Engaging Rod Assy.
49. Transmission Control Switch Assy.
50. Selector Switch Lever
51. Neutral and Limit Switch Rod Assy.
52. Power Unit Mounting Bracket Assy.
53. Transfer Rod Ball Joint
54. Transfer Key
55. Neutral and Limit Switch Rod Lock Nut
56. Neutral and Limit Switch Trunnion Block
57. Neutral and Limit Switch Rod Lock Nut
58. Shift Shaft Transfer Key, Hub Assy.
59. Shift Shaft (Hand Shift) Lever Assy.
60. Shift Rod to Power Shift Lever Pin
61. Transmission Shift Rod Assembly
62. Accelerator Cross Shaft Operating Rod
63. Valve Lever Cam Adjusting Screw
64. Bellcrank to Shift Shaft Lever Rod
65. Off-On Switch Operating Rod
66. Accelerator Pedal Link Bellcrank Bracket Shaft
67. Throttle Lock Diaphragm Rod Swivel
68. Cross-Over Switch Rod Clip
69. Hand Shift Bell Crank Support
70. Throttle Lock Cable Lock Nut
71. Hand Shift Bellcrank
72. Cross-Over Switch Rod
73. Shift Rail Switch
74. Governor Switch
THROTTLE LOCK

The throttle lock, Figure 3, consists of a vacuum operated diaphragm connected to the accelerator linkage through a cable.

Vacuum in the cylinder actuates the diaphragm which pulls up on the cable closing the throttle and holding the accelerator switch against its stop even if the accelerator pedal is pushed to the wide open position, preventing gear clash while the transmission shift is being made.

A solenoid mounted beside the clutch control unit solenoid and connected to it controls the vacuum to the throttle lock.

ACCELERATOR SWITCH

The accelerator switch, Figure 4, used in junction with the Clutch Control Unit prevents engine racing when shifting into high.

TRANSMISSION SHIFT RAIL SWITCH

The shift rail switch, Figure 5, permits automatic clutch operation in low, second or reverse gears regardless of car speeds.
The transmission power shifting unit, Figure 6, is made up of the transfer diaphragm cylinder, power shift cylinder and solenoid valves.

**TRANSFER DIAPHRAGM, POWER SHIFT CYLINDER AND SOLENOIDS:**

The solenoid selector valves control the transfer diaphragm and the movement of the piston in the power shift cylinder.

The power cylinder piston is connected to the piston rod, which in turn is connected through linkage to the shift lever mounted on the transmission. Both ends of the power shift cylinder are closed except for the vacuum lines to the solenoid control valves.

The solenoid selector valve assembly is comprised of the transfer diaphragm solenoid, a second gear solenoid and a high gear solenoid.

If the solenoid valve controlling the rear end of the cylinder is energized, the valve opens to the vacuum line and the piston moves to the rear. This movement shifts the transmission into pickup gear.

If the solenoid valve controlling the forward end of the cylinder is energized, the piston is moved forward, shifting the transmission into high gear.

**OPERATING LINKAGE AND TRANSFER KEY**

The movement for manual or power shifting is transferred to the transmission lever through a rod from the transfer key lever.
mounted on a stationary shaft at the rear of the power unit mounting bracket, Figure 7.

This shaft also carries the manual and power shifting levers, each provided with a notch for engagement with the transfer key.

Normally the transfer key is held in the manual shifting lever notch by spring pressure exerted on the transfer diaphragm rod. When the instrument panel control switch is "ON" and the gear shift lever on the high and second side, electrical connections open the solenoid valve, admitting vacuum to the transfer diaphragm cylinder, positioning the transfer key so that it engages in the notch of the power shift lever. This operation prepares the transmission for automatic or power shifting.

When the gear shift lever is moved to neutral and lifted through the "neutral gate" as required to make a shift to reverse or low, the circuit is broken to the solenoid operating the transfer diaphragm and the spring pressure behind the diaphragm positions the transfer key so that it re-engages in the manual shift lever notch. Low or reverse gear can then be shifted with the gear shift lever in the regular manner.

Returning the gearshift lever to neutral and dropping through the "neutral gate" again closes the transfer key circuit causing the key to engage the power shift lever notch. This again prepares the transmission for power shifting.

**TRANSMISSION CONTROL SWITCH ASSEMBLY**

The control switch, Figure 8, bolted to the power unit bracket on the left side of the engine, contains the mechanically operated switches used to control the Drive-Master.

The switches contained in this unit are:

- (A) Transfer Switch
- (B) Clutch Switch
- (C) Selector Switch
- (D) Neutral and Limit Switch
(A) **THE TRANSFER SWITCH**, Figure 8, is located at the top of the transmission switch and is operated by a non-adjustable link connected to the transmission cross shift selector lever.

The gear shift lever, when in neutral must return by means of its own return spring, to the second-high side when released from any position in the crossover. It must work free.

When the gear shift lever on the steering column is moved through the neutral or crossover to second high side, the transfer switch lever is moved forward closing the switch points. This completes a circuit to the solenoid of the power unit, which controls the transfer diaphragm drawing the diaphragm back and connecting the power shift lever to the transmission shift lever through the transfer key.

When the gear shift lever is again moved to the low-reverse side, the transfer switch lever moves backward, opening the switch. The diaphragm spring moves the transfer key and linkage to disconnect the power shift lever and reconnect the manual shift thus preparing it for shifting into low or reverse.

(B) **THE CLUTCH SWITCH** is located at the bottom of the transmission switch housing, it is operated by a non-adjustable link connected to the clutch throwout shaft lever. When the clutch is disengaged the clutch switch lever is moved backward.

One set of points closes to complete the circuit to the starter button.

A second set of points is closed completing the circuit to the selector, neutral and limit switches.

The clutch switch is open when the clutch is engaged, therefore, no current (except that required for the transfer diaphragm solenoid) is used when the car is being driven in any gear speed.

(C) **THE SELECTOR SWITCH** lever, Figure 9, is connected to the transmission manual shift lever by a non-adjustable rod. When the gear shift lever on the steering column is moved to second gear position, the selector switch lever closes the circuit to the power unit causing the power unit piston to move into second or pick-up gear position.

When the gear shift lever is moved to the high gear position, the selector switch lever closes the circuit to the governor, which automatically selects the pick-up (second) or high gear. When the gear shift lever is placed in neutral, the selector switch closes a circuit to the neutral switch.

(D) **THE NEUTRAL SWITCH AND LIMIT SWITCH**, Figure 10. Both neutral and limit switches are operated by the same lever. This lever is connected to the transmission power shifting lever by an adjustable rod. The neutral switch has two sets of points, both of which are open when the transmission is in neutral. When the transmission gears are in either pick-up or high gear position, one set of points is closed and the other open.
If neutral is selected on the gear shift lever and the transmission gears are in high gear position, the circuit then is from the neutral point on the selector switch to the closed points of the neutral switch and from there to the power unit solenoid which controls the shift forward to pick-up gear position. The piston then moves rearward shifting the gear out of high toward neutral. When the shift reaches the neutral position, the neutral switch points are opened and the shift stops.

**FIGURE 10**

If the transmission gears are in pickup position when neutral is selected the other set of points in the neutral switch are closed and complete the circuits to the power unit solenoid which controls forward movement of the power cylinder. As before, when the transmission reaches neutral, the neutral switch points are opened and the shift stops.

The limit switch also has two sets of points, but both are closed when the transmission is in neutral. One set of points is opened when the shift to high gear is completed and the other set of points opens when the shift to pick up gear is completed.

The limit switch completes the circuit to the throttle lock solenoid on the clutch control, thus preventing the throttle being opened until each shift is entirely completed.

**GOVERNOR SWITCH**

The governor switch is located on the rear of the transmission and is operated by the speedometer drive gear.

NOTE: There are two types of governors used in the "A" series cars identified as follows:

Figure 11 illustrates the governor used on the 4A series with Drive-Master only and all 5A Models with Drive-Master or SuperMatic Drive.

**FIGURE 11**

Figure 12 illustrates the governor used on Model 4A with Drive-Master and Overdrive (SuperMatic Drive).

**FIGURE 12**
Although different type connections are used for these two governors the wiring circuits are the same. The No. 1 blade in Figure 10 corresponds to "Y" terminal in Figure 11. No. 2 is the same as "RW", No. 3 same as "BL", No. 4 same as "B". "R" terminal is common to both governors and is used only with cars equipped with both overdrive and Drive-Master.

The governor controls circuits in the clutch control unit and in the transmission power unit.

When the gear shift lever is in the high gear position, the circuit is completed from the selector switch to the No. 1 or "Y" terminal of the governor. At speeds below 9 to 13 miles per hour the points are closed to connect No. 1 or "Y" terminal to No. 3 or "BL" terminal.

The No. 3 or "BL" terminal is connected with the transmission power unit so as to actuate the rear of the power cylinder and shifts into pick up gear.

At speeds above 9 to 13 miles per hour the No. 1 or "Y" terminal is connected to the No. 4 or "B" terminal actuating the front of the power cylinder and the transmission is shifted into high gear.

### SERVICING THE DRIVE-MASTER

In the servicing of Drive-Master any of the following units which tests prove to be faulty must be replaced in their entirety rather than to attempt internal repairs: solenoids, transmission switch, governor switch, accelerator switch, and instrument panel switch. As power for operating the clutch control unit and the power unit of the Drive-Master is obtained from engine vacuum it is very important that engine performance be checked first when servicing the Drive-Master. The vacuum gauge should read from 17 to 18 to insure proper engine performance as well as correct Drive-Master operation.

### LEAKS IN THE VACUUM LINES

Leaks in the vacuum lines will cause sluggish operation or failure of the Drive-Master.

All vacuum line fittings should be checked and hose connections given particular attention. These are as follows:

1. Between clutch power unit and intake manifold.
2. Between clutch power unit solenoids.
3. Between throttle lock solenoids and diaphragm.
4. Between transmission power unit and air cleaner.
5. Between transmission and clutch power unit.
6. Between front of power cylinder and solenoid housing.
7. Between rear of power cylinder and solenoid housing.

### ELECTRICAL CONNECTIONS

The battery should be in good condition and gravity not less than 1225.

All terminal connections should be clean and in solid contact.

The important points to be checked are as follows:

1. Connector plugs on clutch power unit.
2. Connections at accelerator switch.
3. Power unit plug.
4. Transmission control switch plug.
5. Shift rail terminal.
6. Governor switch plug.

The following checks are general but experience has shown that it is good practice to make these checks before attempting any changes or adjustments.

### TRANSMISSION SWITCH PLUG

This plug is held in place by clips, Figure 13. When replacing, be sure clips enter and engage behind the plug cover plate. The plug is released by pressing the clips together indicated by arrows.
NOTE: Be sure the boot is in place to keep water from entering the switch housing. The prongs and sockets are silver coated to eliminate corrosion.

**INSTRUMENT PANEL SWITCH**

Always determine that panel switch is on. Also check fuse and fuse holder.

**LINKAGE**

While checking power unit wires and plugs, make sure all the rods and linkage are in place and properly connected and locked by their clips.

Recheck the ball and socket joint at the transfer key. This is a specially designed joint to permit adjustment without affecting clearance of the ball in the socket, Figure 14.

Adjustment is made by loosening the lock nut and turning the threaded sleeve inward so that it has no appreciable looseness and yet works free. Lubricate this joint and the transfer key pivot with viscous chassis lubricant through the fitting on the transfer key.

The accelerator linkage and the bell crank with the torsional spring assembly must work freely and should be well lubricated.

The accelerator switch lever must return solidly against the stop when the accelerator is released, otherwise, the clutch will not release and the Drive-Master cannot work. THIS IS VERY IMPORTANT.

Before checking the operation of the clutch switch B, Figure 15, (housed in Transmission Switch Assembly) check clutch pedal lash. Clutch pedal must have $1\frac{1}{2}$ inch free play. With engine not operating, ignition switch turned on and starter button depressed, slowly push the clutch pedal down. The starter should operate before the pedal is within two inches of the toeboard.
1. Power Unit Air Intake Pipe Assy.
2. Power Unit Vacuum Pipe Assy.
3. Power Unit Mounting Bracket Studs
4. Clutch Unit Bellcrank Bracket Assy.
5. Accelerator Switch to Cross Shaft Rod
6. Power Unit to Air Cleaner Pipe Assy.
7. Accelerator Switch
8. Clutch Power Cylinder Tension Spring
9. Clutch Power Unit Mounting Bracket
10. Clutch Unit Compensator Trip Lever
11. Clutch Unit Compensator Trip Lever Spring
12. Clutch Unit Solenoid Valve Assy.
15. Clutch Power Unit Solenoid Gasket
16. Clutch Power Unit Cylinder Assy.
17. Throttle Lock Diaphragm Cylinder Assy.
18. Throttle Lock Solenoid to Diaphragm Tube Assy.
19. Clutch Unit Compensator Trip Lever Shaft
20. Clutch Power Unit Piston Rod Guard
21. Clutch Power Unit Piston Rod Assy.
22. Clutch Unit Piston Rod Pivot Bolt
23. Clutch Unit Piston Valve Rod Link Pin
24. Clutch Unit Piston Valve and Rod Link
25. Clutch Unit Piston Valve and Rod Assy.
26. Clutch Power Unit Valve Lever Eccentric Bushing
27. Clutch Unit Bellcrank and Compensator Assy.
28. Valve Lever Cam
29. Bellcrank to Clutch Coupling Lever Rod
30. Threaded Sleeve Rod Swivel
31. Threaded Sleeve Rod Assy.
32. Control Lever to Bellcrank Rod Ball Joint Assy.
33. Accelerator Pedal Link Bellcrank Bracket Stop
34. Accelerator Pedal Link Bellcrank Bracket
35. Throttle Lock Diaphragm Rod Check Nut
36. Valve Lever Cam Adjusting Screw Nut
37. Transfer Diaphragm Solenoids
38. Solenoids to Power Cylinder Tube Assy.
40. Transfer Diaphragm Assy.
41. Power Cylinder Mounting Stud, Nut, Spacer and Ferrule
42. Power Cylinder Piston Guard
43. Transfer Diaphragm and Rod Assy.
44. Transfer Rod Lock Nut
45. Transfer Diaphragm Engaging Rod Assy.
46. Transmission Control Switch Assy.
47. Selector Switch Lever
48. Neutral and Limit Switch Rod
49. Drive-Master Mounting Bracket
50. Transfer Key Ball Joint
51. Transfer Key
52. Neutral and Limit Switch Rod Lock Nut
53. Neutral and Limit Switch Trunnion Block
54. Neutral and Limit Switch Rod Lock Nut
55. Shift Shaft Transfer Key, Hub Assy.
56. Shift Shaft (Hand Shift) Lever Assy.
57. Transmission Shift Rod Assy.
58. Accelerator Cross Shaft Operating Rod
59. Valve Lever Cam Adjusting Screw
60. Bellcrank to Shift Shaft Lever Rod
61. Off-On Switch Operating Rod
62. Accelerator Pedal Link Bellcrank Bracket Shaft
63. Throttle Lock Diaphragm Rod Swivel
64. Throttle Lock Cable Lock Nut
65. Cross-Over Switch Rod
66. Shift Rail Switch
67. Governor Switch
TRANSFER SWITCH

When the gear shift lever is in neutral, the switch lever A, Figure 15, must return to the second-high side when released from any position in the cross over by means of its own return spring. If it sticks, it will cause incomplete shifting, throttle locking, engine racing, etc. The hand gear shift lever must be on the second and high side at all times to energize the transfer cylinder and hold the transfer key engaged in the power shift lever.

Check the operation by moving the gear shift lever through the neutral cross over. The key should engage in the manual lever during the upper part of the movement, and engage the power shift lever during the lower half of the movement.

ADJUSTMENTS

NOTE: Do not attempt any adjustments of the Drive-Master until the engine has reached normal operating temperature. The engine must be in proper tune and should idle smoothly at 580 to 300 RPM, when the Drive-Master instrument panel control switch is at the "on" position.

1. CLUTCH PEDAL ADJUSTMENT:

   Clutch pedal must have 1-1/2" free play.

   To adjust proceed as follows:

   A. Loosen lock nut (A) Figure 17.

   B. Remove cotter pin and clevis pin (C).

   C. Turn clevis Yoke (B) to increase or decrease length of rod for proper pedal clearance.

2. LINKAGE:

   All linkage joints must work freely; check for binding at throttle cross rods, throttle bell-crank and clutch control unit bellcrank and lubricate as necessary. Depress control switch "off" button and open throttle slightly. Release very slowly and check to see that bellcrank arm (0) comes solidly against stop (P), Figure 18.
3. ACCELERATOR PEDAL ADJUSTMENT:

All 4A and 5A models equipped with overdrive and Drive-Master have a kickdown switch mounted in the floor panel under the accelerator pedal.

All 5A models with Drive-Master but without Overdrive have an accelerator pedal stop in the kickdown switch location.

The accelerator pedal rod on these cars should be so adjusted, that the carburetor throttle is in the wide open position just before the accelerator pedal touches either the pedal stop or the moveable stem of kickdown switch. On the 4A model without Overdrive and equipped with Drive-Master the accelerator pedal rod should be so adjusted that wide open throttle is obtained just before the tip of the accelerator pedal strikes the floor mat.

4. ACCELERATOR SWITCH ADJUSTMENT:

With the throttle bellcrank (0), Figure 18 against its stop (P) loosen screws (D) Figure 19 and slide the accelerator switch forward until switch arm (C) bottoms against stop (CC) on switch. Tighten screws (D). Figure 19.

Recheck by depressing the accelerator pedal and releasing pedal slowly. After releasing pedal both accelerator switch lever (C) Figure 19 and bellcrank lever (0) Figure 18 should solidly contact their stops.

5. THREADED SLEEVE ROD ADJUSTMENT:

Adjust the threaded sleeve (33), Figure 20 until the vacuum cylinder piston is 1/2" from its extreme forward position.

Check this adjustment by pushing on valve - lever (28) and then releasing. Above adjustment should be made with the compensator lever in the starting position: pin (10) forward as shown in solid lines Figure 21.
6. **COMPENSATOR PIN ASSEMBLY CHECK:**

Check compensator by pushing the compensator lever and pin (10), Figure 22, down to its normal running position; piston rod (22) should move forward. If the piston rod (22) moves backward, the eccentric (27) is assembled upside down.

![Figure 22](image)

7. **PISTON VALVE ROD CHECK:**

Check length of valve rod assembly (25), Figure 23. If the setting is correct the center line of the pin (24) will be exactly in line with the center line of the piston rod pivot bolt (23) as indicated by large arrow.

![Figure 23](image)

Valve rod (25) can be adjusted by loosening lock nut and turning the valve rod in or out of the threaded trunnion (26).

**NOTE:** The valve rod assembly is properly adjusted at the factory and should never have to be adjusted unless the adjustment has been altered by someone unfamiliar with proper adjustment procedure.

8. **CLUTCH PULL ROD ADJUSTMENT:**

Stop the engine. Pull the piston rod (22), Figure 24, out to its full travel (to rear of car). Pull the clutch rod up and forward to check for 1/8" lash. If lash is correct, front end of slotted clevis (30) will just touch pin (10).

![Figure 24](image)

![Figure 25](image)
9. THROTTLE ADJUSTMENT:

Back out cam adjusting screw (63), Figure 25, until there is approximately 1/2" gap between cam (29) and screw (63). Depress clutch pedal (IMPORT ANT) and start engine; hold clutch pedal down until clutch control unit cylinder takes up load. DO NOT RACE ENGINE. Put transmission in second gear and release the brakes. Slowly rotate throttle bellcrank (36) until clutch drags.

FIGURE 26

Adjust screw (T), Figure 26, until there is a slight increase in engine speed to 625-750 RPM when the car begins to move forward.

NOTE: Above adjustment should be made with the compensator in the starting position, pin (10) forward. The throttle adjusting screw on the 4A series is mounted in a bracket on top of the cylinder head.

10. CUSHION POINT ADJUSTMENT:

Stop engine; depress clutch pedal (IMPORTANT) and restart engine; DO NOT RACE ENGINE. Set hand brake, transmission in second gear. Screw cam screw (63), Figure 7, in fully towards cam (29). Push cam (29) against screw (63) and back out screw (63) until engine stalls. Above adjustment should be made with the compensator in the starting position.

FIGURE 27

11. ROAD TEST:

A. To check slow start, depress accelerator pedal very slowly - engine should speed up slightly just before car starts to move. If necessary adjust screw (T), Figure 26, to meet this requirement.

B. To check fast start, depress accelerator pedal 1/2 way to floor - car should move forward smoothly without excessive slipping of clutch. If necessary adjust screw (63) "in" or "out" to meet this requirement, Figure 27. Do not screw adjusting screw (63) "in" toward cam more than two (2) turns from No. 9 Adjustment setting.

CAUTION: Too frequent operation of the clutch will cause it to become overheated, making satisfactory adjustment impossible. Drive two city blocks between starts while adjusting.

12. TRANSFER KEY:

Check adjustment of ball joint for free rotation without perceptible end play. Adjust by loosening the lock nut, Figure 28, and turn the threaded sleeve inward or outward. Re-tighten lock nut.
13. TRANSFER ROD:

With engine not running shift transmission into high gear and adjust length of selector diaphragm rod (48), Figure 29, until it is just long enough to allow selector key (54) to bottom solidly in the slot in hand shift lever (59). Check this adjustment by starting engine and shifting transmission to neutral. Selector key (54) should bottom solidly in the slot in power shift lever (59). If it does not, recheck above adjustment. CAUTION: While adjusting length of rod (48) hold diaphragm rod end (46) with a wrench to prevent rod from turning and damaging diaphragm.

14. TRANSMISSION SHIFT ROD:

On model 5A (equipped with Drive-Master), place transmission in neutral, disconnect rod (61) at pin (60), Figure 30. Push or pull rod (61) to obtain a free crossover at the transmission.

Move lever (59) until ball is seated solidly in neutral detent. Adjust length of rod (61) so that it can be reconnected to pin (60) without moving either lever to which it is attached. Adjust in 1/2 turn steps until crossover works free. On model 4A loosen adjusting nuts at end of rod (64), figure 16 and retighten when crossover is free.

15. GEAR SHIFT LEVER:

Adjust length of remove control tube to bellcrank rod assembly (38) so that when in neutral, the end of the gear shift lever is approximately 1" above a transverse horizontal line, Figure 31.
16. POWER SHIFT LEVER:

With engine running and instrument panel control switch "on", shift to second gear. Turn stop screw (M) down until it contacts shift lever (0) and then turn it down 1/2 turn more. Lock in place with Allen head set screw (N).

FIGURE 32

17. THROTTLE LOCK CABLE:

With engine running, operate throttle lock by running a jumper wire from the battery negative post to either one of the throttle lock solenoid pins. Adjust nut (37), Figure 33, on the diaphragm cable until lever (67) is held solidly against stop (36) when accelerator pedal is depressed. Securely lock nut (37) with nut (70). Cable (21) should not be so short that shaft (66) is deflected when throttle lock operates.

18. NEUTRAL AND LIMIT SWITCH:

With instrument panel switch "on" and engine running, gear shift in neutral, disconnect rod (61), Figure 34; then move gear shift lever to second and back to neutral, push or pull slightly on rod (61) until a free crossover is obtained. If rod (61) appears too short to go back on pin (60) shorten neutral switch rod (51); if too long, lengthen neutral switch rod. Adjust nuts (55) and (57) against trunnion block (56) as required. Repeat all above operations until rod (61) can be reconnected without moving either of the levers to which it is attached.

FIGURE 33

FIGURE 34

19. CROSS-OVER:

If cross-over is sticky recheck adjustments 14 and 16 and see that transfer switch rod (72) is centered in clip (68) at clutch housing, Figure 16.
UNIT CHECKS

1. PLUG CHECK:

Insert a blade 1/4" wide and 1/32" thick successively into each socket of plug for a distance of 1/2". Socket should grip rod tightly enough to make a good electrical contact.

![Figure 36](image1)

2. INSTRUMENT PANEL SWITCH CHECK:

Ignition switch on. Ground long lead of test lamp. Switch button pushed in DRIVE-MASTER SIDE (Right Side). Examine fuse and if fuse is OK, test lamp prod to terminal H, Figure 36, should light test lamp.

![Figure 37](image2)

3. GOVERNOR SWITCH:

Raise rear wheels, start engine, shift hand shift to high gear. Remove harness plug. Long lead of test lamp to negative terminal of battery. Test lamp prod to No. 2 prong or (RW) Douglas female terminal of governor should light test lamp up to 18-21 miles per hour.

![Figure 38](image3)

Ground No. 1 (Y) prong of governor, test lamp prod to No. 3 (BL) prong should light test lamp up to 9-13 miles per hour, above that speed test prod to No. 4 (B) prong should light test lamp.

A separate terminal for use with over-drive should light test lamp any speed over 16-21 MPH.

![Figure 39](image4)

4. SHIFT RAIL SWITCH:

Disconnect double wire bullet terminal at accelerator switch and connect a test lamp between this bullet terminal and battery negative.
5. CLUTCH POWER UNIT SOLENOID:

Remove connector socket, connect one jumper wire between a ground and No. 2 prong of the clutch power unit solenoid Figure 41 at A, connect another jumper wire between No. 3 prong and negative battery terminal. Solenoid should be felt and heard to operate.

All the 4A and 5A models equipped with Drive Master have an improved check valve at the clutch power unit solenoid which provides a smoother clutch engagement with less racing of the engine. To test the effectiveness of check valve, set hand brake, put gear shift lever in neutral and warm up engine. Then stop the engine by grounding the low tension ignition circuit at the distributor or at the distributor terminal of the ignition coil. Do Not Turn Off Ignition. After engine has stalled, note the rate at which the clutch control piston falls out and allows the clutch to engage. Time required for piston to fall out should be more than 7 seconds. If piston falls out faster than this examine valve seat for dirt and valve poppet to see that the rubber faced side is toward the valve seat. Also check for vacuum leaks between the solenoid valve and the cylinder and around the piston.

6. THROTTLE LOCK SOLENOID:

Disconnect the wires at throttle lock solenoid (B) Figure 42, connect a jumper wire from the battery negative terminal to either throttle lock solenoid terminal, valve should operate. Move the jumper wire to the other terminal, valve should operate.
7. THROTTLE LOCK FAILURE:

It is the function of the throttle lock to hold the throttle closed until a shift is complete. Failure to shift through neutral and clashing gears when accelerator pedal is pushed down again immediately after releasing is a sign of defective throttle lock.

To check proceed as follows:

With engine idling and H.D.M. button pushed in, shift from neutral to second, throttle should lock momentarily. Next shift from second back to neutral throttle should again lock momentarily. If preceding checks were OK put transmission in second gear by pulling the hand lever down into automatic (high) position. Stop engine, pull plug connector from transmission power shifter unit. Start engine and move hand lever to neutral. Throttle should lock. Jack up rear wheels and push accelerator down to floor while holding foot lightly on clutch pedal to stop it if clutch control should release suddenly.

A. The throttle lock should hold engine at idling speed while the accelerator pedal is at floor. If it does not, adjust cable length (Adjustment No. 17). If this adjustment does not stop pedal from break¬ing through throttle lock, check adjustment No. 4 and No. 5 of Adjustment Instructions. If these adjustments fail to correct the trouble, change transmission control switch.

If the throttle failed to lock on either the shift into or out of second, check as follows:

With engine idling disconnect the wires at throttle solenoid Figure 42 at B; attach jumper wire from the negative battery terminal successively to each terminal. Lock should operate in each case. If it does not operate, check for a defective solenoid, ruptured diaphragm, or a defective throttle lock ground wire, Figure 43.

8. ACCELERATOR SWITCH:

Ground one lead of jumper wire, other lead to one terminal of the accelerator switch Figure 44, long lead of test lamp to negative battery terminal and other switch terminal. Lever against stop, test lamp should light. Move lever 5° to 10° from stop. Light should go out.
9. TRANSMISSION POWER UNIT SOLENOIDS:

Start engine, remove connector socket. Connect a jumper between negative battery terminal and No. 2 prong of power shift unit solenoid Figure 45. Piston rod should move "out". Moving jumper to the No. 4 prong, piston rod should move "in", to the No. 1 prong should operate transfer diaphragm.

10. DRIVE-MASTER HARNESS CHECK:

Before test is started, harness should be disconnected from all Drive-Master units. These points are:

- White wire at bullet connector 4" from instrument panel switch.
- Ten contact plug at control switch. Connector plug at power shift unit. Connector plug at clutch control solenoid. Two wires at accelerator switch.
- One wire at shift rail switch.
- Connector plug or wires at governor.

In cases of starting motor failure remove the tape at the bolted together splice located 6" from the power shift unit and disconnect the wire at the 10-32 terminal of the starter solenoid.

Guard against unintentional grounding of any leads while making the check by taping all loose bullet connectors which might accidentally make contact with metal parts of the car.

The following chart gives a complete check of continuity and shows up any unwanted cross circuits. To use the chart, ground the indicated lead and connect one terminal to test lamp to negative terminal of battery and then touch test lamp prod successively to each of the prongs in the transmission control switch ten contact plug. If lamp fails to light on the indicated prong a continuity break is indicated. If lamp lights when it should not, a cross circuit or ground is indicated.

On cars equipped with both Drive-Master and Overdrive the two harnesses are taped together to make a single unit. However, there is no electrical connection between the two and either harness may be checked independently of the other.
<table>
<thead>
<tr>
<th>GROUND LEAD TO</th>
<th>TEST LAMP PROD TO 10 CONTACT PLUG PRONG NO.</th>
<th>TEST PROD TO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Power shift unit plug socket No. 1</td>
<td>x</td>
<td>0</td>
</tr>
<tr>
<td>Power shift unit plug socket No. 2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Power shift unit plug socket No. 4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clutch control solenoid socket No. 1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clutch control solenoid socket No. 2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clutch control solenoid socket No. 3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clutch control solenoid socket No. 4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>White wire at instrument panel Switch</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Governor plug socket No. 1 or Y wire *</td>
<td>0</td>
<td>x</td>
</tr>
<tr>
<td>Governor plug socket No. 2 or RW wire *</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Governor plug socket No. 3 or BL wire *</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Governor plug socket No. 4 or B wire *</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Y wire at shift rail switch</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Splice near shifter unit □</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Starter solenoid wire terminal □</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

x  Model 4A with Overdrive and Drive-Master combination uses separate wires at the governor switch instead of a plug.

0  Lamp not lighted.

* Lamp lighted.

□ For starting failure only.
### 1. TRANSMISSION SWITCH:

Place gear shift in neutral. Remove connector plug. Insert plug of test harness. Long lead of test lamp to negative terminal of battery. Test lamp prod free for testing.

![Figure 46](image)

<table>
<thead>
<tr>
<th>Clutch and Transfer Switch</th>
<th>Test Lamp from battery to Prong No.</th>
<th>Ground Lead to Prong No.</th>
<th>Lamp Lights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disconnect clutch switch operating rod.</td>
<td>8</td>
<td>1</td>
<td>Yes*</td>
</tr>
<tr>
<td>Move switch lever to rear (on).</td>
<td>8</td>
<td>5</td>
<td>Yes</td>
</tr>
<tr>
<td>Gear shift lever in neutral.</td>
<td>9</td>
<td>10</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Selector Switch</th>
<th>Test Lamp from battery to Prong No.</th>
<th>Ground Lead to Prong No.</th>
<th>Lamp Lights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clutch switch on.</td>
<td>1</td>
<td>4</td>
<td>Yes</td>
</tr>
<tr>
<td>1. - Move gear shift to second gear. Neutral switch in neutral.</td>
<td>1</td>
<td>5</td>
<td>No</td>
</tr>
<tr>
<td>Clutch switch on.</td>
<td>1</td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>2. - Move gear shift to neutral. Neutral switch in neutral.</td>
<td>1</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>3. - Move gear shift to high. Neutral switch in neutral.</td>
<td>1</td>
<td>2</td>
<td>Yes</td>
</tr>
<tr>
<td>3. - Move gear shift to high. Neutral switch in neutral.</td>
<td>1</td>
<td>4</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Neutral and Limit Switch</th>
<th>Test Lamp from battery to Prong No.</th>
<th>Ground Lead to Prong No.</th>
<th>Lamp Lights</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. - Move power lever to neutral (center). Gear shift lever in neutral.</td>
<td>3</td>
<td>7</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>No**</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>No**</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>6</td>
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<tr>
<td>2. - Move power lever to second (to the rear). Gear shift lever in neutral.</td>
<td>3</td>
<td>7</td>
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<tr>
<td>3. - Move power lever to high (forward). Gear shift lever in neutral.</td>
<td>3</td>
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Remove test harness and replace plug.

* When clutch switch is moved forward (off) the lamp should burn dim, and brighten when lever is moved to rear (on).

** If lamp lights, recheck neutral switch adjustment, before proceeding further.
TROUBLE SHOOTING

PRELIMINARY CHECKS

When checking a Drive-Master complaint first determine that the clutch and transmission are functioning properly in manual operation.

Do not attempt any adjustments of the Drive-Master until the engine has reached the normal operating temperature.

The engine must be in proper tune and should idle smoothly at 580 to 600 RPM, with the Drive-Master switch "ON".

The vacuum gauge should read from 17 to 18 inches of vacuum.

Check all joints of throttle and Drive-Master linkage to see that they work freely.

All terminal connections, sockets and lugs should be clean and in solid contact. The battery should be in good condition and gravity reading not less than 1225.

All electrical checks should be made with the Ignition and Drive-Master switches in the "ON" position; test should be made with a test lamp of 15 candle power rating.

NOTE: A call for a lamp to light indicates a call for a bright light; a dim light indicates a high resistance circuit and for checking purposes is the same as no light.

CONDITION NO. 1

CLUTCH DOES NOT DISENGAGE:

A. Check vacuum lines for leaks or collapsed hose.

With ignition and Drive-Master switches "ON", disconnect plug at clutch unit solenoid plug, connect one end of test harness to the clutch unit solenoid prongs, other end to car harness plug. Connect a test lamp between No. 3 lead of test harness and a ground. If test harness is not available connect direct to the No. 3 socket of harness plug.

C. Lamp should light in test B. If it does not, instrument panel switch (Check No. 2 under unit checks) or wire harness is defective. Also check wire connection located 4 inches from instrument panel switch, feed wire from ignition switch and the fuse in this feed wire.

D. Place gear shift lever in neutral, remove harness plug from clutch control solenoid and connect the test harness to harness plug but DO NOT connect to solenoid. Connect a test lamp between the test harness No. 2 lead and negative battery terminal. If test harness is not available connect direct to No. 2 socket of harness plug.

Lamp should light; if it does not, shift rail switch or the wire in the harness is defective. If tests B, C and D show completed circuits, check for defective socket plug or clutch power unit solenoid. Make (Checks No. 1 and 5) under unit checks.

CONDITION NO. 2

CLUTCH DOES NOT DISENGAGE WHEN COMING TO STOP:

A. Make adjustment Checks 2 and 4, Pages 9-13 and 9-14.

B. If above adjustments are OK, remove red and white wire at accelerator switch and connect a test lamp between this wire and the negative battery terminal. Lamp should light.

C. If lamp lights accelerator switch may be defective. Make check No. 8 under unit checks.

D. If lamp does not light, check connection at governor switch and with the test lamp still connected as in B connect a wire between
socket plug and a ground. If lamp lights, governor switch is defective; make Check No. 3 under unit checks. If lamp does not light harness is defective; make Check No. 10 under unit checks.

**CONDITION NO. 3**

**CAR FREE WHEELS AT ALL SPEEDS IN HIGH GEAR:**

A. Disconnect accelerator switch wires and connect a jumper wire between ground and one switch terminal; connect a test lamp between the battery negative terminal and the other terminal of the accelerator switch.

![FIGURE 47](image)

B. With lever (C) Figure 47 against stop (CC) as indicated by an arrow lamp should light.

C. Move lever (C) 10 degrees from stop (CC) light should go out.

D. One black and one yellow wire are soldered together at a single bullet terminal at the accelerator switch. Disconnect this bullet terminal from the accelerator switch and connect a test lamp between the battery negative terminal and this bullet terminal. Shift gear shift. Light should be dim when in high gear, bright in all other. If so proceed to paragraph F.

E. If lamp is bright when transmission is in high gear; disconnect wire at shift rail switch Figure 48 if light goes dim shift rail switch is defective. Make Check No. 4 under unit checks. If light stays bright harness is defective.

![FIGURE 48](image)

F. Disconnect red and white single wire at accelerator switch and connect test lamp between bullet terminal of the wire and negative terminal of battery. Jack up rear wheels and drive car in high gear. If lamp does not go out at speeds over 20 MPH, disconnect plug at governor switch. If lamp does not go out harness is grounded (Check No. 10) if lamp does go out governor is defective (Check No. 3). Also check for missing shift rail detent ball.

**CONDITION NO. 4**

**TOO MUCH ENGINE SPEED ON START:**

Make Adjustments No. 9 and 10, Page 9-16.

**CONDITION NO. 5**

**ENGINE STAGGERS OR STALLS ON START:**

Make Adjustments No. 9 and 10, Page 9-16.
CONDITION NO. 6
CLUTCH CHATTERS ON ENGAGEMENT:

Chatter will be less if engine speed does not exceed 625 RPM as car starts to move.

Make Adjustments No. 9 and 10, Page 9-16.

CONDITION NO. 7
ENGINE STALLS ON FAST STOP:

A. Tune engine and set idle speed at 580-600 RPM if necessary make tests under Condition No. 2 "Clutch Does Not Disengage When Coming to A Stop".

B. Check to see that car starts to free wheel at not less than 16 MPH. If car does not free wheel at less than 16 MPH when in high gear, check governor drive pinion for proper number of teeth. Also check governor (unit check 3).

CONDITION NO. 8
HARD SHIFTING AND GEAR CLASH:

Above complaint is due to incomplete clutch disengagement and throttle lock failure. Make Adjustments No. 5 and 8 and Unit Check No. 7, Pages 9-14, 9-15 and Page 9-22.

CONDITION NO. 9
CLUTCH DOES NOT DISENGAGE AT SPEEDS ABOVE 21 M P H, TRANSMISSION NOT IN HIGH GEAR:

A. One black and one yellow wire are soldered together at a single bullet terminal at the accelerator switch. Disconnect this bullet terminal from the accelerator switch and connect a test lamp between the battery negative terminal and this bullet terminal. Shift gear shift. Light should be dim when in high gear, bright in all others. If so proceed to test B.

B. If lamp does not light brightly in any gear in tests A, place transmission in neutral; with test lamp still connected as in test A, connect a jumper wire from a ground to the shift rail switch terminal Figure 49 at A. Now if lamp does not light, the wire from the accelerator switch terminal to the shift rail switch is defective.

FIGURE 49

C. If lamp does light brightly, shift rail switch is defective. Make Check No. 4 under unit Checks, Page 9-20.

CONDITION NO. 10
CLUTCH SLIPS WHEN FULLY ENGAGED:

Make Adjustments No. 1 and No. 8, Pages 9-13 and 9-15. Also try clutch operation manually. Refer to "Clutch Section:

CONDITION NO. 11
CLUTCH DRAGS:

Make Adjustments No. 5 and No. 8, Pages 9-14 and 9-15.

CONDITION NO. 12
CLUTCH SLIPS EXCESSIVELY ONLY WHEN FIRST OPERATING CAR AFTER STARTING EN- GINE:

Make Adjustment No. 6, Page 9-15
CONDITION NO. 13

STARTING MOTOR WILL NOT OPERATE:

A. Check clutch switch rod (65) Figure 1, to see that it operates the clutch switch in transmission control switch when the clutch pedal is depressed.

B. Remove the friction tape from wire splice at (A) Figure 50 and connect a jumper wire from this connection to the small terminal on starting motor solenoid at (B).

C. If starter does not operate when starter button is pushed, trouble is in the regular starting circuit.

D. If starter does operate, the trouble is in either the wire harness, see "Wire Harness Check", or in the transmission control switch. Make Checks 10 and 11 under unit checks.

E. Remove transmission control switch plug Figure 51. Short across plug prongs No. 9 and No. 10 while pressing the starter button.

F. If starter does not operate, harness is defective, see "Wire Harness Check". Check 10 under unit checks.

G. If starter operates, trouble is in the transmission control switch. Make Check 11 under unit checks.

FIGURE 51

CONDITION NO. 14

TRANSMISSION REMAINS IN NEUTRAL:

A. Lift gear shift lever through cross-over and return. If transfer diaphragm works proceed to paragraph (J).

B. If transfer diaphragm does not work, make check 9 under unit checks, also see that cross-over switch operating rod (72), Figure 1, is connected; and if OK, proceed to paragraph C.

C. With engine idling, attach a jumper wire from the negative battery terminal to the No. 1 power shift unit prong.

D. If transfer key does not operate check for leaks in vacuum lines. If none are found either the solenoid valve is defective or the diaphragm is ruptured. If engine speeds up when solenoid is energized check for ruptured diaphragm by disassembling unit.
If solenoid valve seems dead and cannot heard or felt to operate when energized it should be replaced.

E. If the transfer key does operate, connect a test lamp between a ground and No. 1 socket of power unit plug.

F. If lamp lights in test E, plug is at fault. Make Check 1 under unit checks.

G. If lamp does not light, remove the ten prong plug from transmission control switch and connect a test lamp from No. 8 prong to a ground Figure 52.

H. If lamp does not light, the wire between No. 8 prong and terminal "H" of the instrument panel control switch is open. Also check connector 4" from instrument panel switch.

I. If lamp does light in test (G) disconnect the transmission control switch plug. Connect a test lamp between the battery negative terminal and power unit plug socket No. 1 and ground the No. 1 prong of the 10 prong plug.

J. Move gear shift lever from neutral to second while watching power unit. If transmission shifts to second gear, proceed to paragraph (M).

K. Touch a jumper wire from the battery negative terminal to the No. 2 prong and No. 4 prong of the transmission power shift unit alternately; power cylinder piston rod should move "out" and "in".

L. With engine running and the gear shift lever in second gear, ground one lead of the test lamp, other end to No. 2 socket of power shift unit harness plug. If lamp does not light, transmission control switch or wire harness is defective. Make check No. 10 and 11 under unit checks.

M. If transmission shifts to second gear in paragraph J, connect No. 1 and No. 3 sockets at governor socket plug with a short jumper wire.

N. Place gear shift lever in high gear position. If transmission shifts from neutral to second, the governor socket plug or the governor is defective. Make Checks 1 and 3 under unit checks.

O. If shift does not occur, either the wire harness, or the transmission control switch is faulty. Make checks 10 and 11 under unit checks.
CONDITION NO. 15

DOES NOT SHIFT INTO SECOND FROM HIGH AT SPEEDS BETWEEN 9 AND 12 MPH:

A. If transmission shifts from neutral to second; but not from high to second; check for binding throttle linkage which may be restricting clutch disengagement. Adjustment No. 2, Page 9-13.

B. If clutch disengages but transmission stays in high gear, check for defective governor switch or switch socket plug. Make Checks No. 1 and No. 3 under unit checks.

CONDITION NO. 16

DOES NOT SHIFT OUT OF SECOND INTO NEUTRAL:

A. With engine idling, attach a jumper wire from the battery negative terminal to the power shift unit No. 4 prong. Power cylinder piston rod should move "in". If it does not move "in" check for air leaks in lines to end of cylinder if engine speeds up when solenoid is energized, and for defective high gear solenoid if valves seems dead and cannot be heard or felt to operate when energized.

CONDITION NO. 17

DOES NOT SHIFT OUT OF SECOND INTO HIGH AT SPEEDS BETWEEN 9.5 AND 14 MILES PER HOUR:

A. Improper adjustment of power shift lever stop screw. Make adjustment No. 16.

B. If trouble still exists, set hand brake. Install a jumper wire between socket No. 1 (Y) and No. 4 (B) of governor switch plug or wires; on the 4A model with overdrive, disconnect RW, Y and B wires. Start engine and shift to automatic (High) position while holding the clutch pedal down lightly with left foot. DO NOT REMOVE FOOT FROM CLUTCH PEDAL DURING THIS CHECK. Shift to high gear will be indicated by an increase in pressure on the clutch pedal.

C. If shift to high gear does occur, either the governor socket plug or the governor is faulty. Make Checks No. 1 and No. 3 under unit checks, Page 9-20.

D. If shift to high gear does not occur, check wire between the governor socket No. 4 (B) wire and power shift unit socket No. 4 for an open circuit also check both plugs. Make Check No. 1 under unit checks.

CONDITION NO. 18

SHIFT INCOMPLETE, STOPS IN NEUTRAL:

Make Check No. 7 under unit checks, Page 9-22.

CONDITION NO. 19

FREEWHEELS AT SPEEDS ABOVE 21 MPH:

If free wheeling never continues for more than 2 or 3 seconds, check spring behind gear shift lock detent as indicated by arrow, Figure 53. This should be a 30 pound spring (Part No. 41236). If free wheeling continues for longer periods, check governor switch and see Condition No. 3 "Car Free Wheels At All Speeds In High Gear". If car is equipped with overdrive push Drive-Master Switch "off" button and if free wheeling continues see "Overdrive Trouble Shooting Chart Condition No. 12".
CONDITION NO. 20

THROTTLE REMAINS LOCKED:

NOTE: A locked throttle indicates an incomplete shift.

A. If locking occurs when shifting from second to neutral, refer to Condition No. 16 "Does Not Shift Out Of Second Into Neutral".

B. If locking occurs on some other shift, check accordingly under the condition covering that particular shift.

C. Follow with Adjustment Checks 13, 15 and 17. Pages 9-17 and 9-18.

CONDITION NO. 21

SLOW RELEASE OF THE THROTTLE LOCK:

Check transmission lubricant. In cold weather too heavy of a lubricant in the transmission will result in slow shifting, causing the throttle to remain locked for a longer period of time. Check for vacuum leaks in tubing.

CONDITION NO. 22

NOISY CROSS-OVER:

Check for loose transfer diaphragm ball joint Figure 28, Adjustment Check No. 12. Lubricate transfer key, Page 9-16.

CONDITION NO. 23

STICKY CROSS-OVER:

Make Adjustment No. 19, Page 9-18.

CONDITION NO. 24

GEARS CLASH DURING SHIFT:

Check for throttle lock failure. Make unit check No. 7, Page 9-22.

PARTS REMOVAL AND REPLACEMENT

CLUTCH POWER CYLINDER

REMOVAL:

1. Disconnect power unit air intake pipe (1) Figure 16, and pipe from intake manifold to clutch power unit solenoid.

2. Remove valve lever eccentric bushing nut (27) and pull bellcrank lever (28) out to allow clearance for removal of link (25).

3. Remove cotter pin at (24) and disconnect lever link from bellcrank.

4. Remove pivot bolt (23).

5. Remove two screws attaching throttle lock diaphragm bracket to clutch power unit cylinder and disconnect pipe (19).

6. Remove two bolts attaching clutch unit solenoid (13) to clutch power unit cylinder and remove clutch unit and throttle lock solenoids as a unit.

7. Remove palnut, nut and bolt attaching clutch power cylinder to mounting bracket (9) and remove clutch power unit, piston rod and piston valve rod and link as a complete unit for disassembly and overhaul.
INSTALLATION:

Reverse procedure of removal and recheck piston valve rod adjustment, Adjustment No. 7 - also check that ground wire Figure 43 has not been broken.

**CLUTCH POWER CYLINDER MOUNTING BRACKET**

REMOVAL:

1. Remove two nuts, washers and bolts attaching rear of bracket to throttle bell-crank bracket.

2. Disconnect air intake pipe (1) Figure 16, and vacuum pipe at clutch power unit solenoid.

3. Remove two bolts attaching clutch power unit mounting bracket to support bracket and one bolt attaching mounting bracket to throttle cross rod mounting bracket.

4. Remove palnut, nut and bolt attaching clutch power cylinder to mounting bracket.

5. Disconnect accelerator switch operating rod at the accelerator lever.

6. Pull complete bracket towards fender to allow for removal of the cotter pin, flat washer, one small and one large spacer washer and spring washer attaching bell-crank support pin to mounting bracket.

7. Slide out bracket toward engine and remove.

**PISTON VALVE LEVER**

REMOVAL:

1. Remove cotter pin at (24), Figure 16.

2. Remove cotter pin attaching threaded sleeve swivel (32) to valve lever cam (29).

3. Remove valve lever eccentric attaching nut (27) and washer, and remove lever (28) with valve lever cam (29) and springs attached.

**INSTALLATION:**

Reverse procedure of removal, recheck cushion point adjustment No. 10 and piston valve rod adjustment No. 7, Page 9-15, also stake nut (27) securely after tightening.

**COMPENSATOR LEVER**

REMOVAL:

1. Perform operations 1, 2 and 3 under valve lever removal and remove pin attaching the eccentric bushing to the compensator lever shaft.

2. Push piston rod forward (towards power cylinder) and remove compensator lever.

NOTE: A spring loaded detent ball is positioned between the compensator lever and bell-crank; use care when removing the compensator lever.

**INSTALLATION:**

Reverse procedure of removal, and check eccentric bushing installation. Heavy side of bushing is assembled up. Also check adjustment No. 6 Page 9-16.

**VALVE LEVER CAM**

REMOVAL:

1. For easy removal of the valve lever cam (29) Figure 16 follow removal and installation procedure for the "Valve Lever" and remove the nut, washer, bolt and spring attaching the cam lever to the valve lever. After installing recheck adjustment No. 10 under adjustments.
BELLCRANK TO COUPLING LEVER ROD AND PLAY LINK

REMOVAL:

1. Perform operations 1, 2, and 3 under valve lever removal and remove the cotter pin, flat washer, spring, and pin attaching play link to piston rod bellcrank.

2. Raise car and remove cotter pin and flat washer at clutch coupling lever and remove rod (30).

INSTALLATION:

Reverse procedure of removal and check Adjustments 7 and 8, Page 9-15; also make sure spring is underneath flat washer at play link. Cotter pin should be securely fastened with the ears of the pin down so not to interfere with the action of the compensator lever.

COMPENSATOR TRIP LEVER AND SPRING

REMOVAL:

1. Remove nut and washer (20) Figure 16. Remove spring (11).

2. Remove spring (11).

3. Remove lever and pin (11).

INSTALLATION:

1. Install lever and pin (10).

2. Install spring (11) hooking one end of spring on anchor but do not fasten other end of spring on trip lever.

3. Install washer and nut (20) and fasten securely.

4. Hook end of spring at trip lever and stake nut (20) securely in place.

TRANSMISSION POWER SHIFT CYLINDER AND TRANSFER DIAPHRAGM

REMOVAL:

1. Disconnect the diaphragm to transfer key engaging rod (48) Figure 1 from rod diaphragm end (46).

2. Disconnect shift strap by removing bolt attaching the strap to the power shift cylinder.

3. Disconnect battery cables, battery hold down, battery, battery tray.

4. Disconnect the vacuum lines at transfer diaphragm solenoids.

5. Remove two cotter pins, nuts, ferrules, flat washers, and rubber bushings (44) attaching the power shift cylinder to power shift cylinder support bracket and remove the power shift cylinder (42) and transfer diaphragm as a unit.

INSTALLATION:

1. Place complete unit in position and enter mounting studs with flat rubber bushings inserted between power cylinder support bracket and mounting bracket.

2. Install two bushings (with collar) over studs and through holes of mounting bracket and install brass ferrules over studs with flanged ends of ferrules entered in counter-bore of the rubber bushings.

3. Install flat washers, nuts, and cotter pins. Tighten nuts sufficiently to enter cotter pins, then back off nuts until face of nut touches cotter pin.

4. Attach power shift cylinder shift strap and transfer diaphragm engaging rod (48). Adjust engaging rod Adjustment No. 13 under adjustment checks.
NOTE: Hold diaphragm rod (46) with a wrench to prevent rod from turning and damaging the diaphragm.

5. Adjust sleeve nut so that joint (53) is loose on transfer key ball without any appreciable end play.

6. Connect vacuum lines (1) and (2) at diaphragm.

7. Install battery support tray, battery, battery hold down, and battery cables.

NOTE: Tighten battery hold down nuts to 3 lbs. torque.

8. Recheck operation of unit and adjust as necessary.

POWER SHIFT UNIT SOLENOID AND TRANSFER DIAPHRAGM REMOVAL:

NOTE: Use same procedure as outlined in "Power Cylinder and Transfer Diaphragm Removal and Installation" and remove transfer diaphragm unit from power unit on bench by removing the transfer diaphragm attaching screws.

NOTE: The solenoid valves are not serviced separately.

TRANSMISSION CONTROL SWITCH REMOVAL:

1. Lift off distributor cap (on 6 cylinder engines).

2. Disconnect coil wire at distributor vacuum control tube, distributor attaching screw, and remove distributor (6 cylinder only).

3. Disconnect clutch operating rod (65) transfer switch rod (72), neutral and limit switch rod (51) and selector switch rod (50).

4. Disconnect harness plug.

5. Remove one bolt, lockwasher and nut attaching transmission switch to support bracket at top and one bolt, lockwasher and nut at bottom and remove transmission switch.

INSTALLATION:

Reverse procedure of removal, attaching upper bolt first. Make sure all cotter pins and clips have been locked securely. Check adjustments and engine timing.

POWER SHIFT UNIT TRANSFER DIAPHRAGM ENGAGING ROD AND/OR ROD END AND SLEEVE REMOVAL:

1. Hold diaphragm rod end (46) Figure 1, with a suitable wrench and loosen the lock nut (47).

2. Hold diaphragm engaging rod (48) with pliers and back out sleeve nut sufficiently to remove shift rod from transfer key ball.

INSTALLATION:

To install, reverse procedure of removal and adjust diaphragm engaging rod, Adjustment No. 13. Sleeve nut should be adjusted so that rod swivels freely on transfer key ball without any appreciable end play.

POWER UNIT SHIFT STRAP REMOVAL:

1. Remove bolt and lockwasher at power cylinder.

2. Remove cotter pin, plain washer and disconnect neutral and limit switch rod (51).

3. Remove inner cotter pin, flat washer, anti-rattle washer and remove shift strap.
INSTALLATION:
Reverse procedure of removal.

TRANSFER KEY

REMOVAL:
Use procedure of "Power Unit Transfer Diaphragm Engaging Rod" and remove cotter pin and clevis pin from transfer key.

NOTE: Push shift shaft to rear to allow clearance for cotter pin removal.

INSTALLATION:
Reverse procedure of removal and check adjustment.

NOTE: To lubricate transfer key, (54) grasp diaphragm engaging rod (48) and pull towards front of car. This action will allow clearance at transfer key alemitite for lubrication gun.

DRIVE-MASTER SHIFT SHAFT AND/OR SHIFT LEVERS

REMOVAL:
1. Remove shift shaft nut located at rear of Drive-Master support bracket. (It will be necessary to disconnect transfer switch rod (72) at transmission switch to allow more wrench clearance.)
2. Remove cotter pin and clevis pin and disconnect power shift rod (61).
3. Slide the shift shaft out toward fender (use care as detent balls and springs may fall out of their retainers)

INSTALLATION:
Reverse procedure of removal and make sure the detent ball springs are properly positioned as follows: Part 163442 a 19 pound spring when compressed to 11/16" is assembled in Drive-Master mounting bracket pin for the (Hand shift) Lever Assembly. Part 41236 a 30 pound spring when compressed to 13/16" is assembled in the shift shaft mounting bracket recess.

The detent balls should be well lubricated with water resistant grease prior to assembly.

NOTE: If replacement of the transfer key hub bushing is necessary, remove bushing with a driver having a .625 pilot. Bushing inside diameter to be 625 to .626 after assembly. Shift shaft bushings also have a .625 to .626 inside diameter to allow a shift shaft clearance of .0025" to .0035".

REFERENCE

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SECTION 10
OVERDRIVE

FIGURE 1
FIGURE 1

1. Transmission mainshaft
2. Transmission mainshaft snap ring
3. Transmission mainshaft bearing
4. Transmission snap ring
5. Bearing oil baffle
6. Overdrive to transmission case gasket
7. Overdrive housing adapter
8. Sun gear plate & balk ring
9. Sun gear plate cover
10. Cover plate snap ring
11. Sun gear snap ring
12. Sun gear
13. Pinion cage assembly
14. Pinion cage retainer clip
15. Cam assembly
16. Cam roller retainer spring
17. Cam roller
18. Cam roller retainer
19. Cam retainer clip
20. Shift rail retractor spring
21. Shift rail
22. Control shaft
23. Control shaft oil seal
24. Control lever
25. Shift rail sleeve spring
26. Shift rail sleeve
27. Shift fork
28. Sun gear shift collar
29. Sun gear pawl
30. Sun gear pawl oil seal
31. Solenoid assembly
32. Overdrive mainshaft ring gear
33. Overdrive mainshaft output shaft
34. Snap ring
35. Overdrive mainshaft bearing - front
36. Overdrive housing gasket
37. Overdrive housing
38. Overdrive housing to adapter bolt
39. Governor switch
40. Lock ring
41. Governor pinion
42. Speedometer drive gear
43. Shaft bearing snap ring
44. Overdrive mainshaft bearing - rear
45. Overdrive mainshaft oil seal
46. Companion flange
47. Mainshaft plain washer
48. Mainshaft lockwasher
49. Mainshaft nut
50. Control switch gasket
51. Control switch gasket
52. Control switch
Overdrive provides a driving ratio of engine speed to rear wheel speed that is numerically lower than direct drive. In overdrive the engine revolves 30% slower than in direct gear at the same car speed, resulting in less wear on engine parts as well greater fuel and oil economy and smoother operation at high speeds.

HIGHWAY DRIVING:

When the car is operated below a pre-determined "cut-in" speed, varying from 18 to 21 mph, the direct drive is used, making available the acceleration so desirable at lower speeds. As the car speed increases above the cut-in point the overdrive unit will shift into overdrive ratio, but only when the driver desires no further acceleration; when consciously, or unconsciously, he lifts his foot from the accelerator, whereupon the shift is completed. Thereafter, the overdrive remains in effect until the car speed falls below the "cutout" points, 16 to 19 mph, when the overdrive is released.

However, at high speeds, the driver while operating in overdrive may require additional acceleration beyond that available by opening the throttle wide. His natural impulse is to press the accelerator further, and his act releases the overdrive, making available the full acceleration of direct drive. The direct drive is retained as long as the full acceleration is required; when the driver no longer requires it he unconsciously lifts his foot from the accelerator, whereupon the overdrive is resumed. If the driver so desires, he may retain the direct drive indefinitely by maintaining a small amount of throttle opening. By thus combining the unconscious reflexes of the driver with the automatic mechanism of the overdrive unit, it is possible to endow mechanical "brain" with "judgement", and still have the entire action subject to the conscious control of a skilled driver.

CITY TRAFFIC DRIVING:

Much city driving is under conditions which permit speeds of 20-32 mph, with frequent stops. Many drivers are accustomed to start in second gear under such conditions. With overdrive-equipped cars, the driver may start in second gear, accelerate up to the cut-in speed, and, by merely lifting the foot from the accelerator pedal, engage the overdrive-second gear combination, which is approximately the same ratio as the usual third speed. At the first traffic stop, it is merely necessary to release the clutch; the gear shift lever is not touched. Furthermore, if a special burst of acceleration is needed in a tight traffic spot, the full power of second gear may be had by pressing the accelerator to the floor, resuming the overdrive-second by the usual method of closing the throttle.
MECHANICAL
FREE-WHEELING DIRECT DRIVE

The transmission mainshaft, Figures 2 and 3, extends through the sun gear and is spindled into the pinion cage and roller clutch cam. The latter has 12 cam surfaces and 12 clutch rollers located against these surfaces by means of the roller cage and the roller cage spring.

FIGURE 4

When a driving torque is applied against the cam, the rollers are forced outward into wedging contact with the outer race, Figure 5-A, thus driving the car. Under such driving conditions, all the overdrive gears and their directly-associated control parts revolve together as a unit.

On the other hand, if the throttle is closed, removing the driving force, the rollers release their wedging contact, Figure 5-B, permitting the roller clutch, to overrun, with the mainshaft, slower speed than the ring gear, output shaft and propeller shaft. Under such conditions the ring gear will turn faster than the pinion cage, and the sun gear will turn slower than the latter. In fact, the sun gear may turn forward, stand still, or turn backward, depending solely upon the relative speeds of the transmission main shaft, and the output shaft. If the former is turning at exactly 70%

FIGURE 5

FIGURE 6
of the speed of the latter, the sun gear will stand still; if it turns faster than this, relatively, the sun gear will turn forward; and if it turns slower, the sun gear will turn backward. If the engine is idling with the car moving forward, this reverse rotation may be quite fast.

Assuming that the car is being driven with the dash control pushed in, Figure 4, the sun gear control plate revolves along with the sun gear at the speed of the transmission mainshaft. Under such circumstances, the blocker ring, by its frictional drag upon the hub of the control plate, is rotated into such a position as to latch the control pawl against inward movement, Figure 8-A.

When the car reaches a predetermined speed (the "cut-in" speed, which varies between 18 and 21 mph.) the governor contacts close, acting through the overdrive electrical circuit to energize the solenoid. The latter sets up a spring pressure against the pawl, tending to push it into engagement. This movement is prevented by the blocker. However, the driver either consciously, or unconsciously, and according to his own choice, may momentarily close the throttle, whereupon the roller clutch releases, and the engine slows down. At the same time, the sun gear slows down, more rapidly, so that the sun gear passes through the stand-still condition when the engine speed has fallen 30%, and then reverse its motion. Upon the instant of reversal, the blocker ring, moved by its frictional drive from the control plate hub, also rotates slightly in this direction and releases the pawl which snaps into the first notch of the backwardly-rotating control plate, Figure 8-B.

The extreme rapidity of this action insures that the control plate cannot rotate backward more than 1/3 turn at the most; usually, it will be less. This engagement, at nearly perfect synchronism, accounts for the smooth action of this control. Once engaged, under the conditions of normal driving, the overdrive is in action until the car speed falls to a value 2 or 3 mph lower than the cut-in speed, when the governor contacts open, releasing the solenoid, which withdraws the pawl (if throttle is closed), whereupon the condition of freewheeling direct drive is resumed.

**DRIVER-CONTROLLED DOWNSHIFT (KICKDOWN)**

It has been noted above that when the overdrive is engaged, the engine only turns 0.7 as fast as when in direct drive. This reduces the power available (excepting at high car speeds) and although this reduced power is usually sufficient for all purposes, there are
times when it is desirable to return to direct drive for more power without reducing the car speed to the point where the overdrive would normally release.

Under such circumstances, the driver merely presses the accelerator pedal beyond the wide-open position. Through suitable electrical controls, this releases the solenoid, urging the pawl toward release from the control plate. However, due to the driving torque reaction, the pawl is held, and cannot move to release until the torque is momentarily relieved. This is accomplished by interrupting the ignition, whereupon the pawl snaps to release, which immediately restores the ignition. When the overdrive has been thus disengaged the roller clutch carries the direct drive, and the driver may hold it in this condition at his pleasure, until he chooses to reengage overdrive by merely lifting his foot from the accelerator momentarily. Thereupon the overdrive is resumed, unless the car speed has in the meantime fallen below the overdrive release point.

**CONVENTIONAL DRIVE:**

Although the normal procedure is to operate that unit as above, taking advantage of the free-wheeling and the overdrive, there are times as when descending long steep grades, where it may be desirable to use the frictional drag of the engine as a brake.

Under such circumstances, the overdrive dash control may be pulled out, swinging the control lever, Figure 9, forward, thus moving the shift rail and shift fork backwards, shifting the sun gear so that the lockup teeth will engage the corresponding teeth of the pinion cage. This causes the entire group of working parts to revolve as a unit, duplicating in all respects the action of the conventional transmission.

In order to thus lock up the unit, if the car is in motion, it is necessary to open the throttle, to assure that all parts revolve together, or to release the overdrive, if engaged, by pressing the accelerator pedal to the floor, pulling out the overdrive dash control at the same time. Thereafter, the car will have the usual conventional drive until the driver chooses to push the overdrive dash control in, which may be easily done at any time.

Since the roller clutch will not transmit a reverse drive, it is necessary for the lockup mechanism to be used whenever it is desired to reverse shift mechanism, which pushes the shift rail to the rear, independently of the overdrive control lever, whenever the transmission is shifted into reverse.

**ELECTRICAL**

While the mechanical structure of the overdrive unit just described, may be considered the working portion of the combination, its automatic action is controlled entirely by the external electrical control system. This system consists of certain units, connected by a wiring circuit. Figure 10.

**SPEED-CONTROLLED OPERATION:**

At low car speeds, the electrical control system is completely inactive. Whenever the car speed reaches the predetermined cut-in point, (18 to 21 miles per hour) centrifugal force, acting upon the revolving governor weights, is sufficient to cause the governor contacts to close.
This grounds that portion of the circuit connected to one terminal of the relay (marked 2), and if the generator is charging the relay contacts will close. This sends battery current to the solenoid terminal No. 4 (1/4" terminal screw) energizing the windings of the solenoid, causing the solenoid plunger to move, compressing the inner spring, and urging the pawl toward engagement.

Upon completion of the plunger movement, a contact within the solenoid opens, disconnecting the heavy traction-coil winding, leaving the lighter holding-coil winding energized.

The solenoid parts remain in this position until the driver closes the throttle, which causes the slowing-down of the sun gear to the reversal point and permits the pawl to move into engagement under the pressure of the inner spring.

The movement of the solenoid plunger also compresses the outer spring; whenever the car speed falls to a point 2 or 3 mph. below the cut-in point, the governor contacts open, releasing the relay, and opening the solenoid circuit, whereupon the outer spring withdraws the pawl from engagement. The circuit then remains inactive until the car speed again reaches the cut-in point.

**DRIVER CONTROLLED OPERATION**

When operating in overdrive, the driver may require to return to direct drive without reducing the car speed below the cut-out point. If the accelerator pedal is pressed down beyond the position corresponding to wide-open throttle, the stem of the kickdown switch is pressed, thus opening that part of the control circuit between the governor and relay, whose contact points open, de-energizing the solenoid, the outer spring of which urges the pawl toward release. Due to the fact that the engine is driving the car through the overdrive gear train, the pawl is pinched by the torque reaction and cannot release until the driving torque is removed. This is accomplished as follows:

The solenoid stem is provided with a contact which closes whenever the pawl is engaged grounding the No 10-32 screw terminal of the solenoid, which is connected to one of the lower terminals of the kickdown switch; when the latter is moved to open the connection across its upper terminals, the lower terminals are connected, and this grounds the primary breaker of the ignition distributor, thus interrupting the engine torque. The pawl immediately snaps out of engagement, and this movement opens the grounding contacts of the solenoid, restoring the ignition. This entire action occurs with such rapidity that not more than 3 or 4 cylinder explosions are missed.

In the event that the driver raises his foot slightly from the accelerator pedal the normal position of the throttle switch is restored, thus re-energizing the solenoid, but the pawl cannot reengage until the throttle is closed to cause the engine to slow down sufficiently to reverse the rotation of the sun gear, as previously explained.

**LOCKED-OUT OPERATION:**

When the overdrive unit is operated in the locked-out, or conventional drive condition, either by having the dash control knob pulled out, or by shifting the transmission into reverse, the shift rail is moved to the rear which also opens the control switch. Since this opens the circuit between the governor and relay, the latter cannot act to energize the solenoid. This prevents any possible attempt to engage the pawl when operating in either conventional drive or reverse.

**OVERDRIVE REPAIR**

**SERVICING EXTERNAL UNITS**

**GOVERNOR SWITCH AND PINION:**

Servicing of governor switch and governor switch pinion may be accomplished by disconnecting wire or wires at governor switch and then screwing governor switch out of overdrive case. When reconnecting wires on cars not equipped with H.D.M., make sure that the overdrive wire (Red) is inserted in the 5/32" dia. terminal and not in the 3/16" dia. terminal.
CONTROL SWITCH

The control switch is attached to the Overdrive housing by two 10-24 screws. Before reinstalling check for damaged gasket and defective wire terminals.

SOLENOID

Detach the solenoid by removing the two mounting screws and turning solenoid 1/4 turn clockwise while pulling out. To install, reverse this procedure. After holes in flange and housing are lined up, but before installing cap screws, pull straight out on solenoid. If it can be pulled out, the ball at the end of the solenoid rod was improperly installed (not locked in the pawl.)

OIL SEAL (OD. MAINSHAFT)

1. Disconnect universal joint at transmission companion flange.

2. Remove the bolts attaching the propeller shaft center bearing support bracket and move propeller shaft rearward to clear companion flange.

3. Remove the companion flange nut, washer, and with puller tool J-820, remove the companion flange.

4. Pry out oil seal from rear of case.

NOTE: DO NOT DAMAGE overdrive case bore during this operation.

To install, reverse procedure of removal and coat outside of seal with a film of white lead and drive seal into place with a suitable driver. Tighten companion flange nut to 90100 foot pounds.

OIL SEAL (OD. CONTROL SHAFT)

Remove control lever and pry out seal with sharp punch. Coat outside of new seal with white lead and drive seal into place with a tubular driver having an inside diameter of 5/8" and outside diameter of 15/16".

SERVICING UNITS REQUIRING REMOVAL OF OVERDRIVE HOUSING ONLY

Repairs to the overdrive case, overdrive mainshaft, mainshaft ring gear, free wheeling cam, pinion cage assembly, stationary gear, shift rail and fork assembly, overdrive main-shaft rear and front bearing, overdrive main-shaft oil seal, speedometer drive gear, solenoid pawl and interlock plunger may be performed underneath the car by removing the overdrive housing without disturbing the transmission. See "Overdrive Housing Removal". However, if the transmission mainshaft, overdrive adapter, or transmission mainshaft bearing are to be replaced, it will be necessary to proceed as outlined under "Transmission and Overdrive Removal".

OVERDRIVE HOUSING REMOVAL

1. Place car on stand jacks.

2. Remove drain plugs and drain transmission and overdrive cases.

3. Disconnect governor switch and overdrive solenoid and control switch wires.

4. Disconnect universal joint at overdrive companion flange.

5. Remove the bolts attaching center bearing support bracket and move propeller shaft rearward to clear companion flange.

6. Remove speedometer cable and speedometer driven gear.

7. Disconnect overdrive control cable at control shaft lever.

8. Remove the companion flange nut, washer and with puller J-820, remove the companion flange.
9. Drive out the overdrive control shaft tapered pin, Figure 11, and pull control shaft out as far as possible to disengage the operating cam of the shift shaft from the slot in shift rail.

NOTE: Small end of taper pin is down.

10. Remove the four bolts attaching the overdrive housing to transmission and overdrive adapter.

11. Remove overdrive housing. (Lightly tap the end of the overdrive mainshaft with a rawhide mallet to prevent mainshaft from coming off with the overdrive housing and spilling the free wheeling rollers).

NOTE: Removal of the overdrive housing will expose the overdrive mainshaft and ring gear, free wheeling cam, pinion and cage assembly, shift rail and fork, stationary gear, stationary gear cover plate and overdrive mainshaft bearing.

**REMOVAL OF PARTS FROM REAR OF ADAPTER**

Install one bolt removed from housing to hold the adapter plate to the transmission case.
4. Remove the retaining clip at the end of the clutch cam, Figure 14, this will allow removal of the cam and the pinion cage assembly.

5. Remove the "U" clip located between the free wheeling cam and pinion cage and separate these units, Figure 15.

6. Remove the sun gear and shift rail assembly, Figure 16.

7. Remove the solenoid attaching screws, turn the solenoid one-quarter turn clockwise and remove, Figure 17.

8. Remove the large snap ring at the adapter plate, Figure 18.

9. The retainer plate, the sun gear, control plate and blocker assembly, and the pawl can then be removed, Figure 19.

10. The interlock lock plunger can be removed by lifting out the plug at the adapter with a sharp punch. Remove interlock by pushing it through the opening uncovered by the plug. Use a stiff wire and work through the opening uncovered by the solenoid.
DISASSEMBLY OF HOUSING

1. Place overdrive housing (37), Figure 1, on front face and use a brass drift against the rear face of speedometer drive gear to drive out the overdrive mainshaft and speedometer drive gear.

2. Remove the overdrive mainshaft oil seal (46) with Remover J-943.

3. Remove the two bearing snap rings (44) and remove overdrive mainshaft rear bearing (45).

CLEANING AND INSPECTION

As each part is removed from the assembly, wash it clean solvent and wipe dry. Protect parts from subsequent dirt accumulation.

After cleaning give parts visual inspection for wear or damage. Replace any broken or excessively worn parts.

Roller clutch parts should be carefully inspected. If rollers show surface markings of any kind they should be replaced. If inner surface of the outer roll shows slight lengthwise indentations, they are normal and do not impair the action of the clutch. However, if the 12 flat surfaces of the cam show such markings, it should be replaced.

BEARINGS:

DO NOT place bearings where dirt is liable to mix with the lubricant in the bearings.

Bearings should be washed in clean gasoline or kerosene. DO NOT SPIN the bearings and particularly do not spin bearings with an air hose. Spinning a bearing at high speeds will almost certainly do considerable damage. After washing the bearings, blow them out with clean dry air. Direct the flow of air into the open face of the bearing while holding the inner race and slowly rotate the outer race by hand. DO NOT ALLOW the air to spin the bearing.

a. Inspect the bearing for cracks and defects.

b. Lubricate the bearing with clean, new engine oil, rotating the bearings by hand in order to spread the lubricant over all surfaces.

Transmission mainshaft bearings are built originally with end play and although they may feel quite loose, it does not necessarily indicate that they are worn and unfit for use.

GEARS:

Inspect all gears for damaged teeth. Remove any and all raised edges from tooth surfaces by hand stoning. Pitted and worn gears should be replaced.

CONTROL SHAFT AND SEAL:

Recommended clearance between control shaft and overdrive housing bore is .001" to .003 but clearance of twice this amount if not accompanied by oil leakage is permissible.

If a new control shaft seal is installed make sure that it does not interfere with rotation of control shaft.

OVERDRIVE MAINSHAFT OIL SEAL:

If the seal is hard, cracked, or glazed, or if signs of oil leakage are apparent at disassembly, install a new seal.

OVERDRIVE SHIFT RAIL DISASSEMBLY:

Drive out shift rail pin (2), Figure 20, remove sleeve (1), spring (3) and shifter fork (4).

Check weight of shift rail springs. The shift rail sleeve spring (3) should have a free length of 2-7/32" and 1-25/64" length under load of eight pounds. The retractor spring has a free length of 2-3/4" and 1-21/32" under load of 12 pounds.
REASSEMBLY OF OVERDRIVE HOUSING

1. Install overdrive mainshaft rear bearing, rear lock ring (44) Figure 1, rear bearing (45), and rear bearing front lock ring (44).
2. Install new oil seal (46) in overdrive case (37).
3. Install speedometer drive gear (42) and overdrive Mainshaft front bearing (35).
4. Before installing shift shaft (22) in the overdrive housing, coat the shift shaft oil seal counterbore with white lead and tap in a new oil seal (23). Dip the threaded end of the shift shaft in liquid soap, and using care, push the shaft through the new seal, turn the shaft so that the shifter lug will be in an upright position.

INSTALLATION OF PART TO REAR OF OVERDRIVE ADAPTER

1. Position the adapter plate and fasten the adapter to the transmission case and install the solenoid pawl, sun gear control plate and blocker assembly, Figure 21.

NOTE: Insert the pawl with the notched side up, be sure that the blocker ring and pawl are properly positioned before installing the snap ring, Figure 22. The interlock plunger is furnished in six different lengths. With pawl fully engaged in slot in stationary gear and one end of the interlock plunger contacting shift rail (NOT SLEEVE) there should be .008" to .021" clearance between the other end of the plunger and the side of the pawl. Select a plunger of proper length to give this clearance.
4. Install the solenoid by turning the solenoid counter-clockwise one-quarter turn, Figure 24, and attach the solenoid to the case with the two lock washers and cap screws.

5. Install the sun gear, shift rail and fork assembly, Figure 25. Check position of shift rail slots as shown in Figure 20, at assembly. (THIS IS IMPORTANT).

NOTE: If shift rail assembly has been taken apart, prick punch pin (2), Figure 20, securely in place before reinstalling assembly. Shifter fork should be a sliding fit in sun gear collar groove.

6. Install clutch cam and pinion cage, attach the clutch cam to the pinion cage assembly with the large retaining clip, Figure 26.

7. Install the pinion cage and the clutch cam assembly on the main shaft and secure the assembly in place with the retaining clip, Figure 27.

NOTE: Replace any "U" clips that are worn or damaged.
8. Install the ring gear (1), Figure 28, on the overdrive mainshaft (3) and lock it in place with the large snap ring (2).

NOTE: To facilitate installation of the main-shaft (output shaft on the free wheeling cam rollers, insert the free wheeling rollers in the cam roller retainer cage, using heavy grease to hold them in position. Then, with the low gear of the transmission engaged, turn the cage and rollers counter-clock wise until the rollers are in their low positions, and snap a tight fitting rubber band around them. Install the output shaft and ring gear on the pinion cage and free wheeling clutch cam and roller unit assembly, turning the shaft to the left as it assembles over the clutch rollers Figure 29.

OVERDRIVE HOUSING INSTALLATION

1. Remove bolt holding adapter to transmission case.

2. Install overdrive to adapter gasket.

3. Install overdrive case, hold speedometer gear with a drift for alignment until case has been installed in position.

4. With the control switch removed, insert a long thin drift through the housing at the control switch opening to line up the retractor spring and the overdrive shift rail.

5. While case is being installed, push the control shaft inward and engage the slot in the shift rail with the shifter shaft lug. (Lug must be up and outside control lever down.)

   Insert J-4149 O.D. Aligning Pilot in lower right hand hole of adapter and housing while tightening the other three Overdrive to transmission case bolts. Tighten all 4 bolts to 2030 ft. lbs. torque.

6. Install control shaft locating pin, large end up.

7. Install control switch, governor pinion, and governor switch.

8. Install companion flange, washer, and nut. Tighten nut to 90-100 lbs. torque.

9. Add lubricant to get proper level in both transmission and O.D. units.
10 - 16 OVERDRIVE

SERVICING UNITS THAT REQUIRE REMOVAL OF COMPLETE ASSEMBLY

REMOVAL:

1. Remove front seat cushion.

2. Remove the four bolts attaching the bottom of front seat frame to seat track. Remove two screws attaching seat adjusting lever to seat frame and remove seat back from car.

3. Disconnect accelerator pedal at accelerator rod.

4. Remove foot brake pedal rod from brake lever.

5. Pull the steering column hole rubber grommet up out of the way.

6. Remove the floor mat.

7. Remove Hudson Weather Control blower unit held by four screws, (2 each side). Disconnect cable at Ranco weather control valve.


9. Release speedometer cable from clip on under side of floor opening cover.

10. Remove the floor opening cover over the transmission.

11. Raise car place on stand jacks.

12. Drain transmission and overdrive units.

13. Disconnect wires at governor switch, solenoid, and overdrive control switch (located at left rear side of overdrive case).

14. Disconnect speedometer cable and remove speedometer driven gear.

15. Disconnect overdrive control cable from overdrive shift shaft lever.

16. Disconnect the front universal joint at transmission. Remove bolts attaching centerbearing support bracket and move propeller shaft rearward to clear transmission companion flange.

NOTE: Use a wire or rubber band to prevent the trunnions from slipping off the "U" joint journal.

17. Disconnect the clutch pedal lever return spring.

18. Remove the two clutch cross shaft bracket bolts and remove clutch cross shaft bracket.

19. Remove the clutch control link clevis pin and unhook clevis.

20. Remove shifter shaft outer lever, nut and washer. This will disconnect the linkage connecting the gear shift to the transmission.

21. Remove two screws and remove flywheel guard from bottom of clutch housing.

22. Remove the two engine rear mounting bolts.

23. Jack up rear end of engine about 1/2" off the frame.

CAUTION: Place a block of wood under head of jack to prevent damage to oil pan.

24. Remove the two top screws holding clutch housing to engine end plate and install two J-2969 headless screws or studs to support the transmission until the balance of the screws are removed.

25. Remove breather pip bracket from clutch housing and bolt attaching breather pipe and rear tappet cover.

26. Remove the nut from brake control hand brake cable lever pivot plate brace and and remove bolt and nut attaching hand brake cable lever to cable lever pivot plate side brace. This will allow the hand brake.
control levers to be pushed out of the way to facilitate removal of the overdrive and transmission.

27. With a helper pull transmission and clutch housing back towards the rear and down, removing the unit from underneath the car.

NOTE: For removal of parts from rear of adapter, see instructions on page 10-10.

NOTE: For disassembly of housing, see instructions on page 10-12.

**DISASSEMBLY-COMPLETE UNIT**

1. Remove six bolts attaching clutch housing to transmission case and remove clutch housing.

2. Install transmission on bench holding fixture and remove transmission cover, gasket, shift rail ball spring and ball.

3. Remove low and reverse shifter fork lock screws.

   **NOTE:** To remove these special self locking screws, use a screwdriver having a straight blade that will enter to the bottom of screw slot. DO NOT USE A TAPERED BLADE SCREW DRIVER.

4. Slide low and reverse shift rail out of front of case, then remove shift fork and shifter, also the shift rail interlock.

5. Remove the set screw from the second and high shift fork and the shift rail stop screw, then slide the shift rail out of front of case. Remove the lock ball and spring from case.

6. Pull mainshaft rearward and main drive gear forward until mainshaft is fully withdrawn from needle roller pilot bearing in rear end of main drive gear

   **NOTE:** Some of the bearing rollers may fall into transmission case at this time.

7. Remove mainshaft lock ring with Lock Ring Pliers KMO-630.

8. Remove the synchronizer shift sleeve and hub assembly, intermediate gear low and reverse gear through cover opening in transmission and pull out mainshaft with overdrive housing adapter.

**DISASSEMBLY OF ADAPTER ASSEMBLY**

1. Remove the mainshaft rear bearing snap ring, Figure 30.

   ![FIGURE 30](image)

2. Remove transmission mainshaft rear bearing and oil baffle from adapter.

   **NOTE:** For inspection procedure, see instruction on page 10-12.

**REASSEMBLY-ADAPTER ASSEMBLY**

1. Thoroughly clean both transmission and overdrive cases.

2. Install transmission mainshaft bearing and oil baffle on mainshaft and in overdrive adapter.

3. Install bearing lock ring in adapter.

**REASSEMBLY-COMPLETE UNIT**

1. Install new overdrive adapter to transmission case gasket.
2. Install transmission mainshaft part way in transmission case and install low and reverse gear with shifter fork groove toward front of shaft.

   It is important that the four oil holes be lined up with the grooves in mainshaft.

   NOTE: The transmission mainshaft and transmission gears are a select fit. If it is ever necessary to replace a transmission mainshaft or a complete overdrive assembly, the fit between the involute splines of the mainshaft and splines in the gears should be free from any binding. In the event binding exists, it may be necessary to stone the splines of the mainshaft to obtain proper clearance.

3. Slide the intermediate gear on mainshaft with the tapered side of the hub toward the front of the mainshaft.

4. Install synchronizer shift sleeve assembly and two bronze synchronizer rings on the mainshaft with the tapered end of the shift sleeve toward the front of the mainshaft.

5. Install synchronizer shift sleeve hub lock ring on end of mainshaft using lock ring pliers.

6. Apply a coating of viscous grease to mainshaft pilot bearing recess end of main drive gear. Insert the sixteen individual rollers comprising the pilot bearing.

7. Engage front end of mainshaft in pocket of main drive gear and press firmly in place. NOTE: Do not hammer on end of mainshaft.

8. Place one bolt to hold adapter to transmission case while performing balance of assembly.

9. Install second and high shift rail lock ball and spring in transmission case.

   NOTE: Light spring for high and second shift rail. Heavy spring for low and reverse shift rail.

10. Place second and high shift fork in position in synchronizer shift sleeve groove and install shift rail and set screw.

11. Install shift rail stop screw.

12. Install shift rail interlock.

13. Place low and reverse shifter in position behind shift shaft inner lever.

14. Place low and reverse shift fork in position, install shift rail and shift fork and shifter set screw.

   Install parts per "Installation of parts to rear of adapter." Page 13.

Reassemble and install housing per "Reassembly of Housing" and "Installation of Housing." Page 13.

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**TRANSMISSION AND OVERDRIVE INSTALLATION**

1. Install two headless screws or studs in engine end plate to assist in supporting the overdrive and transmission at installation.

   NOTE: Before installing the overdrive and transmission to engine rear support plate, check cylinder block rear support plate very carefully for tightness and alignment. This is especially important in cases where the car has been subject to chronic transmission trouble, noisy and jumping out of gear. Make a similar check of transmission clutch bell housing.

   In lieu of highly precise equipment, use a steel straightedge to check steel rear support plate and a surface plate or other flat surface to check the front face of clutch bell housing. Both units should be flat and in plane within .005".
Be sure to check position of clutch driving plate and see that it is perfectly centralized within the clutch assembly. This can be done by using the J-449 aligning arbor or with a standard main drive gear if arbor is not available. If this precaution is not taken, difficulty will be encountered when installing the transmission and the front end of the drive gear shaft and pilot bearing in the flywheel will be damaged.

2. Rotate clutch collar and throwout bearing to position for proper alignment with throwout yoke on transmission.

3. Tighten all rear engine support plate to block screws.

4. Bring the overdrive and transmission assembly to position where the main drive gear (clutch shaft) is aligned with bore of clutch throwout collar, then carefully push transmission forward to enter drive gear splined shaft through grease retainer leather washer, splines of clutch driving plate and into pilot bearing in flywheel.

NOTE: During this operation the main drive gear must be relieved of all over hanging weight of the transmission until the bell housing engages the dowels on engine rear support plate. Before transmission assembly is moved up against rear support plate make a last inspection to verify that end face of throwout collar in clutch is properly aligned with throw-out yoke on transmission and that oil seal lip has not turned under.

CAUTION: Alignment of bell housing with engine is controlled by the sleeve dowel in the upper left location of the bell housing attaching bolt circle and by the dowel bolt at the lower right location viewed from rear of car. Make sure that the former is in place and entered in bell housing hole before tightening bolts. Install lower right bolt (dowel bolt) first. NEVER grind or otherwise reduce the diameter of the dowel bolt to facilitate installation.

5. Remove the two headless screws or guide studs, J-2969.

6. Install remaining clutch bell housing bolts and screws and tighten with a torque wrench to 40-45 foot pounds.

7. Complete remainder of installation by reversing the order of removal of the remaining parts. Check adjustments and refill transmission and overdrive. A total of 3-1/4 pounds of lubricant is required, two pounds for transmission and 1-1/4 pounds for the overdrive unit. S.A.E. - 90 E.P Summer, S.A.E. - 80 Winter.

UNIT CHECKS

OVERDRIVE RELAY CHECK:

Disconnect plug at relay and install test harness to overdrive relay, but do not connect test harness to overdrive harness plug. 1) jumper wire must be connected between No. pin 3, and negative terminal of battery at all times during check 1. Connect test lamp successively between a ground and Nos. 1 and contact pins. The test lamp should not light on either of these checks. Connect No. 1 to No. 3 (pin) and a test lamp between No. 4 and a ground. Relay should click and test lamp should light when No. 2 pin is grounded.
If relay clicks and test lamp does not light, check fuse and fuse holder.

SOLENOID CHECK:

A. CLOSING COIL - Remove solenoid from transmission, connect a jumper wire between positive terminal of battery and mounting flange of solenoid. Connect a second jumper wire between the battery negative terminal and solenoid terminal No. 4; this should cause the solenoid pawl rod to move out. If solenoid chatters in Check A, Hold-In Coil is defective.

B. ENGAGING SPRING - With jumper wire still connected as in paragraph "A" (solenoid energized, plunger extended) place ball end of solenoid against bench. Push down on solenoid. The pawl rod should move in 3/8" under a load of not less than 8 lb s. nor more than 12. Pawl should move out to extended position when load is removed.

C. IGNITION GROUNDING CONTACT - Place a test lamp between negative battery terminal and solenoid terminal No. 6. Lamp should light when this connection is made. Remove jumper from between negative battery terminal and solenoid terminal No. 4. Pawl rod should snap "in" and test lamp should go out.

GOVERNOR CHECK:

Remove overdrive wire at governor and connect test lamp between governor overdrive terminal and negative terminal of battery Figure 32. Drive car on road or raise on jacks. The lamp should light at a car speed of between 18.5 to 21 M.P.H. Upon decreasing speed, the lamp should go out at between 18.5 and 16 M.P.H. Differential between light "on" and light "off" should be 2 or 3 M.P.H. car speed.

FIGURE 32

CONNECTOR PLUG CHECK:

Insert a blade 1/4" wide and 1/32" thick successively into each socket of plug for a distance of 1/2".

Socket should grip blade tightly enough to make a good electrical contact.

NOTE: Flutes on side of plug indicate the plug numbers for example 1 flute or notch is for the No. 1 terminal, 2 flutes No. 2 terminal etc.
KICKDOWN SWITCH CHECK:

Disconnect plug at kickdown switch and install test harness to kickdown switch but do not connect test harness to overdrive harness.

A. Connect test lamp between No. 1 terminal and negative terminal of battery; with switch in normal position, lamp should light when No. 4 is grounded but should not light when No. 2, No. 3 or switch case is grounded.

B. Connect test lamp between No. 2 terminal and negative terminal of battery; with switch arm pushed in, lamp should light when No. 3 is grounded, but should not light when No. 1, No. 4 or switch case is grounded.

NOTE: All models with overdrive have a kickdown switch mounted in the floor under the accelerator pedal. The accelerator pedal rod on these cars should be adjusted so that the carburetor throttle is wide open just before the accelerator pedal touches the moveable stem of the kickdown switch.

CONTROL SWITCH CHECK:

If switch is tested after removal from car, lamp should light when switch plunger is "out" and should not light when plunger is "in".

HARNESS CHECK:

1. Remove overdrive harness plug at the overdrive relay and connect test harness to overdrive harness but not to overdrive relay. Disconnect harness plug at kickdown switch.

2. Connect test lamp between test harness lead No. 1 and ground. Lamp should light.

3. Connect test lamp between test harness leads No. 1 and No. 3. Lamp should light with engine not running but should go out when engine is started. Shut off engine after this test.

4. Connect test lamp between test harness leads No. 1 and No. 4. Disconnect overdrive black wire at solenoid terminal No. 4. Lamp should light only when this black wire is grounded.

5. Connect test lamp between test harness leads No. 1 and No. 2. Lamp should light when kickdown switch plug socket No. 4 is grounded but not before. To ground this plug socket use a second test harness or a suitable jumper wire.

6. Connect test harness to kickdown switch harness plug but not to kickdown switch put transmission in neutral and push overdrive control button "in". Connect test lamp between negative battery terminal and No. 1 test harness lead. Remove red overdrive wire at governor switch. Lamp should light when the wire is grounded but not before. If the harness does not meet this test the overdrive control switch may be at fault. Disconnect the two wires at the control switch, join them with a 153622 connector, and repeat test.
7. Connect test lamp between negative battery terminal and No. 2 test harness lead. Also connect a jumper wire to negative battery terminal. Touch other end of jumper wire to 10-32 terminal of starter solenoid. Lamp should flash on and off in time with distributor contacts.

8. Connect test lamp between negative battery terminal and test harness lead No. 3. Lamp should light only when overdrive green wire from solenoid terminal No. 6 is grounded.

TROUBLE SHOOTING
MECHANICAL
CONDITION NO. 1

DASH CONTROL IMPROPERLY CONNECTED:

A. Unless the overdrive dash control wire is connected to the control lever on the left side of the overdrive housing in such a manner as to move the lever all the way back when the dash control knob is in, the lockup switch may be held open, thus disabling electrical control operation. Likewise, it may hold the shift rail in such a position as to interlock the pawl against full engagement, even though the control switch is not held open, resulting in a buzzing noise when overdrive engagement is attempted.

B. To correctly make this connection, loosen binding post at lever, pull dash control knob out 3/64”, move lever all the way to the rear, and tighten binding post.

CONDITION NO. 2

TRANSMISSION AND OVERDRIVE IMPROPERLY ALIGNED:

A. The same symptoms as above may also result from misalignment at assembly of the overdrive housing to the transmission case, resulting in binding of the overdrive shift rail, so that the retractor spring cannot move the rail fully forward, when the dash control knob is pushed in, and the transmission is not in reverse. Under such conditions, the unit may remain fully locked up.

B. To test for this, be sure that the transmission is not in reverse; disconnect the dash control wire from the lockup lever, and feel the lever for free forward movement. If the lever can be moved forward more than 1/4 inch, it indicates that misalignment probably exists. To correct this, loosen the 4 cap screws holding the overdrive housing to the transmission; remove the lower right hand screw completely and insert J-4149 Aligning Pilot or any short .375” diameter rod. Tighten the 3 cap screws to 20-30 foot pounds torque. Remove pilot and similarly tighten 4th cap screw. To check shift rail alignment compare loads on overdrive control lever with transmission in reverse and with transmission not in reverse.

NOTE: With transmission in reverse overdrive control lever will move forward under a pull of less than 1 oz. When transmission is not in reverse pull required should be about 5 lbs.

CONDITION NO. 3

THROTTLE SWITCH IMPROPERLY ADJUSTED:

The accelerator pedal rod should be so adjusted that the carburetor throttle lever at carburetor strikes its full open stop just before the pedal touches the throttle switch stem.
CONDITION NO. 4

IMPROPER INSTALLATION OF SOLENOID:

A. If car cannot be rolled backward under any circumstances and there is no relay click when the engine is started it is probable that the solenoid has been improperly installed, jamming the pawl permanently into overdrive engagement.

B. If the car will occasionally roll backwards, but not always, (and there is no relay click when the engine is started) it may indicate that upon installation the bayonet lock was caught and the solenoid forcibly twisted into alignment with the attaching flange, thus shearing off the internal keying of the solenoid. Under these circumstances, the end of the solenoid stem may not catch in the pawl and upon release of solenoid the pawl will not be withdrawn promptly from engagement. If the stem can be rotated when grasped by a pair of pliers, it indicates that the internal keying has been sheared.

CONDITION NO. 5

IMPROPER POSITIONING OF BLOCKER RING:

A. Occasionally, either in assembly at the factory, or in service operations in the field, the internal parts of the overdrive unit may have been rotated with the solenoid removed, and the pawl withdrawn from its normal location. This may cause the blocker ring to rotate, so that its two lugs are not located with respect to the pawl. In other words, the solid portion of the blocker ring may be in alignment with the pawl, which will prevent full engagement of the pawl with the sun gear control plate.

B. To test for this condition, remove solenoid cover, pull dash control knob out, roll car 2 ft. forward. Push dash control in, disconnect "A" wire at generator and connect loose end of wire to negative post of battery. Then ground the governor terminal, and watch movement of center stem of solenoid. It should not move more than 1/8 inch when the solenoid clicks. Then, with the relay terminal still grounded, shift into low gear, and roll car forward by hand. Solenoid stem should then move an additional 3/8 inch as the pawl engages fully. These two tests indicate proper blocker action. Unless both tests are met, the blocker ring is probably not in the correct position.

CONDITION NO. 6

ROUGH ENGAGEMENT OF OVERDRIVE:

A. If the unit engages with a severe jolt, usually accompanied by noise, it indicates that the blocker ring has lost its frictional grip upon the hub of the sun gear control plate. This grip should be sufficient to set up a frictional drag of 4 to 6 pounds when new, which will fall to 1 to 1 1/2 pounds when thoroughly broken in. This is easily measured by carefully holding one lug of the control plate in a soft-jawed vise, and with a spring balance hooked into the notch of the nearest blocker lug, and noting the pull required to rotate the blocker after it has started moving. While it is frequently possible to correct this by squeezing the blocker ring together for a tighter fit, installation of new parts is recommended.

ELECTRICAL

CONDITION NO. 7

OVERDRIVE DOES NOT ENGAGE:

A. Disconnect wire from "A" terminal of generator and connect loose end of wire to negative post of battery by means of a jumper.
B. Install test harness at overdrive relay and ground the No. 2 terminal of harness. If relay does not click, check wiring between relay and "A" terminal of regulator by connecting a test lamp between the relay No. 3 terminal and ground. If lamp lights but relay does not click, replace relay. If relay clicks, but solenoid does not click, follow procedure F. If both relay and solenoid click, make check C.

C. Leave generator wire connected as in A but remove test harness from overdrive relay and install it at the kickdown switch. Ground the No. 1 and No. 4 terminals of the kickdown switch in turn. If no click results, it indicates a defective wire or poor terminal connection between the kickdown switch and overdrive relay. If a click results from grounding one terminal, but not from grounding the other, it indicates an open kickdown switch. If a click results as the two terminals are grounded in turn make check D.

D. Make similar test at overdrive control switch (test harness not required). If an open switch is indicated, note Condition No. 1 before discarding switch. If click results as the two terminals are grounded in turn -

E. Ground the governor terminal. If no click results it indicates defective wire or terminal connections between the governor and the control switch. If relay clicks, replace governor unless governor drive pinion is found to be missing or governor drive gear is slipping.

F. If, in procedure 7-B, relay clicked but solenoid did not, connect a test lamp between relay terminal No. 4 and ground. If test lamp does not light when relay clicks, inspect relay fuse; replace it if necessary. If fuse is good, connect the test lamp between ground and each of the fuse clips in turn. If lamp does not light at either fuse clip, inspect wire between relay terminal No. 1 and voltage regulator terminal "B". If lamp lights at each fuse clip, replace relay.

G. If lamp lit in the first part of test F, connect test lamp between solenoid terminal No. 4 (the terminal with the 1/4" diameter screw) and ground. If lamp does not light when relay clicks a defective wire between relay terminal No. 4 and solenoid terminal No. 4 is indicated. If lamp does light it indicates a defective solenoid or connections. Remove solenoid cover, examine solenoid contacts, clean if necessary, reconnect and test again for clicks before discarding solenoid.

CONDITION NO. 8

FAILS TO SHIFT OUT OF OVERDRIVE BELOW 16-21 M. P. H.

CAUTION: If this condition actually exists car will not roll backward and any attempt to force it to do so may seriously damage the overdrive unit itself.

A. Check for this condition by rolling the car backward by hand with the gear shift lever in neutral. If it will roll forward but not backward, disconnect the wires at No. 4 terminal of solenoid and loosen the solenoid and loosen the solenoid mounting screws. If this does not unlock the transmission, remove the mounting screws completely and pull straight out on solenoid to disengage the solenoid pawl from slot in the overdrive stationary gear.

If solenoid pulls free from transmission in this operation without having been rotated 1/4 turn, indicates that the solenoid was improperly installed (solenoid stem was not engaging pawl). See Condition No. 4 "Improper Installation of Solenoid".
Remove solenoid cover and see if solenoid stem has been forced past upper contact spring. Check pawl for release; if pawl cannot be withdrawn freely from engagement, or if the car cannot be pushed forward by hand, with one of the forward transmission speeds engaged, the solenoid unit has probably been damaged internally and must be repaired or replaced. If no such damage is apparent and the solenoid installation appears proper, the solenoid itself may be sticking. If car will roll backward -

B. Push overdrive dash control knob in, disconnect wire from "A" terminal of generator and momentarily connect loose end to negative post of battery by means of a jumper. If overdrive relay and solenoid do not click, follow procedure at E. If click occurs it indicates a circuit ground between the relay and the governor or within the relay or governor.

C. Pull overdrive dash control knob out and again momentarily connect loose end of generator "A" terminal wire to the negative post of battery. If no click occurs grounded circuit is indicated between the control switch and governor or within the governor; follow procedure E and F. If click occurs -

D. Hold kickdown switch open, either by pressing the accelerator pedal to the floor, or by pressing the kickdown switch stem by hand, and momentarily connect loose end of generator "A" wire to negative post of battery. If no click occurs, a grounded circuit is indicated between the control switch and the kickdown switch; follow tracing procedure F. If click occurs ground is indicated between kickdown switch and relay or within one of these units; follow procedure G and H.

E. With generator "A" wire connected to the negative post of battery and overdrive dash control pushed in disconnect governor. If click occurs, replace governor. If no click occurs at governor, replace connection, and disconnect governor wire at control switch. If click occurs, inspect wire for ground; also inspect switch terminal for grounding contact with some other part of the car. If no click occurs replace connection, and -

F. With governor "A" wire connected as in E, disconnect other wire at control switch; if click occurs inspect terminal for a ground. If none is found replace switch. If no click occurs disconnect harness plug from kickdown switch. If click occurs a ground is indicated in either the wire between the kickdown and the control switch or in the kickdown switch. Connect test harness to overdrive harness plug which was removed from kickdown switch but do not plug into kickdown switch. Connect circuits 1 and 4 momentarily. If no click occurs, kickdown switch is defective; if relay clicks the wire between the kickdown switch and the control switch is grounded.

G. With generator "A" wire connected as in E, disconnect harness plug from kickdown switch. If relay clicks, kickdown switch is grounded. If there is no click the wire between the relay and the kickdown switch or the relay is grounded.

H. Connect test harness in system at relay and break the No. 2 circuit. If relay clicks the wire to the kickdown switch is grounded, if it does not click relay is grounded and should be replaced.

**CONDITION NO. 9**

**WILL NOT KICKDOWN FROM OVERDRIVE:**

A. Ground No. 6 (3/16" terminal screw) terminal of the solenoid, with engine running. Press kickdown switch stem by hand. If engine stops inspect connection at terminal, and also contacts inside solenoid for proper closing when stem is extended. If engine does not stop, install test harness at kickdown switch and ground No. 4 circuit. When the No. 3 circuit is grounded engine should stop when the throttle switch stem is pressed. If it does not, replace switch. If the engine does not stop when either of the terminals is grounded, wire or connections are defective between the throttle switch and the primary terminal of the ignition coil. This connection is made to the primary terminal of the ignition coil that is connected to the distributor.
B. Occasionally, the upper contacts of the kickdown switch will not open. To test for this condition disconnect "A" generator wire at generator and connect loose end of wire to negative post of battery. Ground overdrive wire at control switch or governor; this should cause the solenoid to click. Press the accelerator pedal all the way to the floor; this should cause a second click; no click indicates a defective kickdown switch, or that the kickdown switch is not being opened. See Condition No. 3 "Throttle Switch Improperly Adjusted".

**CONDITION NO. 10**

**ENGINE CUTS OUT WHEN KICKDOWN IS ATTEMPTED:**

With engine running, press kickdown switch stem with hand. If engine stops, disconnect wire from No. 6 terminal of solenoid and press switch stem again. If engine does not stop, it indicates a damaged No. 6 terminal insulator in the solenoid cover, or a defective solenoid. If the engine stops with this terminal disconnected, it indicates either a grounded wire between the kickdown switch and the solenoid, or a defective kickdown switch.

**CONDITION NO. 11**

**HARD SHIFT INTO REVERSE:**

**NOTE:** A car equipped with Overdrive is normally more difficult to shift into reverse than a car with a standard transmission. When the car is new and all controls a little stiff the shift into reverse will be easier if done as follows:

A. Shift lever into reverse position as far as it will go easily, then allow clutch to engage slightly while continuing to push on lever.

B. If unusual difficulty is experienced at any time, shift to reverse can be made much easier by pulling Overdrive control button "out" before shifting.

C. If shift to reverse is impossible, make check under Condition 15, "Remains in Overdrive after car is stopped".

**CONDITION NO. 12**

**FREE WHEELS AT SPEEDS OVER 16-21 MPH.**

**NOTE:** If car is equipped with Hudson Drive-Master, check to see if free wheeling is caused by disengagement of clutch. If it is, see trouble shooting for this equipment in Hudson Drive-Master Section 9.

A. If continuous, make checks for failure to shift into Overdrive, Condition No. 7.

B. If intermittent, check for poor electrical contacts in all parts of Overdrive wiring.

**CONDITION NO. 13**

**SHIFTS OUT OF OVERDRIVE AT SPEEDS ABOVE 21 M.P.H.**

" See check for intermittent free wheeling under "Free Wheels at Speeds Over 16-21 M.P.H."

**CONDITION NO. 14.**

**TRANSMISSION LOCKED:**

**NOTE:** If transmission does not shift out of overdrive when the car is brought to a stop and the car then rolls backward slightly, the transmission will lock. The car cannot be moved forward or backward by the engine or by towing. Make check under Condition No. 8 "Fails to Shift Out of Overdrive Below 16 to 21 M.P.H.", under Test A.

**CONDITION NO. 15**

**REMAINS IN OVERDRIVE AFTER CAR IS STOPPED:**

If car is in overdrive, engine running, a clicking noise will be heard whenever the relay plug is connected or disconnected. To remedy this condition, make checks as outlined under Condition No. 8.
HYDRA-MATIC TRANSMISSION INSTRUCTIONS ON OPERATING HUDSON WITH HYDRA-MATIC

The manual selector lever located just below the steering wheel Figure 1, is used to select neutral, one of two forward speed ranges and reverse. These position’s are all shown on the indicator dial. The indicator dial is illuminated when the lighting switch is turned on. An explanation of the indicator dial markings are as follows:

- N-Neutral.
- DR-For all normal forward driving.
- LO-For maximum power forward, such as operating up steep grades under heavy loads, or in sand and also to be used as a brake when descending steep grades.
- R-For Reverse. (Selector lever must be raised to engage reverse position.)

FIGURE!: 1

STARTING

NOTE: The starting circuit is wired so the starter will not (and should not operate) unless the manual selector lever is in the "N" (neutral) position.

TRANSMISSION

To start the engine:
(a) Apply the hand brake.
(b) Place the manual selector lever in "N" (neutral) position.
(c) Depress the accelerator pedal halfway and release.

CAUTION: Never pump the accelerator or race the engine.

(d) Turn ignition switch on and press starter button.

NOTE: If the engine fails to start in five to ten seconds, it is possible that the carburetor is flooded. In that case, it will be necessary to depress the accelerator pedal to the wide open position while continuing to operate the starter.

OPERATING IN "DR" RANGE

After the engine is started, move the manual selector lever to the "Dr" position and allow it to remain in this position for all normal forward driving.

NOTE: When both the engine and transmission are cold, there may be a tendency for the car to creep slightly due to the increased engine RPM, when the engine is operating on fast idle and the manual selector lever is in the "Dr" position. A slight application of the foot brake or hand brake will hold the car during this condition. When the brakes are released, the car will move forward when the accelerator pedal is depressed.

ACCELERATION:

The shifts from first speed to second, second speed to third and from third to fourth (direct drive) will occur at different car speeds depending upon the amount of accelerator pedal pressure. With slight accelerator pedal pressure, the shifts will occur at lower car speeds. As the accelerator pedal pressure is increased, the car speed at which the shifts will occur will be higher.

DECELERATION:

With the manual selector lever in the "Dr" position and the car is decelerating with the accelerator pedal fully released and free, the
shift from fourth speed to third occurs automatically at approximately 15 to 11 miles per hour and from third speed to first at approximately 10 to 3 miles per hour. "See Chart Below."

**HYDRAMATIC SHIFT POINTS IN M. P. H. FOR HUDSON CARS**

<table>
<thead>
<tr>
<th>SHIFT</th>
<th>DRIVE RANGE</th>
<th>MINIMUM THROTTLE</th>
<th>FULL THROTTLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td></td>
<td>4-8</td>
<td>10-15</td>
</tr>
<tr>
<td>2-3</td>
<td></td>
<td>10-14</td>
<td>27-35</td>
</tr>
<tr>
<td>3-4</td>
<td></td>
<td>15-20</td>
<td>58-66</td>
</tr>
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</table>

**LO RANGE**

<table>
<thead>
<tr>
<th>SHIFT</th>
<th>MINIMUM THROTTLE</th>
<th>FULL THROTTLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td></td>
<td>22-37</td>
</tr>
<tr>
<td>2-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DOWNSHIFTS**

<table>
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<th>SHIFT</th>
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<th>FULL THROTTLE</th>
<th>FORCED</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-3</td>
<td>15-11</td>
<td>19-16</td>
<td>60-15</td>
</tr>
<tr>
<td>*3-2</td>
<td>10-5</td>
<td>14-10</td>
<td></td>
</tr>
<tr>
<td>2-1</td>
<td>5-3</td>
<td>10-5</td>
<td></td>
</tr>
<tr>
<td>4-2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*It is possible for 3-2 downshift to be omitted on rapid braking deceleration.

**LO RANGE**

<table>
<thead>
<tr>
<th>SHIFT</th>
<th>CLOSED THROTTLE</th>
<th>FULL THROTTLE</th>
<th>LOCKOUT</th>
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</thead>
<tbody>
<tr>
<td>4-3</td>
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<td>3-2</td>
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<td>9-5</td>
<td>14-10</td>
<td>48-39</td>
</tr>
<tr>
<td>4-2</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**FORCED DOWNSHIFT FROM FOURTH THIRD:**

For increased power when climbing hills or passing a car on the open highway at speeds below 60 miles per hour, fully depress the accelerator pedal. The drive then changes from fourth speed to third for a rapid pickup and returns to direct drive (fourth speed) automatically when the accelerator is released or when the car has reached approximately 65 miles per hour. "See Chart Above."

**STOPPING THE CAR:**

To stop the car, release the accelerator pedal and apply the brakes in the conventional manner. The manual selector lever remains in the "Dr" position and the engine is then "in gear" and helps to slow down the car until its speed reaches a few miles per hour. The slippage of the fluid coupling is sufficient to prevent the engine from stalling.

**CAUTION:** Always return the manual selector lever to the "N" position whenever the driver leaves the car with the engine still running. For additional safety always apply the hand brake. This precaution prevents movement of the vehicle should the pedal be accidentally depressed.

**"LO" RANGE POSITION:**

With the manual selector lever in the "Lo" position, the transmission will operate in only the first and second speeds; it will not change to the third or fourth speed regardless of engine speed.

The "LO" range position is provided for two special uses. (1) For descending steep hills, where traffic signs call for second gear, this affording the maximum engine braking power. (2) Pulling through deep sand or up steep grades under heavy loads when upshifting is not desired.

The shift change from "DR" to "LO" range position can be made at any speed below 48 miles per hour when the road is dry and traction is good.

**NOTE:** Do not use the "LO" range on slippery pavement as skidding may result.

**REVERSE:**

The car must be brought to a full stop before
before shifting selector lever to the reverse position. To engage reverse after a complete stop, move the manual selector lever to the "Lo" range position, then raise the end of the selector lever slightly, hesitate a second or two then move the selector lever into the "R" position.

PARKING:

For additional safety, when the car is parked, place the selector lever in "Lo" position shut off the engine, then place the selector lever in the "R" position.

COASTING:

Do not coast with selector lever in the neutral position. To maintain better control of the car it is advisable to keep the manual selector lever in the "Dr" or "Lo" range position when traveling forward.

PUSHING TO START THE ENGINE:

To start the engine by pushing the car, move the selector lever to the "N" (Neutral Position). When the car reaches a speed of approximately 18 to 20 miles per hour, turn on the ignition switch and move the selector lever to the Drive position (not to LO).

TOWING OR PUSHING:

FOR TRANSMISSION NOT FUNCTIONING PROPERLY - The propeller shaft must be disconnected at the rear universal joint or the rear wheels raised off the ground to prevent possible damage to the transmission.

FOR MECHANICAL FAILURES OTHER THAN TRANSMISSION - Propeller shaft need not be disconnected if transmission has been operating normally provided that the car has been driven a minimum of 1000 miles and that towing speeds of not less than 15 or not more than 25 miles per hour be maintained.

FUNDAMENTAL PRINCIPLES OF THE HYDRAMATIC TRANSMISSION

DESCRIPTION

The Hydra-Matic Transmission is an automatic means of transmitting the engine power to the vehicle propeller shaft, after which it is directed to the rear axle and the rear wheels in the conventional manner.

The Hydra-Matic Drive consists of a fluid coupling which replaces the clutch and is combined with a hydraulically-controlled automatic transmission having four speeds forward and one reverse.

Gear ratios are obtained through planetary gears in the Hydra-Matic transmission.

PLANETARY GEAR TRAIN

A planetary gear train, Figure 2, consists of three members:

1. A "Center" or "Sun" gear.
2. A planet carrier with three planet pinion gears.
3. An internal gear.

FIGURE 2

The "Sun" gear is surrounded by and meshes with the planet pinion gears, the pinion gears rotate freely on pins attached to a common housing called a "planet carrier." A ring with teeth machined on the inside circumference surrounds the planet assembly and meshes with the planet pinion gears. This ring called the "internal" gear, because of its internal teeth.
ADVANTAGES OF A PLANETARY GEAR TRAIN:

1. With the use of a planetary gear train, the load is distributed over several gears and while planetary gears are smaller and occupy less space than the sliding type gears, they can transmit more tooth load because there is more tooth area in contact at all times.

2. As the planetary gears are always completely in mesh, there is no possibility of gear tooth damage due to gear clash or partial engagement.

3. The common axis for all members of the planetary train makes the unit more compact and facilitates its use as a coupling.

OPERATION OF THE PLANETARY GEAR TRAIN:

1. A planetary gear train can be used to increase power and decrease speed in either of two ways.

(a) In Figure 3, the internal gear is held stationary, and power is applied to the center gear. As the "Sun" gear turns, the planet pinion gears which are in mesh with it, rotate on their respective pins. Since they are also in mesh with the stationary internal gear, they must "walk around" inside the internal gear carrying the planet carrier with them in the same direction of rotation as the "Sun" gear. The planet carrier then rotates at a speed less than that of the "Sun" gear, and the planetary gear train functions as a power-increasing speed reducing unit.

(b) The same results can be obtained by holding the "Sun" gear stationary and applying power to the internal gear, Figure 4. In this case, rotation of the internal gear causes the planet pinion gears to rotate on their respective pins and at the same time "walk around" the "Sun" gear, thus rotating the planet carrier at a speed less than that of the internal gear, and making the gear train function as a power-increasing, speed reducing unit.

2. A planetary gear train can be used to reverse direction of rotation when the planet carrier is held stationary. In this instance, if power is applied to the "Sun" gear, the planet pinion gears rotate on their respective pins; but since the carrier is stationary, they act...
act merely as idlers, transmitting power to the internal gear and causing it to rotate in the opposite direction, Figure 5.

In all of the examples shown, one member has been held stationary, the power applied to another member, and taken off the third member.

3. A planetary gear train can be used to function as a coupling for direct mechanical drive when any two members are locked together.

4. When no member is held and no two members are locked together the planetary gear train will not transmit power, therefore, it is in neutral, Figure 7.

**COMPONENTS OF A TWO-SPEED PLANETARY TRANSMISSION**

A simple two speed planetary transmission will be described as an introduction to the operation of the Hydra-Matic Drive.

The following components make up the two speed transmission:
- A single planetary gear train.
- A band and servo for band application. A clutch to lock two members together. An oil pump and pressure regulator.
- A manual valve.
- A shifter valve.
- A governor.
- A regulator plug.

**PLANETARY GEAR TRAIN:**

The planetary gear train in the two speed transmission is arranged as shown in Figure 8.
other set is attached to the drum. The annular piston is also attached to the drum and when applied, locks the "Sun" gear to the planet carrier.

**BAND AND SERVO FOR BAND APPLICATION:**

A band is used to hold the drum which is attached to the center gear. At one time, some cars used planetary transmissions in which the band was applied by a foot pedal. Figure 9.

Hydraulic application of the band will be used to coincide with the method used in the Hydra-Matic transmission, Figure 10.

The two pistons are mounted on a common stem. The piston and stem assembly is installed in a cylinder or servo body with a division in the body between the pistons to hold the servo in the released position when no fluid pressure is applied. When the piston stem acts on one end of the band the anchor holds the other end to facilitate band application.

**OPERATION OF THE SERVO:**

When hydraulic force greater than the spring pressure is applied at point A, Figure 11, the piston stem will be forced against the band, applying the band on the drum.

When hydraulic force equal to that applied at point A is applied at both points B and C the piston stem will be forced away from the band because in this case "release" force is greater than "apply" force, Figure 12.
CLUTCH TO LOCK TWO MEMBERS TOGETHER:

A multiple plate clutch is used to lock the planet carrier and output shaft to the “Sun” gear. The clutch could be applied mechanically and released by spring pressure as shown in Figure 13.

OIL PUMP AND PRESSURE REGULATOR:

A gear type oil pump driven by the input shaft, and a spring loaded pressure regulator valve are required to provide hydraulic pressure for operation of the transmission, Figure 15.
the valve will bypass oil to the pan. When pressure in the system falls Blow that required to hold the valve open, the valve will close. This cycle is repeated continuously and constant regulated "main line" pressure results.

MANUAL VALVE:
A manually operated valve is placed in the main line beyond the pressure regulator valve to permit shutting off oil to the hydraulically operated components. Figure 16.

![FIGURE 16](image1)

SHIFTER VALVE:
A shifter valve is required to make the automatic shift from low to direct drive. The valve is held in the closed position by a spring. Figure 17.

![FIGURE 17](image2)

GOVERNOR:
The shift from reduction to direct drive must be made at the correct time in relation to vehicle speed so that the engine will be neither racing excessively nor overloaded. This can be accomplished by means of a simple centrifugal or flyweight governor, Figure 18, driven by the transmission output shaft.

![FIGURE 18](image3)

![FIGURE 19](image4)
When the vehicle is standing, the governor weight, to which a valve is attached, is "In", closing off the oil passage. As the vehicle starts to move, the output shaft rotates the governor assembly. As the vehicle speed increases, the governor weight moves outward moving the valve and uncovering the oil passage to the shifter valve. Oil going through the valve exerts force against the large area of the valve, acting against centrifugal force. The valve then regulates pressure to the shifter valve, variable with vehicle speed, Figure 19.

As vehicle speed continues to increase, centrifugal force increases, moving the valve further outward thus increasing the variable regulated pressure to the valve. This pressure is known as governor pressure.

**REGULATOR PLUG:**

With the shifter valve, shifter valve spring, and governor described above, the shift from low to direct drive will always occur at the same vehicle speed.

This arrangement is undesirable in a vehicle because many circumstances arise when a shift at higher or lower speeds is desired. Examples of this are when rapid getaway is desired or when climbing a hill.

The need for a higher shift point thus corresponds closely with the need for increased power output of the engine. Since engine power output is controlled by throttle opening, which in turn is controlled by the accelerator pedal, the timing of the shift can be regulated with the position of the accelerator pedal.

One way of accomplishing this is shown in Figure 20. Assume that the shifter valve spring is seated against a movable regulator plug which is connected to the accelerator pedal. As the accelerator pedal is depressed, the plug is moved inward compressing the spring and thereby increasing its tension. Because of this increased tension, more governor pressure is required to move the shifter valve and consequently the shift will occur at higher vehicle speeds, determined by the accelerator pedal position.

With this arrangement, the transmission will upshift at a very low vehicle speed when the throttle is nearly closed, and at a much higher speed when the throttle is wide open.

*FIGURE 20
OPERATION OF A HYDRAULICALLY OPERATED TWO-SPEED TRANSMISSION*

In order to simplify the explanation of the two speed transmission, the components described above will be illustrated schematically.

**LEGEND FOR SCHEMATIC ILLUSTRATIONS:**

1. Solid lines with arrows represent passages filled with oil at constant regulated main line pressure.
2. Solid lines without arrows represent passages in which no pressure exists.
3. - - - Broken lines with arrows represent passages filled with oil at variable pressure.
4. - - - Broken lines without arrows represent passages in which no variable pressure exists.
NEUTRAL (ENGINE RUNNING):

In neutral the manual valve is closed. The oil pump, driven from the input shaft which turns with the engine, delivers oil to the pressure regulator and the shifter valve. The regulator returns excess oil to the pump, Figure 21.

The band is released by the spring because there is no oil pressure on the servo piston. The clutch is released by springs because there is no oil pressure to apply the annular piston.

LOW GEAR (REDUCTION):

The manual valve is moved to direct oil pressure to the servo piston and governor. Oil pressure is present on the land of the closed shift valve. The servo applies the band and the clutch is released by springs, Figure 22.

When vehicle speed is such that the governor pressure overcomes the shifter valve spring, the valve will open automatically and allow oil to flow through the oil line to apply the clutch and release the servo. This places the planetary unit in direct drive.
HIGH GEAR (DIRECT DRIVE):

The manual valve continues to direct oil pressure to the servo piston at A, and to the shifter valve and governor. Governor pressure, due to vehicle speed, has overcome the shifter valve spring pressure and moved the valve so that the mainline regulated pressure is directed to the servo at B and C, releasing the band, and to the planetary unit to apply the clutch, Figure 23.

The transmission will stay in direct drive as long as vehicle speed is sufficient to maintain governor pressure high enough to hold the shifter valve spring compressed. When speed is reduced to a point where the spring overcomes governor pressure the transmission will automatically downshift to low, Figure 22.
REGULATOR PLUG:

The need for a regulator plug was outlined on page 13. In that case, the regulator plug was moved mechanically to increase spring tension to delay the upshift. To coincide with the Hydra-Matic Drive the regulator plug in the simple two speed transmission is moved by a variable regulated hydraulic pressure called "Throttle pressure."

Throttle pressure is obtained by the use of a throttle valve assembly which is moved by mechanical linkage from the accelerator pedal. The valve assembly is so designed that "throttle pressure" increases with carburetor throttle opening. Therefore, the further the accelerator pedal is depressed, the more the shifter valve spring tension is increased to delay the upshift, Figure 24.
FLUID COUPLING
A fluid coupling is employed in the Hydra-Matic drive to relieve the driver of operating a clutch pedal and to cushion the shifts.

The fluid coupling consists of two parts called "torus members" splined to independent shafts and located in a fluid filled housing consisting of a flywheel and torus cover. The principal parts of each torus member Figure 25 are, the outer shell and hub, the inner shell, and the vanes interconnecting these shells. The two members are identical in construction except for the hubs which are different in size to fit their respective shafts, Figure 27.

FIGURE 25

A schematic cross-section of two torus members attached to independent shafts and located in a fluid filled housing; the shape of the compartment formed by the vanes is shown shaded. Figure 26 illustrates the component parts which make up the fluid coupling.

FIGURE 26

FIGURE 27
In operation, rotation of the drive torus member causes the fluid within that member to be forced radially outward. Fluid then crosses over and strikes the vanes of the driven torus member causing it to rotate in the same direction as the drive member as shown in Figure 28.

The higher the speed of the drive member, the greater the force exerted by the fluid on the driven member due to centrifugal action. Consequently, a fluid coupling is:

- Very effective at high speed.
- Less effective at low speed.
- Non-effective at idle speed.

### HYDRA-MATIC DRIVE COMPONENTS AND THEIR LOCATION

It is possible to obtain only two forward speeds, reduction and direct, from one planetary gear train or unit when applying power at the same source (for example the sum or center gear). As a greater variation of speed ratios is required to satisfactorily operate a vehicle, the Hydra-Matic transmission contains two planetary gear trains arranged to provide four speeds forward. This accomplished by various combinations of bands and clutches. It also contains a third planetary gear train for reverse. In all forward speeds the reverse planetary unit has no function and simply revolves with the output shaft.

Power travels from the flywheel to the torus cover through the front planetary, which is in reduction because the band is applied, and then to the rear torus, Figure 30. The rear torus in the Hydra-Matic Drive is the drive member while the front torus is the driven member. As the vehicle starts, power travels from planetary, in reduction, then through the fluid coupling and back to the rear.
planetary unit. When the speed of the vehicle has increased to a point where the reduction of the front planetary unit is no longer required, the front planetary unit shifts to direct drive and the drive torus turns at the same speed as the engine.

In the Hydra-Matic transmission two planetary units are used to give four forward speeds, Figure 31. Although both units are similar, the rear unit differs in two ways from the front unit.

1. It is longer, has more clutch plates and greater gear reduction.
2. The servo is normally applied by spring pressure and released by oil pressure.

Memorize band and clutch application for the four forward speeds. One way this can be done is as follows:

The greatest forward speed reduction will be wanted in first speed -- call this 100% usable reduction.

The next greatest reduction will be wanted in second speed--call this 60% usable reduction.

The next greatest reduction will be wanted in third speed -- call this 40% usable reduction.
In fourth speed, direct drive is wanted -- call this 0% reduction.

For simplicity in this example, the front unit will be considered capable of giving 40% usable reduction and the rear unit 60% usable reduction. The two units then can be used in various reduction and direct drive combinations to provide four speeds forward and reverse, Figure 32.

NOTE: Review clutch and band applications frequently. Ability to visualize "reduction" or "direct drive" in each unit for each forward speed is invaluable in diagnosing trouble.

HYDRAULIC ACTION AND POWER FLOW IN THE HYDRA-MATIC TRANSMISSION

The hydraulic principle of the Hydra-Matic transmission is basically the same as in the two speed transmission described earlier. Oil is delivered by the oil pump to a pressure regulator, which maintains constant "main line" pressure, then to the manual valve. When the manual valve is in the "Dr", "Lo" or "R" position it directs oil to the front servo to apply the band.

FIGURE 33

NEUTRAL

CAR STANDING - ENGINE NOT RUNNING:

The front servo is oil applied and oil and spring released. Therefore, when the car is standing and the engine not running, the front band and the front clutch are released by springs, Figure 33.

The rear servo is spring and oil applied and oil released. When the vehicle is standing and the engine not running, there is no oil pressure. The band is applied by spring pressure, placing the rear unit in reduction. The clutch is released by spring pressure.

FIGURE 34

NEUTRAL

CAR STANDING - ENGINE RUNNING:

Hydraulic Action in Neutral - Engine Running:

When the manual valve is in the neutral position, oil is directed to the rear servo to release the band. No oil can get into the line leading to the front servo so it is held in the released position by a retracting spring. Both bands and clutches are then released and the transmission is in neutral, Figure 34.
POWER FLOW IN NEUTRAL (ENGINE RUNNING):

The flywheel, torus cover, and the front drive gear (front unit internal gear) are all attached to each other and rotate at engine speed. Since the front drive gear is the internal gear of the front planetary unit, its rotation causes the front unit planet gears to rotate on their pins. Since no member of the front unit is held, no power is transmitted to the planet carrier and drive torus, Figure 35.
FIRST SPEED

HYDRAULIC ACTION IN FIRST SPEED:

Placing the manual selector lever in "Dr" range positions the manual control valve for all forward speeds. It cuts off oil pressure to the rear unit servo, permitting the spring to apply the band, and at the same time directs oil pressure to the front unit servo, applying the front band. There is no oil pressure to the clutches. Oil is also directed to the shifter valves, but their position is such that the oil is blocked off from the units.

When the vehicle is set in motion the output shaft and governor start to rotate and oil from the governor, "governor pressure," is directed against the governor plugs. Both units are in reduction, and the transmission is in first speed, Figure 36.
POWER FLOW IN FIRST SPEED:

When the vehicle starts to move, the path of power is through the flywheel to the torus cover and front drive gear, Figure 37, to the front planet carrier. The front band is holding the front unit "Sun" gear, carrying the front planet carrier in the same direction as the internal gear but at reduced speed.

Since the drive torus is connected to the front planet carrier it also turns at reduced speed. From the drive torus the power is transferred through fluid to the driven torus, then along the main shaft to the "Sun" gear of the rear planetary, then, through the planet pinions to the planet carrier on the output shaft in reduction because the internal gear of the rear unit is held stationary by the band.
SECOND SPEED

HYDRAULIC ACTION IN SECOND SPEED:

Governor pressure increases with vehicle speed to a point where it will overcome the 1-2 shifter valve spring and automatically open the valve. Oil is then directed to the front unit where it releases the band and applies the clutch. Application of the front unit locks the planet carrier to the "Sun" gear and the front unit acts as a coupling. The drive torus is now revolving at the same speed as the flywheel. The rear unit meanwhile remains in reduction. Figure 38.
POWER FLOW IN SECOND SPEED:

Power travels from the flywheel to the torus cover. Through the front planetary unit in direct drive, forward to and through the fluid coupling, then back along the main shaft. Through the rear planetary which is in reduction, to the output shaft, Figure 39.
THIRD SPEED
HYDRAULIC ACTION IN THIRD SPEED:

Two additional valves are needed to make the shift from second to third speed.

1. A 2-3 shifter valve to place the rear in direct drive.
   A double transition valve to cut off the oil holding the front unit in direct drive, allowing it to go back into reduction automatically.

The 2-3 shifter valve opens at a high speed than the 1-2 valve because of great spring tension. When vehicle speed is such that the increasing governor pressure overcomes the 2-3 shifter valve spring, the valve opens allowing oil to flow to the rear unit where it releases the band and applies the clutch.

At the same time oil is directed against the double transition valve moving it over and cutting off the oil that holds the front unit in direct drive. The front servo "apply pressure" applies the front unit band causing the unit to go into reduction. With the front unit in reduction and the rear unit in direct drive the transmission is in third speed, Figure 40.

Thus it can be seen that to transfer from 2nd to 3rd speed, a complete change or transition takes place in each planetary unit.
POWER FLOW IN THIRD SPEED:

Power travels from the flywheel to the torus cover, then through the front unit in reduction. But at the front planet carrier the power divides. Part of it travels forward, through the shaft of the front planet carrier, through the fluid coupling and back along the mainshaft to the "Sun" gear and planet gears of the rear unit. The other part of the power travels back through the shaft of the front planet carrier, through the rear unit clutch to the internal gear, where it is combined with the power from the fluid coupling at the "Sun" gear and planet pinion gear, then passes to the output shaft. Figure 41.
FOURTH SPEED

HYDRAULIC ACTION IN FOURTH SPEED:

A 3-4 shifter valve is added to obtain the shift into fourth speed. The 3-4 shifter valve spring is heavier than the 2-3 valve spring and therefore its operation requires higher governor pressure.

When the vehicle reaches sufficient speed, governor pressure will overcome the 3-4 shifter valve spring, opening the valve and directing oil through the double transition valve to the front unit without affecting the rear unit. This applies the front clutch and releases the front band. Both units are in direct drive and the transmission is in fourth speed, Figure 42.
POWER FLOW IN FOURTH SPEED:

The path of power is exactly the same as in third speed except that it passes through the front planetary in direct drive instead of reduction. The same division of power applies in fourth speed as in third. Thus the fluid coupling is relieved of excess strain which prevents it from slipping. Figure 43.
TIMING THE SHIFTS

To delay the shifts for rapid acceleration or hill climbing, a throttle valve assembly is used. This valve assembly is operated by linkage from the accelerator pedal and regulates the oil pressure which varies with the carburetor throttle opening. This pressure, called "Throttle pressure," works against three regulator plugs to increase shifter valve spring pressure. Figure 44.

Therefore, higher vehicle speeds and higher governor pressure will be required to accomplish each shift. When accelerating slowly the accelerator pedal is depressed only slightly, the shifts will then occur at a low vehicle speed. When accelerating rapidly, the accelerator pedal is almost fully depressed and, therefore, the shifts will not take place until a higher vehicle speed is reached.
FORCED 4-3 DOWNSHIFT

It is sometimes desirable, while driving in fourth speed, to shift the transmission into third speed for rapid acceleration.

The 4-3 downshift is accomplished through the "T" valve (part of the throttle valve assembly) and a detent plug. The detent plug is located at the end of the throttle valve assembly, Figure 45.

When the accelerator pedal is depressed to wide open throttle position, the throttle valve comes into contact with the detent plug where resistance can be felt in the pedal. Depressing the pedal further will overcome this resistance and move the detent plug.

The "T" valve then reaches a position where it opens a port directing main line pressure back of the 3-4 shifter valve, forcing it closed. This cuts off the pressure to the front unit clutch and it is disengaged by spring pressure. Pressure is also cut off from the release side of the front servo and pressure on the apply side of the servo applies the band. The transmission is then in third speed. With accelerator pedal held fully depressed, throttle pressure with spring pressure is sufficient to hold the valve closed until a high vehicle speed is reached. If the accelerator pedal is released, the shift from third to fourth will occur when governor pressure overcomes throttle and spring pressure.
"LO" RANGE

When descending steep grades where maximum braking power of the engine is desired or when pulling through deep sand, or up steep grades, it is desirable to keep the vehicle operating in first and second speeds regardless of vehicle speed. This is accomplished by moving the manual valve to the "Lo" position which directs main line pressure back to the 2-3 shifter valve, locking it closed, Figure 46.

NOTE: If the manual valve is moved from "Dr" to "Lo" position when vehicle is traveling at high speed the shift will not occur until speed decreases to where the gear reduction will not be detrimental to the engine. The vehicle speeds obtainable in first and second speed do not develop enough governor pressure to open the 2-3 shifter valve against spring and main line pressure. Therefore, the transmission will not shift above second speed.
When the manual selector lever is moved to the "R" position the reverse anchor engages the external teeth on the reverse internal gear. At the same time the manual valve is moved with the following results, Figure 47.

1. Oil is directed to the front servo to apply the band.
2. Oil is directed to the rear servo to release the band.
3. Oil to the governor is cut off so there can be no upshift in reverse.
POWER FLOW IN REVERSE:

Power travels from the flywheel and torus cover through the front planetary in reduction to the fluid coupling, then along the mainshaft to the "Sun" gear of the rear planetary. The clutch and band of the rear planetary are released and the planet carrier is held by the propeller shaft. The planet pinion gears then act as idlers and the rear unit "Sun" gear turns the internal gear in the opposite direction. The internal gear through a flange, drives the "Sun" gear of the reverse unit in a reverse direction. Power then travels through the reverse planetary to the output shaft (which is also the planet carrier of the rear unit) in reduction because the internal gear is held by the reverse anchor. Figure 48.
The increased torque developed under rapid acceleration requires additional pressure to hold the bands to the drums without slipping. The pressure is obtained through the use of a compensator valve which directs variable regulated oil pressure to both the front and rear servos, Figure 49.

The compensator valve which is operated by throttle valve, regulates a pressure that varies with accelerator opening. Therefore, the greater the accelerator pedal travel (giving greater throttle pressure) the greater the resulting compensator pressure to assist in applying the band.
**OPERATION OF FRONT SERVO**

**NEUTRAL:**

When the selector lever is in the "N" position there is no oil pressure to the servo and the retracting spring holds the servo apply piston in the released position, Figure 50.

**APPLY:**

With the selector lever in "DR", "LO" or "R", position regulated main line pressure is directed to piston area (A) to move the piston and stem and apply the band, Figure 51.

**COMPENSATOR PRESSURE:**

Compensator pressure is applied at point (D), Figure 51, to assist the regulated main line pressure (which is applied at piston area (A) to prevent the band slipping under heavy acceleration. Compensator pressure is always present when there is any carburetor throttle opening and this pressure increases with carburetor throttle opening.
RELEASE:

To release the band, regulated main line pressure is applied at piston area (B) and (C), Figure 52. The area of these two pistons is greater than the area of pistons (A) and (D) and the apply piston is moved to the released position.

4 TO 3 VALVE:

The 4 to 3 valve controls the passage leading to piston area (A), Figure 53. At car speeds below approximately 25 miles per hour regulated main line pressure under the 4-3 valve keeps the valve in a position so the entire passage leading to point (A) is open.

OPERATION OF REAR SERVO

APPLY:

The rear servo is applied by the servo springs which operate on the accumulator piston, the stem of which contacts the Booster piston applying the band, Figure 54.

FIGURE 54

COMPENSATOR PRESSURE:

Compensator pressure is applied at points (A) and (B) to assist the servo springs and to prevent the band slipping under rapid acceleration. Compensator pressure is always present when there is any carburetor throttle opening and increases with carburetor throttle opening, Figure 54.

RELEASE:

Regulated main line pressure is applied at points (C) and (D) to release the band. The force applied at these two areas is greater than the force of the servo springs and the compensator pressure and the servo pistons are moved to the released position, Figure 55.

REAR SERVO ACCUMULATOR CHECK VALVE AND PLUNGER:

This accumulator check valve controls the passage through which oil flows to the face of the accumulator piston at (D). The oil going through this passage lifts the check valve off its seat and allows the oil to flow through freely to release the band, Figure 55.
NOTE: There are two different ways in which this check valve operates when the servo is being applied.

1. On a closed carburetor throttle downshift when the main line pressure applied at point (D) is released the check valve then returns to its seat causing the oil under the accumulator piston to pass through the small hole in the check valve and in this way delays application of the band, Figure 55.

2. On an open carburetor throttle downshift, compensator pressure is effective at points (A) and (B) and also on the end of the check valve plunger which is connected to the accumulator check valve. When the pressure applied at point (D) is released the compensator pressure applied on the check valve plunger holds the check valve off its seat and the oil under the accumulator piston is allowed to exhaust freely for a rapid application of the band, Figure 55.

BLOCKER PISTON:

A blocker piston is located in the reverse bracket assembly. It is operated by regulated main line oil pressure. Its function is to prevent engagement of the reverse anchor into the reverse internal gear until the rear band is applied to the drum to stop the rear unit and reverse internal gears from turning, Figure 55.
ADJUSTMENTS WITH TRANSMISSION IN CAR
THROTTLE CONTROL LINKAGE ADJUSTMENT

1. Adjust engine idle speed at 480-520 RPM, with engine at normal operating temperature, transmission warm and manual control lever in neutral ("N") position.

2. With the carburetor throttle idle screw (A), Figure 56 against its stop and carburetor off fast idle, adjust the accelerator cross shaft operating rod trunnion nuts (B), Figure 56 and 57, until gauge pin J-2544 can be installed freely into the accelerator pedal bellcrank lever (C) and the hole in the boss of the cylinder block at (D), Figure 57, for Models 5A, 6A and 7A or in the throttle support assembly for Model 8A.

   Tighten the trunnion lock nuts (B) securely. Recheck this adjustment by removing and installing the gauge pin into the bellcrank lever and boss hole. Pin should again enter both holes freely. After rechecking this adjustment remove the J-2544 Gauge Pin.

3. Raise the car, disconnect the transmission throttle rod (G), Figure 58 at the transmission outer lever (H) by removing the cotter pin and clevis pin. Tighten outer throttle lever clamp bolt (F) if necessary.

4. Check position of the outer throttle lever as follows:
   (a) Clean the machined surface at back of transmission case and place The Throttle Lever Checking Fixture J-2195 flat against the back surface of the transmission case with the edge of the checking
gage against the transmission side cover, Figure 58. (b) With the transmission outer throttle lever held against its stop (toward rear of transmission), the throttle outer lever hole should enter freely over the small diameter of the gauge pin (1) and the inside face of the throttle control lever should just touch the larger diameter of the gauge rod. Do Not Force the outer lever against its stop and Do Not try to bend this lever unless you have the proper bending tool.

**NOTE:** If the outer throttle lever lower hole will not enter over the checking fixture pin as outlined in paragraph (b) use the Throttle Lever Bending Tool J-3310 and bend the throttle lever to secure proper alignment, employing the bending tool as illustrated in Figure 59 with pins facing outward to bend the lever rearward.

To bend the lever forward, reverse the bending tool (bending tool pins will now face towards transmission).

(c) After making the proper alignment of the throttle outer lever to the throttle checking fixture, install the transmission throttle rod (G), clevis pin and cotter pin to the outer throttle lever (H), secure the cotter pin; lower car.

5. Disconnect the transmission throttle rod trunnion (J) from the accelerator pedal link bellcrank lever by removing the cotter pin and flat washer from the trunnion pin, Figure 60.

Install Gauge Pin J-2544 into accelerator bellcrank lever (C) and hole in boss.

FIGURE 60

6. Holding the transmission throttle lever (H) against its stop in the transmission by pushing the transmission throttle rod rearward lightly by hand, Figure 60, adjust the transmission throttle rod so trunnion pin will slide freely into the accelerator pedal link bellcrank lever (L).

FIGURE 61
7. Install the trunnion pin, flat washer and cotter pin. With the trunnion pin (M) in position, shorten the throttle rod (G) by backing off the rear lock nut (K) 1-1/2 turns and tighten the upper lock nut securely. Figure 61. Remove the J-2544 Gauge Pin.

8. Loosen lock nut "N", Figure 61.

9. While holding the carburetor throttle wide open and with the accelerator pedal against its stop at the floor panel (driver's compartment), adjust lock nut "N" until it touches the trunnion; increase adjustment 1/4" further and tighten front lock nut. This will give approx. 1/16" clearance between bottom of accelerator and the stop.

**MANUAL CONTROL LINKAGE ADJUSTMENT**

1. After determining that the upper and lower control tube brackets are tightened securely on the steering column jacket tube, disconnect the transmission shift rod (O) at the manual control lower lever (P).

2. With the transmission shift rod (O) disconnected, place transmission shift lever (Q) (at transmission) in the reverse position by pushing the transmission shift rod (O) rearward as far as it will go (reverse position), Figure 62. Next pull shift lever rod (O) forward one detent, placing transmission shift lever (Q) in "Lo" position.

**CAUTION:** Move the transmission shift rod (O) slowly so that shift lever (Q) is moved only one detent (to "Lo" position).

3. Place the manual control lever (at steering wheel) in the "Lo" position and pull the manual control lever as far as it will go toward reverse without lifting the manual lever.

![Figure 62](image1.png)

![Figure 63](image2.png)
4. Adjust the length of the transmission shift rod (0) until the clevis pin holes in clevis align with the hole in the manual control tube lower lever (P). Figure 63. Do Not move either the transmission shift lever (Q) or the manual control lever (P) when making the rod adjustment. After determining that the pin enters freely, increase the length of shift rod (0) by turning the clevis one full turn. Install clevis pin, flat washer and cotter pin. Tighten clevis lock nut against clevis. Operate manual control shift lever to recheck that all positions of the control lever ("N", "Dr", "Lo" and "R") index properly on the dial.

**NEUTRAL SAFETY SWITCH ADJUSTMENT**

1. Place the manual control lever in the "N" (Neutral) position.
2. Loosen the safety switch adjusting screw (3), Figure 64 and rotate the transmission safety switch and bracket (T) until there is 1/16" clearance between the stop (U) and switch lever (V).

**ADJUSTING HYDRA-MATIC TRANSMISSION BANDS**

**EXTERNAL ADJUSTMENT:**

1. Set hand brake firmly and block front wheels with wheel chocks to prevent car running forward during adjustment.
2. Remove accelerator pedal, floor mat and adjusting hole cover.
3. Connect an Electrical Tachometer to distributor and ground. Set dwell-meter to either 6 or 8 cylinder reading.
4. Start engine and allow engine to run until normal operating temperature is reached. (Choke and fast idle off).
5. Position control lever in "Dr" range.

**NOTE:** With the manual control lever in the "N" (Neutral position) the starter should operate when the ignition switch is on and starter button on instrument panel is pressed. The starter should not operate in any other position but "N" (Neutral), when the starter button is pressed and ignition switch is on.
6. Adjust carburetor idle speed screw to give 700 RPM.

**FRONT BAND:**

7. Using Band Adjusting Tool No. J-2681-A loosen the front band adjusting screw lock nut, Figure 65.
8. Loosen the front band adjusting screw (by turning top handle while holding lower handle of Tool J-2681) until the engine speed increases to 900-1000 RPM (front drum is now spinning freely).
9. Tighten the front band adjusting screw slowly until engine returns to 700 RPM (front drum has now stopped turning).
10. Once more loosen the front band adjusting screw until engine speed increases and tighten the screw again (slowly) until engine speed returns to 700 RPM.

**NOTE:** The object in loosening and retightening the screw is to locate the exact point at which the band stops the drum from spinning. At this point wait 30 seconds. If engine speed again increases, tighten screw 1/10 of a turn more. Repeat this procedure until engine speed remains at 700 RPM for at least 30 seconds.

11. Set counter on tool to 00.
12. While holding lock nut stationary with long handle of tool, tighten adjusting screw exactly 5-1/2 turns with short handle (counter will read 5.5).
13. Hold the front band adjusting screw stationary with the short handle of Tool J-2681 and tighten the adjusting screw lock nut by turning the outer body of the tool with the long (outer) handle.

**NOTE:** Adjusting screw must not move during this tightening operation.

**REAR BAND:**

14. With control lever in "Dr" range, loosen the rear band adjusting screw lock nut, Figure 10.
15. Loosen the rear band adjusting screw until the engine speed increases to 900-1000 RPM (rear drum now spinning freely).
16. Tighten the rear band adjusting screw slowly until engine returns to 700 RPM (rear drum now stopped).
17. Loosen the rear band adjusting screw until engine speed increases and tighten again slowly until engine speed returns to 700 RPM.

**NOTE:** At this point wait 30 seconds. If engine speed increases, tighten adjusting screw 1/10 of a turn. Wait another 30 seconds and if engine speed again increases, tighten screw 1/10 of a turn more. Repeat this procedure until engine speed remains at 700 RPM for at least 30 seconds.

18. Set counter on tool to 00.
20. While holding the lock nut stationary with the long handle of Adjusting Tool, tighten band adjusting screw exactly 2 turns using top short handle (counter will read 20).
21. Position control lever in "Dr" range.
22. Hold adjusting screw stationary with the top handle and tighten the lock nut with the long handle.
23. Reset engine idle at 480-520 RPM (Control lever in "N" position).
24. Turn off ignition.
25. Install floor hole cover, floor mat and accelerator pedal.

**FRONT AND REAR BAND ADJUSTMENT**

(Transmission Oil Pan Removed)

1. Raise front end of car.
2. Remove the oil pan drain plug at (A) and drain the transmission fluid, Figure 66.
3. Remove transmission oil pan.
4. Remove the accelerator pedal and raise the left side of the front floor mat.
5. Remove band adjusting floor hole cover, Figure 67.
6. Loosen both band adjusting screw lock nuts, Figure 67.

FIGURE 67

ADJUSTMENT:

1. Loosen the front band adjusting screw approximately five (5) turns.
2. Remove the pipe plug from front servo.
3. Loosen "hex" adjusting screw of Gauge J-1693, until approximately 1/8" of threads are exposed above gauge body at A.
4. Screw gauge into front servo, tightening by HAND only, Figure 68.
5. Tighten the "hex" adjusting screw with fingers until the stem of gauge is felt to JUST touch piston in front servo.
6. Using a suitable wrench continue tightening the adjusting screw six full turns from the point where it was felt that stem of gauge JUST touched piston.
7. Tighten band adjusting screw until knurled washer on gauge is just free to turn.

NOTE: While tightening screw be sure front band is lined up over drum.
8. After adjustment has been made tighten the band adjusting screw lock nut securely while holding adjusting screw.
9. Loosen the "hex" adjusting screw at least six turns and then remove gauge from servo.
10. Reinstall pipe plug in servo.

FIGURE 68

REAR BAND ADJUSTMENT:

1. Place Servo Gauge J-5071 on finished surface of accumulator body, having leg of gauge resting on servo stem, Figure 69.

FIGURE 69

2. Back off the adjusting screw until face of actuating lever is well away from face of gauge.
3. Tighten band adjusting screw until face of band actuating lever just touches gauge.
CAUTION: Do not go beyond adjustment. If adjusting screw is accidentally turned beyond adjustment, loosen two or three turns and repeat adjustment.

4. After adjustment has been made tighten the band adjusting screw lock nut securely while holding adjusting screw.

MINOR SERVICES AND REPAIRS

FLUID CAPACITY, DRAINING AND REFILLING

CAPACITY:

Eleven (11) quarts of fluid are required to refill after draining torus cover and oil pan. Twelve (12) quarts of fluid are required to refill after the transmission has been disassembled and rebuilt. Use Hudson part #305096 approved Hydra-Matic Drive Fluid only.

DRAINING AND REFILLING:

Drain oil immediately after operation before it has had an opportunity to cool. To drain oil proceed as follows:

1. Remove flywheel housing dust cover.
2. Remove hex head pipe plug from torus cover (using six-point socket) and drain torus cover at (B), Figure. 70.
3. Remove oil pan drain plug (at back of pan) and drain transmission case at (A).

NOTE: Ordinarily, flushing of the unit is not necessary; however, if it is flushed for any reason use only Hudson part #305096 approved Hydra-Matic Drive Fluid.

4. After draining replace and tighten both torus cover and oil pan drain plugs.
5. Replace flywheel housing dust cover.
6. Raise right side of front floor mat.
7. Remove transmission inspection floor hole cover.

CAUTION: Clean all gravel, sand or lint from floor and around oil level indicator before removing indicator and cap.

FIGURE 70

8. Remove indicator and pour eight (8) quarts of Hydra-Matic Fluid into transmission through oil filler hole, Figure 71.

It is important to use only Hudson part #305096 approved Hydra-Matic Drive Fluid in the Hydra-Matic transmission.

9. Set hand brake tightly and allow engine to idle for several minutes. Then add oil (approximately three quarts) to bring level to the full mark when oil is hot.

NOTE: Always check oil level when oil is hot, engine idling, hand brake tightly set and control lever in "N" range.

OIL LEVEL UNDER DIFFERENT CONDITIONS:

Oil level as observed on the level indicator will vary as shown in Figures 72, 73, 74, 75 and 76.
REPLACING TRANSMISSION OIL PAN DRAIN PLUG GASKET

1. Raise rear of car.
2. Remove transmission oil pan drain plug.
3. Remove drain plug gasket.
4. Inspect the threads in oil pan and drain plug for nicks and burrs.
5. Soak new gasket in water until it is sufficiently pliable to install on drain plug. CAUTION: Do not enlarge hole of gasket.
6. Install gasket on drain plug and allow it to dry.
7. Replace drain plug in transmission oil pan.
8. Lower car.
9. Check fluid level of transmission and refill as outlined on pages 41 and 42.
10. Remove transmission inspection floor hole cover.

REPLACING REAR BEARING RETAINER OIL SEAL

1. Raise rear end of car.
2. Disconnect the propeller shaft at the rear axle companion flange.
3. Disconnect propeller shaft at the transmission companion flange.
4. Remove one bolt at center bearing support and slide propeller shaft rearward to clear flange at transmission.
5. Remove transmission companion flange.
6. Remove the rear bearing retainer oil seal dust shield.
7. Using a blunt chisel remove the oil seal. Inspect the rear bearing retainer core and output shaft for nicks and burrs.
9. Apply lubri-plate to felt rubber portion of new rear bearing retainer seal.
10. Install the new seal carefully over the output shaft and seat the seal using Installer Tool J-1354. Figure 77.

**NOTE:** Cleanliness is most important.

11. Apply sealing compound (Form-A-Gasket Cement) to outside of seal against rear bearing retainer.
12. Using Installer Tool, J-1354, install the rear bearing retainer seal dust shield, Figure 78.

13. Install transmission companion flange.
15. Lower car.

**NOTE:** Recheck fluid level.

### PRESSURE REGULATOR VALVE

**REMOVAL:**
1. Remove the accelerator pedal and front floor mat.

**INSTALLATION:**
1. Place a new gasket over pressure regulator plug.

**NOTE:** Gasket must be expanded by soaking in water, then installed on the plug, allowed to dry and shrink on the plug.
2. With pressure regulator valve assembled into spring, locate valve on seat in front pump.

**NOTE:** Install the "TV" plug in bore of the regulator plug.
3. Install regulator plug into spring.
4. Apply pressure to plug to start threads and tighten in transmission case to approximately 40 ft. lbs. torque. Check transmission oil pressure according to instructions on Page 115.
5. Install and seal floor opening cover.
6. Install front floor mat and accelerator pedal.

### GOVERNOR AND REAR OIL PUMP ASSEMBLY

**REMOVAL:**
1. Raise car and place car on car stands.
2. Remove oil pan drain plug, draining fluid into a clean container.
3. Disconnect transmission throttle rod (G) from throttle control lever at transmission, Figure 79.
4. Remove throttle control lever from shaft at side of transmission (7/16" socket).
5. Disconnect selector lever control rod assembly from outer shift lever at side of transmission.
6. Remove shifter lever from shaft (1/2" wrench).
7. Remove the accelerator pedal and front floor mat.
8. Remove transmission floor opening cover. Clean transmission so dirt will not enter assembly when side cover is removed.
9. Remove side cover bolts, cover, and gasket (7/16” socket).
10. Position inner detent control lever so steel ball is in the "Lo" range detent position, then remove four control valve assembly mounting bolts and lock washers (7/16” socket), Figure 80.

11. Pull valve assembly and governor oil delivery sleeve out approximately 1/8" and remove valve assembly from governor oil delivery pipes.

NOTE: Oil delivery pipes from valve assembly to governor sleeve may come off with valve assembly. If pipes do not come off with valve assembly, they should be pulled out of governor sleeve. Do not damage pipes.
12. Wrap valve assembly in clean rag and set aside to prevent damage.
13. Remove transmission oil pan bolts, lock washers, oil pan, and gasket (1-1/2” socket).
14. Remove the oil pan screen.
15. Straighten two front pump intake pipe lock plates; remove bolts, lock plates, intake pipe, and paper gasket.
16. Turn propeller shaft to position governor so that the large round governor weight is toward the front of the transmission.
17. Remove two bolts and lock washers holding governor and rear pump assembly to transmission case (1/2” socket).
18. Remove assembly by moving pump toward left side of transmission and lowering pump to clear case, Figure 81.

CAUTION: Do not lose plug from governor sleeve.
NOTE: For overhaul of governor and rear oil pump assembly refer to
(a) Disassembly Page 80
(b) Cleaning & Inspection Page 81
(c) Assembly Page 82

INSTALLATION:

NOTE: Cleanliness is important, all parts must be free from dust and dirt.

1. Position the large round governor weight to the front of transmission.
2. Slide the pump and governor assembly into position in case.
3. Insert end of rear pump discharge pipe into hole in rear pump. Enter pipe coupling into brass fitting of front servo.
4. Install and tighten two governor and rear oil pump assembly attaching bolts and lock washers. Tighten to 15-18 ft. lbs. torque.

CAUTION: Be sure governor driven gear meshes with bronze driver gear.

5. Install front pump intake pipe to front pump using a new gasket and lock plates. Tighten attaching bolts, to 10-12 ft. lbs. torque. Bend locks up against flats of bolts.
6. Install three oil delivery pipes into holes in governor oil delivery sleeve and pull oil delivery sleeve out 1/8”.
7. With inside detent control lever in “Lo” position push valve body onto oil delivery pipes.
8. To line up control valve assembly start one attaching bolt and lock washer. Then push oil delivery sleeve in to bring valve assembly against case.
9. Install remaining three control valve assembly attaching bolts and lock washers. Tighten all four bolts to 6-8 ft. lbs. torque.
10. Check governor runout according to instructions on Page 54.
11. Slide oil screen over front pump intake pipe and position over rear pump intake pipe.

CAUTION: Make certain screen is free from foreign matter.

12. Position new gasket on oil pan and retain in place with petrolatum. Place pan on transmission case.
13. Start attaching bolts with lock washers to line up pan. Tighten bolts to 10-13 ft. lbs. torque.
14. Before installing the side cover make the following checks:
(a) See that pickup pin of inside detent control lever engages in neck of manual valve.
(b) See that governor oil delivery sleeve plug is in place.
(c) Check operation of inside detent control lever with reverse crank.
(d) See that inner and outer spring washers and rubber seal are in place on manual control shaft, Figure 82.

15. Place a new gasket on side cover and retain in place with petrolatum.
16. Position side cover and gasket assembly over manual shaft.
17. Install side cover attaching bolts with COPPER WASHERS finger tight. Move cover to centralize manual shaft in hole and tighten bolts to 10-12 ft. lbs. torque.
18. Install outer shift lever. Tighten clamp bolt to 10-13 ft. lbs. torque. Make certain lever does not bind on side cover.
19. Connect selector lever control rod to outer shift lever.
20. Install throttle control lever. Tighten clamp bolt to 10-12 ft. lbs. torque.
21. Install oil pan drain plug. Tighten to 34-45 ft. lbs. torque.
22. Check throttle control adjustments, manual shift control adjustments and neutral safety switch adjustments according to instructions, in section "Adjustments With Transmission in Car," Pages 35 through 41.
23. Lower car.
24. Remove indicator and refill with Hydra-matic Fluid which was previously drained from transmission, providing fluid is clean.

25. Recheck fluid level and refill as outlined on Pages 41 and 42.

**CAUTION:** Clean all gravel, sand, or lint from floor and around oil level indicator before it is removed.

26. Set hand brake lever tightly and run engine for several minutes. Add oil to bring level to full mark when oil is hot.

**NOTE:** Check oil level when oil is hot, engine running manual selector lever in "N" range and hand brake lever set tightly.

27. Remove oil pressure line pipe plug from between band adjusting screws using 7/16" six point socket.

28. Check oil pressure according to instructions on Page 115.

29. Replace oil pressure line pipe plug.

30. Replace and seal transmission floor opening cover.

31. Replace front floor mat, and accelerator pedal.

### FRONT OR REAR SERVO

**REMOVAL:**

1. Raise car and place car on car stands.

2. Remove front floor mat.

3. Remove band adjusting floor hole cover.

4. Loosen both band adjusting screw lock nuts (3/4" socket).

5. Loosen both bands adjusting screws approximately five (5) turns.

6. Drain fluid from transmission oil pan into a clean container.

7. Remove the oil pan bolts, lock washers, oil pan and gasket (1/2" socket).

8. Remove the oil pan screen.

9. Straighten two front oil pump intake pipe lock plates. Remove oil pump intake pipe bolts (7/16" socket), lock plates and paper gasket.

10. Remove front and rear servo attaching bolts (9/16" socket).

11. Remove both servos as one unit.

**NOTE:** As servos are removed, rear pump discharge pipe will rotate in the front fitting and slide free. Front pump delivery pipe may come out with servo.

12. Separate front and rear servos at oil transfer pipe. Leave pipe in servo in which it sticks.

**OVERHAUL:**

**NOTE:** For overhaul of servos refer to:

<table>
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### INSTALLATION:

1. With front pump delivery pipe in front pump and rear pump discharge pipe in rear pump, position front servo with piston stem in socket of front band. Place on front delivery pipe, enter rear pump discharge pipe into fitting of servo.

2. Hold front servo in position and enter attaching bolts 2 or 3 threads.

3. Place rear servo in position engaging rear band strut with actuating lever while entering oil transfer pipe from front servo.

4. Enter rear servo attaching bolts, then tighten all four servo attaching bolts to 23-28 ft. lbs. torque.

5. Install front pump intake pipe, using a new gasket and attaching bolt lock plates. Tighten bolts to 10-12 ft. lbs. torque. Bend locks down against flats of bolts.

6. Adjust front and rear bands according to instructions on Pages 38 and 39.

7. Slide oil screen over front pump intake pipe and position over rear pump intake pipe. Make certain oil screen is free of foreign matter.

8. Place new gasket on oil pan and hold in place with petrolatum.

9. Position oil pan to transmission case. Start attaching bolts with lock washers to line up pan. Tighten bolts to 10-13 ft. lbs. torque.

10. Remove transmission oil filler inspection floor hole cover.

**CAUTION:** Clean all gravel, sand or lint from floor and around oil level indicator.

11. Remove indicator and refill transmission with Hydra-Matic Fluid previously drained.

12. Set hand brake lever tightly and run engine for several minutes. Then add oil to bring level to full mark when oil is hot. **NOTE:** Check oil level when oil is hot, engine running, manual selector lever in "N" range and hand brake lever set tightly.
13. Check oil pressure according to instructions on Page 115.
15. In stall band adjusting and transmission oil filler inspection floor hole covers.
16. Install front floor mat.

**REVERSE ANCHOR, BRACKET ASSEMBLY AND SHIMS**

**REMOVAL:**

1. Raise car and place car on car stands.
2. Remove oil pan drain plug, draining fluid into a clean container.
3. Disconnect transmission throttle rod from throttle control lever at transmission.
4. Remove throttle control outside lever from shaft at side of transmission (7/16" socket).
5. Disconnect selector lever control rod assembly from shift lever.
6. Remove shift lever from shaft of side of transmission, (1/2" wrench).
7. Remove front floor mat.
8. Remove transmission floor opening cover. Clean transmission so dirt will not enter assembly when side cover is removed.
9. Remove side cover bolts (7/16" socket) cover, and gasket.
10. Remove two reverse shifter bracket and crank assembly mounting bolts and lock washers (1/2" socket). Figure 83.

**OVERHAUL:**

1. Inspect reverse anchor and reverse internal gear for damaged teeth.
2. Remove blocker piston from bracket assembly.
3. Clean retracting spring and blocker piston.
4. Inspect piston and bore for wear and crankshaft for wear in bracket.

**INSTALLATION:**

1. Position reverse anchor in transmission case and install reverse anchor support bolt with a new lock. Tighten to 10-13 ft. lbs. torque.
2. Replace blocker piston in bracket assembly.
3. Position retracting spring and roller on bracket assembly.
4. Assemble bracket and shims to transmission case.
5. Install attaching bolts with lock washers. Tighten to 15-18 ft. lbs. torque.
6. Remove oil pan bolts, lock washers, oil pan and gasket.
7. Check backlash in reverse internal gear according to instructions on Page 103.
8. Place new gasket on oil pan and hold in place with petrolatum.
9. Position oil pan to transmission case. Start attaching bolts with lock washers to line up pan. Tighten to 10-13 ft. lbs. torque.
10. Before installing side cover make the following checks:
   (a) See that pickup pin of inside detent control lever engages in neck of manual valve.
   (b) See that governor oil delivery sleeve plug is in place.
   (c) Check operation of inside detent control lever with reverse crank.
   (d) See that inner and outer spring washers and rubber seal are in place on
Place new gasket on side cover and retain in place with petrolatum.

Position side cover and gasket assembly over manual shaft.

Inst all side cover attaching bolts with COPPER WASHERS finger tight.

Centralize manual shaft in hole by shifting cover and tighten bolts to 10-12 ft. lbs. torque.

Install shifter lever. Tighten clamp bolt to 10-13 ft. lbs. torque. Make certain shift lever does not bind on cover.

Connect selector lever control rear rod to shift lever.

Install outside throttle control lever. Tighten clamp bolt to 10-12 ft. lbs. torque.

Check throttle control adjustments, control adjustments and neutral safety adjustments according to instructions on Pages 35 through 41.

Lower car.

Remove indicator and refill transmission with the Hydra-Matic Fluid previously drained from transmission providing fluid is clean.

Recheck fluid level and refill as outlined on Pages 41 and 42.

Replace and seal transmission floor opening cover.

Replace front floor mat, and accelerator pedal.

CONTROL VALVE ASSEMBLY

REMOVAL:

1. Raise car and place car on car stands.
2. Drain fluid from transmission oil pan into clean container.
3. Disconnect transmission throttle rod from throttle control lever at transmission.
4. Remove throttle control outside lever from shaft at side of transmission (7/16" wrench).
5. Remove clevis pin connecting selector lever control rod assembly to outside shift lever at side of transmission.
6. Remove shift lever from shaft (1/2" wrench).
7. Remove front floor mat.
8. Remove transmission floor opening cover. Clean transmission so dirt will not enter assembly when side cover is removed.
9. Remove side cover bolts (7/16" socket), cover, and gasket.
10. Position inner detent control lever so steel ball is in "Lo" range detent position, then remove four control valve assembly mounting bolts and lock washer (7/16" socket).
11. Pull valve assembly and governor oil delivery sleeve out approximately 1/8". Valve assembly can then be removed from governor oil delivery pipes.

NOTE: Oil delivery pipes from valve assembly to governor sleeve may come off with valve assembly. If pipes do not come off with valve assembly they should be pulled out of governor sleeve. Do not damage pipes in removal.

OVERHAUL:

NOTE: For overhaul of the control valve assembly refer to the following sections:
(a) Disassembly Page 89
(b) Cleaning and Inspection Page 92
(c) Assembly Page 94

Installation:

1. Install three oil delivery pipes into holes in governor oil delivery sleeve.
2. With inside detent control lever in "Lo" position, and oil delivery sleeve out approximately 1/8", push valve assembly onto oil delivery pipes.
3. To line up control valve assembly start one attaching bolt and lock washer. Then push oil delivery sleeve in to bring valve assembly against case.
4. Install remaining three control valve assembly attaching bolts and lock washers. Tighten all four bolts to 6-8 ft. lbs. torque.
5. Before installing the side cover make the following checks:
   (a) See that pickup pin of inside detent control lever engages in neck of manual valve.
   (b) See that oil delivery sleeve plug is in place.
   (c) Check operation of inside detent control lever with reverse crank.
   (d) See that inner and outer spring washers and rubber seal are in place on manual control shaft, Figure 82.
6. Place a new gasket on side cover and retain in place with petrolatum.

7. Position side cover and gasket assembly over manual shaft.

8. Install side cover attaching bolts with COPPER WASHERS fingers tight.

   Move cover to centralize manual shaft in hole and tighten bolts to 10-12 ft. lbs. torque.

9. Install outside shift lever. Tighten clamp bolt to 10-13 ft. lbs. torque. Make certain shift lever does not bind on side cover.

10. Connect selector lever control rod to outside shift lever.

11. Install throttle control lever. Tighten clamp bolt to 10-12 ft. lbs. torque.

12. Install oil pan drain plug. Tighten to 34-45 ft. lbs. torque.

13. Check throttle control adjustments, manual selector control adjustments and neutral safety switch adjustments according to instructions on Pages 35 thru 41.

15. Lower car.

16. Remove indicator and refill with Hydra-Matic Fluid which was previously drained from transmission.

17. Recheck fluid level and refill as outlined on Pages 41 and 42.

18. Remove oil pressure line pipe plug from between band adjusting screws using 7/16" six point socket.

19. Check oil pressure according to instructions on Page 115.

20. Replace oil pressure line pipe plug.

21. Replace and seal transmission floor opening cover.

Replace front floor mat and accelerator pedal.
REMOVING THE HYDRA-MATIC TRANSMISSION

NOTE: The Hydra-Matic Transmission, Flywheel Housing, Torus Cover and Torus Members are removed as an assembly. To remove the transmission unit proceed as follows:

1. Raise hood and disconnect battery ground cable at battery terminal, also disconnect battery cable at starter motor.
2. Remove two bolts and lock washers attaching the starter motor to the flywheel housing and remove starter motor.
3. Remove the one bolt attaching the breather pipe to the valve chamber.
4. Remove one bolt attaching the breather pipe attaching bracket to the flywheel housing and remove the breather pipe.
5. Pull the floor mat to one side to expose the two floor opening covers, Figure 84.

6. Remove the two opening covers (held by sheet metal screws), and remove the two bolts attaching the flywheel housing to the engine.
7. Raise car and if a twin post hoist, is not available, support car on four jack stands.
8. Disconnect the propeller shaft at the rear axle companion flange and at the transmission at (B), Figure 85.

9. Remove the center bolt attaching the propeller shaft center bearing housing to the center bearing support and slide propeller shaft to rear to allow clearance for the transmission.
10. Disconnect the speedometer cable at (A), Figure 85.

NOTE: Use adhesive tape or rubber band to keep journal bearings assembled to the universal journal when removing the propeller shaft.

11. Disconnect transmission throttle rod (G), by removing cotter pin and clevis pin at throttle control lever (H), Figure 86.
12. Disconnect the selector lever control rod assembly (0) from outer shift lever (E), Figure 86.

13. Remove the left hand side engine rear stone guard assembly. (4 self tapping screws).

14. Disconnect hand brake cable lever return spring (D) at the hand brake cable lever (E), Figure 85.

15. Disconnect hand brake cable clevis (C) at pull rod slide link (E).

16. Remove the hand brake cable retainer clip (A) at No. 3 crossmember, Figure 87.

17. Pull hand brake cable towards front of car through crossmember.

18. Remove the engine rear support bolts (B) attaching rear insulators to No. 3 crossmember. (Two each side).

19. Using a suitable hydraulic hoist equipped with a tilt table and transmission cradle, position the jack and raise the transmission to relieve the weight from the rear supports.

20. Remove the four screws at (C) and three screws at (D), Figure 87, each side of crossmember and remove crossmember.

CAUTION: Crossmember will drop when these 14 screws are removed.

21. Install Engine Holding Fixture 1-4651 by positioning the "U" shaped section around engine oil pan and enter one adjusting hook in open hole in frame just below steer in g housing support and the other hook in the corresponding hole in the opposite frame side rail, Figure 88.

22. With engine holding fixture installed adjust support hooks so that the front end of the oil pan will clear the center tie rod ends by approximately 1/2" and weight of engine is supported by the Engine Holding Fixture J-4651.

23. Remove four screws attaching flywheel housing dust cover and remove the dust cover as an assembly.

24. Drain torus unit fluid into a clean container.

25. After draining the torus cover reinstall the torus drain plug.

26. With the transmission supported with a suitable hydraulic jack, remove the torus cover attaching screws.

27. Using a 5/8" universal socket and a 14" extension, remove the right hand lower flywheel housing bolt.

NOTE: This bolt cannot be removed freely. Allow the bolt to remain in the bolt hole of housing.

28. Using a 9/16" universal socket and a 14" extension remove the flywheel housing left hand lower bolt.

29. Determine that all bolts have been detached from the engine and pull transmission and hydraulic jack rearward until the pilot shaft of transmission clears pilot bushing in flywheel.
HYDRA-MATIC TRANSMISSION DISASSEMBLY

REMOVING TORUS MEMBERS, TORUS COVER AND FLYWHEEL HOUSING

1. Remove oil level indicator from transmission case.

2. Place transmission and torus assembly in Transmission Holding Stand J-2541, Figure 89.

3. Move shift lever on side of transmission toward rear to reverse position, Figure 90.

4. Straighten the main shaft nut lock washer, using a chisel and a light hammer.

5. Remove the torus member to main shaft retaining nut, using 1-7/16" socket.

6. Slide driven torus off front end of transmission main shaft

NOTE: If torus sticks, tap end of main shaft lightly with a rawhide hammer.

7. Remove driving torus snap ring, Figure 91.

8. Remove driving torus assembly, Figure 92.
CAUTION: Do not try to remove the torus cover and driving torus together.

9. Remove the torus cover. Work hub of torus cover back through oil seals gently and then pull the torus cover forward with a quick jerk.

CAUTION: DO NOT attempt to remove torus cover by pulling and pushing on cover in a rough manner as this may result in a broken oil seal ring.

10. Remove four bolts and lock washers holding the flywheel housing to transmission case, using a 3/4” socket.

11. Remove the flywheel housing and gasket.

**FRONT AND REAR SERVOS**

**REMOVAL:**

1. Move shift lever on side of transmission to "LO" position.

2. Loosen shift lever to shift shaft clamp bolt (1/2” socket) and remove the lever.

3. Remove oil pan bolts (1/2” socket) and remove oil pan with gasket.

4. Remove the oil pan screen by lifting from rear oil pump intake pipe and slide screen toward rear from the front pump intake pipe.

5. Straighten the two front oil pump intake pipe lock plates and loosen the pipe flange attaching bolts while lifting slightly on pipe to avoid dropping the bolts (7/16” socket).

6. Remove the front oil pump intake pipe, bolts, lock plates and paper gasket from transmission, Figure 93.

7. Loosen front and rear band adjusting screw lock nuts (3/4” wrench) then loosen the adjusting screw approximately five turns each.

8. Remove front and rear servo attaching bolts (9/16” wrench).

9. Remove both servos as one unit.

NOTE: As servos are lifted from transmission, rear pump discharge pipe will rotate in the front fitting and slide free.
REVERSE SHIFTER BRACKET ASSEMBLY

REMOVAL:

1. Remove side cover bolts (7/16" socket).
2. Remove side cover and gasket.
3. Remove two reverse shifter bracket and crank assembly mounting bolts and lock washers (1/2" wrench).
4. Remove reverse shifter bracket, shims, retracting spring and roller, Figure 95. Do not lose shims, springs and rollers.

CHECK GOVERNOR RUNOUT

1. With side cover removed mount dial indicator on side of transmission case so that spindle of indicator rests against governor oil delivery sleeve, Figure 96. Use one reverse shifter bracket attaching bolt as steady rest for the indicator clamp.
2. Rotate output shaft several revolutions and note runout of governor oil delivery sleeve as measured on dial indicator. Total run-out should not exceed .005".
3. If governor run-out is within the .005" limit, no further check need be made
4. If governor run-out exceeds the .005", mark position of governor body on drive flange

FIGURE 96
After control valve assembly is removed, see control valve "Removal" Page 55, remove two bolts holding governor body to drive flange and remove governor body and governor oil delivery sleeve as an assembly.
5. Relocate dial indicator on transmission case so that spindle of indicator rests against face of flange, Figure 97.

FIGURE 97
6. Rotate output shaft several revolutions and note runout of drive flange as measured on dial indicator. Runout should not exceed .002".
7. If runout of drive flange exceeds .002", correct condition by replacing one or all of the following parts -- governor drive
flange, rear oil pump drive gear and rear oil pump and governor drive gear as a set. See Page 80 for "Rear Oil Pump Repair" and Page 82 for "Replacement of Rear Oil Pump and Governor Drive Gear" or replace the complete rear oil pump assembly. See Page 77 for "Rear Pump Removal".

8. If the run-out of governor drive flange is less than .002", rotate governor body 180° from the original position and reinstall governor body on flange.

9. Relocate dial indicator on governor sleeve and check run-out as described in operation 2.

10. If governor body oil delivery sleeve run-out still exceeds .005", replace governor.

**CONTROL VALVE ASSEMBLY**

**REMOVAL:**

1. With side cover removed, check position of inner detent control lever, so steel ball is in the "LO" range detent position, Figure 98; then remove four control valve assembly mounting bolts and lock washers (7/16" socket).

2. Pull valve assembly and governor oil delivery sleeve out approximately 1/8" and rotate valve assembly counter-clock-wise to clear case, Figure 99. Valve assembly can then be removed from governor oil delivery pipes.

NOTE: Oil delivery pipes should be pulled out of the governor sleeve at this time. Do not damage the pipes in removal.

3. Wrap the control valve assembly in waxed paper or a clean rag and set valve aside to prevent damage.

**PRESSURE REGULATOR ASSEMBLY**

**REMOVAL:**

1. Loosen pressure regulator valve plug in transmission case (1-1/4" wrench).
CAUTION: Pressure regulator valve assembly is under spring pressure.

2. Hold pressure against regulator plug while unscrewing plug by hand, Figure 100.

3. Remove regulator plug, T. V. plug, spring and valve from side of transmission case.

GOVERNOR AND REAR PUMP ASSEMBLY

REMOVAL:

1. With side cover and oil pan removed, position the governor so that the large round governor weight is toward the front of the transmission, Figure 101.

2. To remove governor and rear pump assembly from transmission, position one reverse center gear and drive flange attaching bolt up (at 12 o'clock).

3. Remove the two bolts and lock washers (1/2" wrench), that attach the rear pump and governor assembly to the transmission case.

4. Remove the oil delivery sleeve plug from governor sleeve.

5. Remove the rear oil pump and governor as an assembly by moving the pump assembly toward the control valve side of the transmission case and raise the pump to clear the case and remove, Figure 102.

CHECK END CLEARANCE OF MAIN SHAFT

1. Start driven torus open-type snap ring from the main shaft using Remover Tool J-1458, Figure 103.

NOTE: Hit the tool with a sharp blow, using care not to damage the main shaft with the special tool. Hit the snap ring just enough so that the snap ring can be pried off with a screwdriver.
2. Install Main Shaft Ent Play Guide J-2587 over main shaft and front planet carrier splined shaft.
3. Set up the dial indicator KMO-30 on Indicator Extension Rod J-1465, Figure 101.

4. Insert a screw driver between the front clutch and center bearing cap, holding the front planet unit forward. The screw driver should be placed at an angle to prevent damage to the oil delivery sleeve.
5. Grasp Guide Tool J-2587 and move the main shaft back and forth. End clearance should be .004” to .015”. Be sure to get just the float.

NOTE: Record amount of end clearance so that the proper selective washer can be installed when the transmission is reassembled.

6. Remove the screw driver from between the front clutch drum and center bearing cap.
7. Remove the dial indicator and indicator extension rod.

FRONT OIL PUMP ASSEMBLY AND FRONT DRIVE GEAR ASSEMBLY

REMOVAL:
1. With oil pan and discharge tube removed, remove the snap ring holding front drive gear assembly on front end of front planet carrier assembly, using Snap Ring Pliers KMO-630, Figure 105, and remove the steel and bronze thrust washers from the planet carrier.

NOTE: These washers have a smaller outside diameter than similar washers used in the transmission and should be tied together and kept with the front oil pump to avoid confusion when reassembling.

2. Remove two front oil pump covers to transmission case bolts and flat washers
using a (1/2" wrench).

3. Remove the front oil pump locating washer from its counterbore with Snap Ring Pliers KMO-630, Figure 106.

4. Remove the front oil pump assembly, gasket, and front drive gear as an assembly.

NOTE: Do Not use the front drive gear as a ram to remove the front oil pump. If the pump cannot be removed with a straight steady pull, tap the pump lightly from rear of pump with a light hammer and a brass drift.

5. Remove the bronze thrust washer from front end of planet carrier.

**REVERSE ASSEMBLY AND MAIN SHAFT**

**REMOVAL:**

1. With the oil pan, front and rear servos, and rear oil pump and governor assemblies removed, loosen the five rear bearing retainer to reverse internal gear support attaching bolts. This aids in disassembly after the rear bearing retainer and reverse assembly is removed from the transmission case.

2. Remove six reverse center gear and drive flange attaching bolts (1/2" wrench), Figure 107.

3. Straighten the reverse anchor support bolt lock. Then remove the reverse anchor support bolt (9/16" socket) and remove reverse anchor, Figure 108.

4. Remove the five rear bearing retainer to transmission case attaching bolts and lockwashers (9/16" socket).

5. Remove the reverse assembly from
transmission case, Figure 109. If the assembly sticks, do not rock the unit up and down but tap lightly on the front end of main shaft with a rawhide hammer to assist removal.

**FIGURE 109**

NOTE: The selective washer may stick to the main shaft or it may remain in the counter-bore of the output shaft. Be sure to remove this washer when the reverse assembly is removed.

6. Remove the main shaft from front planet carrier through rear of transmission.

7. Remove the bronze thrust washer from the rear unit clutch hub.

**FRONT AND REAR UNITS**

**REMOVAL FROM TRANSMISSION:**

NOTE: The front or rear unit cannot be removed from the case until the oil pan, front and rear servos, rear oil pump and governor assembly, front oil pump and front drive gear assembly, reverse assembly and main shaft are removed.

1. Install the Rear Hub Retaining Tool J-2174 to the rear unit drum using one of the reverse drive flange attaching bolts, Figure 110.
2. Using a light hammer and chisel, bend back the edges of the lock plate under the two center bearing cap attaching bolts.
3. Remove the two center bearing cap to case bolts and lock plate (5/8" socket).

NOTE: It may be necessary to equalize the distance by moving the front and rear clutch drum to allow the socket wrench to seat on bolt head.

4. Remove the rear band and strut assembly. Lift the rear unit slightly to allow the rear band to slide clear of the rear unit drum.

5. Install a Wheel Cylinder Clamp, KMO-145, or a suitable spring to hold the front band on the front unit drum, Figure 111.

**FIGURE 110**

**FIGURE 111**

6. Lift both front and rear planet assemblies with front band from transmission case, Figure 112.
FRONT AND REAR UNITS

REMOVAL FROM PLANET CARRIER:

1. Remove front band.
2. Place planet carrier with front and rear planet assemblies into Holding Fixture J-2187.
3. Remove the rear clutch hub snap ring, Figure 114.
4. Lift the rear unit from planet carrier.
5. Remove the rear clutch hub front snap ring from planet carrier, Figure 115.

NOTE: This snap ring may be concealed by the oil delivery sleeve at the time the rear unit is removed. If this happens, use the Ring Compressor J-1537 and compress the exposed oil delivery sleeve into the bore of the front clutch drum to expose the rear clutch hub front snap ring. See Figure 216 for "Oil Delivery Sleeve Installation", Page 98.
6. Remove the center bearing cap from the oil delivery sleeve.

7. Remove the oil delivery sleeve from the planet carrier.

8. Remove the snap ring from recess in front unit.

CAUTION: Hold snap ring open during removal, to avoid damage to the bearing surface.

9. Lift the front unit assembly from the planet carrier.

10. Remove the steel and bronze thrust washers from recess of front unit.
DISASSEMBLY, CLEANING, INSPECTION, REPAIR AND ASSEMBLY OF INDIVIDUAL UNITS

FRONT UNIT

DISASSEMBLY:

1. Place the front unit in a suitable press and remove the clutch drum snap ring, Figure 116.

2. Remove the center gear from the front unit by tapping the front face of the center gear with a rawhide hammer, Figure 117.

3. Remove the front unit clutch annular piston from the clutch drum by bumping the front face of the outer gear on a soft wood block, Figure 118.

4. Remove six inner and six outer front clutch release springs from front unit drum.

5. Remove four composition clutch drive and four steel clutch driven plates from drum.

6. Remove the rubber piston seals and expanders from the annular piston and clutch drum piston. Use a blunt edge screw driver, Figure 119.

NOTE: Use care not to lose clutch release springs.
CLEANING AND INSPECTION:

1. Clean all parts thoroughly in a good clean solvent.
2. Inspect clutch drive pins in the front unit drum. If the pins are scored, loose or distorted, replace the drum and drive pins assembly. Drive Pins are not furnished separately.
3. Inspect the drum for deep grooves or scores at band surface and clutch plate surface.
4. Inspect clutch release springs for distortion or collapsed coils.

NOTE: Slight wear, "bright spots," on side of outer release springs indicating slight contact with drum is permissible.

3. Inspect the clutch drive plates for damaged or loose facings.

NOTE: Discoloration of drive plates (composition) is not an indication of failure. If flakes of facing material can be removed by lightly scratching the surface with the thumbnail, the drive plate should be replaced.

6. Inspect clutch driven plates for scored surfaces. (Driven plates must be flat).
7. Inspect annular clutch piston for scores. Be sure oil seal grooves are thoroughly clean.

8. The front clutch drum should be inspected for scores in the piston bore, oil delivery sleeve bore and oil seal grooves. Inspect gear teeth and thrust faces for damage.

9. Inspect front planet carrier gears for damaged teeth and excessive roller bearing wear, bearing surfaces of planet carrier shaft.
10. Check the steel and bronze washers for distortion and wear. See "Specifications", Page 123.
11. Clean all parts that are to be reused; remove all traces of solvent used as cleaner.

ASSEMBLY OF FRONT UNIT:

1. Place the front planet carrier assembly in Holding Fixture T-2187.
2. Place the front unit drum over front clutch hub so that the drum flange rests on pinion gears and the drive pins are up, Figure 121.
3. Install four drive and four driven plates into the front drum, alternating the plates.
CAUTION: Start with a drive (composition) plate and finish with a driven (steel) plate. Assemble the driven plates with the square notches over the drive pins. Apply HydraMatic fluid to the face of each surface as assembled.

4. Install six outer clutch release and then six inner clutch release springs through plates into spring holes of drum. Figure 122.

5. Install a new brass expander into the clutch drum ring groove. While holding the expander with the expanding lips down, Figure 123, work the new inner piston rubber seal into the ring groove with the rubber lip down over the brass expander.
NOTE: To facilitate assembly of the rubber seal, dip the seal in Hydra-Matic fluid. Work the expander well back into position under the seal so brass edges are not exposed. Before replacing the large outer seal on clutch piston, install the piston into the clutch drum to insure proper installation and sealing of the new inner rubber seal and expander. Remove the clutch piston from the clutch drum and inspect the inner seal.

6. Place a new rubber seal (large) over the front annular piston beyond the seal groove.
7. Install a new brass expander (large) in annular piston groove with lips up.
8. While holding the brass expander in position; work the rubber seal well into piston groove with lip up, Figure 123.

9. Install the annular piston into the clutch drum while resting on the outer rubber seal, align the square notches in the piston with the holes in the drum. Apply slight hand pressure to the piston, guide the lip of the seal into the bore with the flat side of a blunt screw driver Figure 124.

10. Install the clutch drum and piston assembly over the front planet carrier into front unit drum, gear end into drum.
NOTE: Be sure clutch release springs center into recesses of the annular piston.

11. Lift the front unit assembly off of the planet carrier, place the unit in a suitable press and compress the clutch drum below the snap ring groove. Install the clutch drum snap ring so that the gap of the ring is equal distance between two drive pin holes, Figure 125.

CAUTION: Snap ring must be well seated into groove to prevent interference with ledge on drum.

13. Tap front face of center gear lightly with a rawhide hammer so that the clutch drum will seat properly against the snap ring, Figure 126.
14. Remove the planet carrier from the holding fixture and insert planet carrier into the clutch drive plates and clutch drum by rolling the drum on bench while pressing the planet carrier firmly into the plates, Figure 127.
15. Place the planet carrier and drum assembly into the Holding Fixture J-2187.
16. Install a bronze then a steel washer over planet carrier into recess of clutch drum, Figure 128. Locating lug on the steel washer must fit over the flat position of the planet carrier.

CAUTION: Keep Snap ring open; DO NOT allow the snap ring to score the bearing surface of planet carrier.
DISASSEMBLY:

1. Remove the rear clutch hub retainer tool J-2174 from the rear unit drum.
2. Remove the rear clutch hub and bronze thrust washer.
3. Remove two fillister head screws attaching the rear internal gear to the rear clutch drum, Figure 129 and remove the rear internal gear.

4. Remove the clutch release springs and guide pins.
5. Remove the clutch drum snap ring.
6. Remove the clutch drum from the band drum by tapping lightly on the rear thrust face of the clutch drum using a block of wood, Figure 130.

NOTE: Do not damage teeth of composition clutch plate.

4. Remove the annular piston from the clutch drum by tapping the clutch drum rear thrust face on a block of wood, Figure 131.

NOTE: Do Not damage the annular piston or the clutch drum bushing in removal.

4. Remove the rubber seals and brass expanders from the annular piston and the clutch drum.
5. Remove seven composition and seven steel clutch plates.
CLEANING AND INSPECTION:
1. Clean all parts thoroughly in a good clean solvent.
2. Inspect the rear internal gear for damaged teeth.
3. Inspect the clutch drive pins in the rear unit drum. If pins are scored, loose or distorted, the rear drum and drive pin assembly must be replaced as a unit. Pins are not furnished separately.
4. Inspect the rear unit drum (2) for deep groove or scores at band surface and clutch plate surface.
5. Inspect drive plates for damaged or loose facings.

NOTE: If flakes of facing material can be removed by lightly scratching the facing surface with the thumb.

FIGURE 132

1. Rear Unit Clutch Drum Assembly
2. Rear Unit Drum and Pin Assembly
3. Rear Internal Gear
4. Rear Clutch Hub
5. Rear Clutch Drum Retaining Ring
6. Rear Clutch Drum Oil Seal
7. Rear Clutch Drum Annular Piston
8. Rear Clutch Drum Oil Seal Expanders
10. Clutch Release Springs
11. Clutch Driven Plates
12. Clutch Drive Plates
nail, the drive plate should be replaced. Discoloration of drive plate (composition) is not an indication of failure.

6. Inspect the driven plate for scored surfaces. (Driven plates must be flat).

7. Inspect the rear unit clutch drum for scores in the piston bore and thrust face surface. Also check the surface of the babbit bushing.

8. Inspect the annular clutch piston for scores. Be sure the oil seal grooves are thoroughly clean.

9. Inspect the clutch release springs for distortion or collapsed coils. Slight wear, "bright spots" on side of outer release springs indicating slight contact with drum is permissible.

10. Inspect clutch release spring guide pins for distortion and length (1-5/8" ± .010").

11. Inspect front and rear thrust faces, internal and external splines and blow out drilled passages on rear clutch hub.

12. Clean all parts that are to be reused. Remove all traces of solvent used as cleaner.

**ASSEMBLY OF REAR UNIT:**

1. Place the rear unit drum and pin assembly on the bench with drive pins up. Be sure bench surface is clean.

2. Install seven drive and seven driven plates into the drum, alternating plates. Start with a drive (composition) and finish with a driven (steel) plate, Figure 133. Assemble driven plates with square notches over the drive pins.

**NOTE:** Apply Hydra-Matic fluid to face of cork plate at assembly.

3. Position a new inner rubber seal on inner piston of clutch drum above the grooves. In stall a new small brass expander into the ring groove of the clutch drum with expanding lip down.

4. While holding the brass expander in position, work the rubber seal into the ring groove with lip down over the brass expander, Figure 134.

**NOTE:** Work the expander well back into position under the seal so brass edges are not exposed.
5. Place a new large rubber seal over the rear annular piston beyond the seal groove.

6. Install a new large brass expander in the piston groove with the lips up.

7. While holding the expander in this position, work the rubber lip up well into the groove of the annular piston. Expander should be well back into position under the rubber seal so that the brass edges are not exposed.

8. Place the annular piston into the clutch drum, aligning square notches in annular piston with holes in clutch drum. While applying slight hand pressure to the piston, guide the rubber seal into drum bore using a blunt screw driver.

9. Install the clutch drum and piston assembly over drive pins in drum, Figure 135.

10. Install the clutch drum snap ring positioning gap of ring between two drive pin holes.

NOTE: With a wood block and hammer, tap clutch drum rear thrust face until the clutch seats against snap ring, Figure 136.

11. Install six outer and six inner clutch release springs into recesses in piston.

12. Install six clutch release spring guide pins, Figure 137.
13. Assemble the rear unit internal gear to the rear unit drum, locating the internal gear on the dowel of the rear unit drum.

14. Install and tighten two fillister head screws, Figure 138.

15. Install the front bronze thrust washer into the deep counterbore in the rear clutch hub, Figure 139. Retain the washer in the bore with petrolatum.

16. Install the rear hub and thrust washer into the clutch plates. Rotate hub and drum to mesh splines with teeth of clutch plate, Figure 140.

17. Install the rear clutch hub holding tool J-2174 on the rear unit drum to hold the clutch hub in place. Use one of the reverse drive flange attaching bolts to hold the tool in place, Figure 141.
REVERSE UNIT

DISASSEMBLY:

1. Remove the speedometer driven gear and sleeve assembly from the rear bearing retainer using a 1" wrench.

2. Remove four reverse internal gear support bolts and copper washers (9/16" Socket).

3. Remove the rear bearing retainer by tapping the end of the output shaft on a hard wood block. Figure 142.

CAUTION: Position the hands in a manner so that the fingers will not be pinched between the reverse internal gear and the rear bearing retainer when removing the rear bearing retainer.

4. Remove the large open type snap ring retaining the ball bearing to the output shaft using Remover Tool 1-2182, Figure 143.

NOTE: Place a rag beneath the snap ring to prevent loss of ring. Do not damage the output shaft with the remover tool during this operation.

5. With the snap ring removed, remove the speedometer drive gear from the output shaft by bumping the end of the output shaft on a wood block. The weight of the reverse internal gears and support will force the speedometer drive gear off the output shaft, Figure 144.

CAUTION: Rap a rag around the output shaft below the speedometer gear to protect the hands so that the retainer will not cause injury when loosened.

FIGURE 142

FIGURE 143

FIGURE 144
6. Remove the reverse gear support snap ring and remove the internal gear, Figure 145.

7. Remove the ball bearing from the internal gear support by tapping the bearing out with a rawhide hammer.

8. Remove the reverse planet carrier from the output shaft.

9. Remove the reverse planet carrier snap ring from the output shaft, Figure 146.

10. Remove the reverse center gear and flange assembly from the output shaft.

NOTE: The reverse center gear and drive flange are serviced only as an assembly and should not be disassembled.

11. Remove the steel and bronze thrust washers from the output shaft.

12. Remove the oil seal from the rear bearing retainer.

CAUTION: Keep the snap ring spread to avoid any damage to shaft splines.

11 - 72 HYDRA-MATIC TRANSMISSION

REMOVAL AND INSTALLATION OF THE REAR OIL PUMP AND GOVERNOR DRIVE BRONZE GEAR FROM AND TO THE REVERSE PLANET CARRIER

REMOVAL:

1. Remove the snap ring, Figure 147.

2. Place the reverse planet carrier assembly in a vise equipped with soft jaws and saw the bronze gear, sawing between the teeth to within 1/32" of hub. DO NOT saw into hub.
3. Using a blunt tapered chisel, remove the gear by splitting in the saw slot, Figure 148. Do not use a slender tapered chisel as hub may be damaged.

4. After removing the bronze gear, remove the steel locating ball from hub.

**INSTALLATION:**

1. Clean all parts thoroughly. Make sure the snap ring groove is clean and free of burrs.

2. Dip the locating ball in petrolatum and place the ball in notch in hub.

3. Place the new drive gear on a clean metal plate; support the plate on two bricks. Heat the gear with a torch until it just begins to discolor or show traces of blue, Figure 149. Do Not overheat.

**NOTE:** The face of the gear having a depression (1/16" deep) goes down to contact the shoulder of the planet carrier assembly hub.

4. Using suitable tongs and heavy asbestos gloves, pick up the gear and drop it quickly over the reverse planet carrier with the groove in gear over the locating ball. Push the gear all the way down against the shoulder of the planet carrier.

5. Install snap ring. Determine that snap ring enters hub groove.

**CLEANING AND INSPECTION:**

1. Thoroughly clean and oil the ball bearings (10), Figure 150; then rotate the bearing slowly by hand, checking bearing for roughness or excessive looseness. Do Not spin bearing with air.

2. Inspect the outer bearing surface of the reverse internal gear support (12).

3. Inspect the reverse internal gear (5), for damaged teeth and scored inside bearing surface.

4. Inspect the reverse planet carrier (6) for damaged gear teeth on planet pinions and for worn pinion roller bearings. Also inspect the bronze oil pump drive gear for damage or excessive wear. Refer to Page 72 for "Removal and Installation of the Rear Oil Pump and Governor Drive Gear."

5. Inspect splines of reverse planet carrier (6) for damage.
6. Inspect gear in reverse center gear and flange assembly (7) for damaged teeth or worn bushing. If necessary to replace the gear, replace the reverse center gear and flange as an assembly.

7. Inspect the output shaft (2) for scored thrust and bearing surfaces. Also check the output shaft splines for nicks and burrs and the output shaft pinion gears for damaged teeth or worn bearing rollers.

8. Inspect all the bronze and steel thrust washers for excessive wear. Refer to "Thrust Washer Specifications", Page 123.

9. Inspect the rear bearing retainer (1) bushing for excessive wear (oil holes in bearing retainer must be open).

10. Inspect mainshaft (9) for damaged gear teeth, thrust and bearing surfaces.
11. Clean all parts that are to be re-used.
   Remove all traces of solvent cleaner.

**ASSEMBLY OF REVERSE UNIT ASSEMBLY**

1. Install the steel and then the bronze thrust washer into the thrust washer retainer on reverse gear and flange assembly, Figure 151. Retain washers in place with petrolatum.

2. Install the output shaft into the reverse center gear and drive flange assembly seating output shaft planet flange against washers. While holding the output shaft firmly against the thrust washers and reverse center gear and flange, stand output shaft on pinion carrier end.

3. Install the reverse center gear snap ring, Figure 152.

   **NOTE:** This snap ring is slightly larger than the other snap rings used in this transmission.

4. Install the reverse planet carrier over the output shaft with the bronze oil pump driving gear down while carefully meshing planet pinions with the reverse center gear, Figure 153.

5. Assemble the reverse internal gear on the gear support and install the large snap ring, Figure 153.

6. Place the internal gear and support over output shaft carefully meshing the internal gear teeth with planet pinions.

7. Install the ball bearing over the output shaft and tap the bearing into the reverse internal gear support counterbore with J-2995-1 Driver, Figure 154.

8. Install the open type snap ring in the groove of the output shaft. This snap ring can be installed by using a flat punch and hammer, Figure 155.
NOTE: The reverse unit should be supported on a hard wood block when installing this "Open Type" snap ring to avoid damage to "Nine and gear teeth.

NOTE: When the speedometer drive gear is properly positioned the "Spacer Gauge" can be removed with light finger pressure. Perform this operation carefully to avoid damage to the spacer gauge and eliminate the necessity of reinstalling the gear.

FIGURE 155

9. Place the speedometer drive gear over output shaft and drive the gear into place using T-2191 Spacer Gauge, and T-2995-1 Driver, Figure 156.

FIGURE 156

10. Paint the outside surface of the oil seal with red lead sealer or Permatex No. 3 and install the oil seal in the rear bearing retainer using J-1354 Oil Seal Installer, Figure 157.

11. Install the rear bearing retainer over the output shaft (lining up bolt holes in rear bearing retainer with bolt holes in reverse internal gear support). Tap housing in place with a rawhide hammer.

12. Install the four reverse internal gear support attaching bolts. (Dip the bolt threads into sealing compound Permatex No. 3. Aviation Form-2-Gasket). Replace all damaged copper washers. Tighten bolts finger tight. Final tightening of these bolts is done after the rear bearing retainer is installed into transmission case.

13. Install the transmission speedometer drive pinion and sleeve assembly.
FRONT PUMP AND
FRONT DRIVE GEAR

DISASSEMBLY:
1. Remove the front pump assembly from the front drive gear by tapping gear with a rawhide hammer.
2. Remove the gasket from the front pump cover.
3. Using Holding Tool X-2184-1 and Screw Driver Socket J-2184-2 remove two 1" and one 5/8" long screws and copper washers from the front pump cover, Figure 158.

CAUTION: It is important that Holding Tool J-2184-1 be used while removing the pump cover attaching screws. DO NOT CLAMP OIL PUMP BODY IN A VISE OR TRY TO HOLD THE PUMP BODY BY INSERTING A BAR INTO THE INTAKE BORE OR PRESSURE REGULATOR PISTON BORE.

4. Remove one 1-3/8" long screw and copper washer from rear of pump, Figure 159.

5. Remove float pump cover from pump body.

NOTE: DO NOT PRY OFF OIL PUMP COVER WITH A SCREW DRIVER as this will damage lapped surfaces. Tap cover lightly with a rawhide hammer at dowel area to loosen.

Use care not to drop gears out of gear pockets in pump body when cover is removed.

6. Remove front pump relief valve and spring from the pump body, Figure 160.

NOTE: Mark top face of driven gear (outer) with a little Prussian Blue for identification when reassembling.

7. Remove both the drive and driven gears.
8. Remove the pump cover oil seal using a small blunt chisel.

CAUTION: Clamp the pump cover to a wood block (4" wide). Position "C" clamps in a manner so as not to damage or distort the pump cover during oil seal removal.

NOTE: The oil seal can also be removed from the oil pump while the oil pump is assembled in the transmission after the torus cover, torus members and flywheel housing have been removed.
CLEANING AND INSPECTION:

1. Clean all parts thoroughly.
2. Inspect pump drive gear and driven gear for damaged teeth or scored end surfaces and pump body for scored gear pocket, Figure 161.
3. All oil passages should be checked for any obstruction.

NOTE: The small drilled hole at the end of the pressure regulator bore must be open.

4. Inspect pump cover for scored surfaces, loose dowels or obstructed passages.
5. Inspect oil seal rings for damage and freedom in grooves.
6. Inspect front drive gear for scored surfaces, worn bushing, or damaged teeth.
7. Check Woodruff keys for wear and looseness of key in key slot.
8. Check for freedom of the relief valve in bore and the spring for length (1-25/64").
9. Inspect the bushing in the pump body for wear or scored. Slight wear of this bushing is permissable.

NOTE: If the bushing shows excessive wear on one side it is an indication that either the bushing is not concentric with the pump cover or the locating bore in the flywheel housing is not aligned with the pilot bearing bore in the crankshaft.
ASSEMBLY:

1. Install new oil seal rings in pump cover (if necessary), Figure 162.

   ![Figure 162]
   
   FIGURE 162

   NOTE: Install new oil seal rings in torus cover and check ring gap before installing, rings on pump cover (gap .001" to .007").

2. Using installer Tool J-2170; install a new oil seal in pump cover, Figure 163, (step side of seal up).

   ![Figure 163]
   
   FIGURE 163

3. Apply Permatex No. 3, Aviation Form-A-Gasket sealer around edge of cover and seal.

4. Lubricate both pump gears with Hydra-Matic Fluid. Install both gears in gear pocket of pump body (Prussian Blue side of driven gear should be up), Figure 164.

   ![Figure 164]
   
   FIGURE 164

5. Install the relief valve spring, and relief valve into the pump body.

6. Press down on relief valve and insert feeler stock in slot to hold valve down, Figure 165.

   ![Figure 165]
   
   FIGURE 165

7. Install pump cover to pump body, locating position of cover with the dowels.

8. Apply Permatex No. 3 Gasket Cement under head of screws.

9. Install 3 covers to body attaching screws,
with copper washers. (replace damaged washers) . Use Tool J-2184A to hold pump and tighten screws to 12 - 15 ft. lbs., Figure 166.

FIGURE 166

10. Remove feeler stock at relief valve, install the 1-3/8" long screw into the rear side of the pump assembly, torque to 1215 ft. lbs.
11. Assemble the front pump assembly over the front drive (1) Figure 167, aligning key to one of the 4 keyways in the pump drive gear.

REAR PUMP AND GOVERNOR ASSEMBLY

DISASSEMBLY:

1. Remove oil delivery sleeve (1) from governor body, Figure 167.

NOTE: Do not lose the governor plug.

2. If governor runout was within .005" as outlined on page 54 "Checking Governor Runout," mark edge of governor body and governor drive flange (if not previously marked) so they may be reinstalled in the original position.
3. Using a 7/16" socket, remove two bolts and lock washers holding governor body to drive flange.
4. Remove the screws and lock washers that retain the G-2 governor plunger and bushing to the governor body.
5. Remove the small governor plunger stop, Figure 168.
6. Remove the G-2 governor plunger and bushing assembly, Figure 167, by pulling the plunger out of the governor body.

CAUTION: Do not remove the governor plungers or weights from either G-1 or G-2 plunger assembly.

FIGURE 167

1. Governor oil delivery sleeve .
2. Governor weight G-1
3. Governor drive flange
4. .Rear oil pump body assembly
5. Oil pump driven gear
6. Oil pump internal tooth gear
7. Oil pump cover
8. Governor plug
9. G-2 plunger and bushing assembly
10. Governor body assembly
11. Plunger stop
12. Pump shaft driven gear
7. Remove four bolts and lock washers that retain the rear pump cover, Figure 167, to pump body and remove pump cover (7/16" wrench).
8. Mark oil pump gears with Prussian Blue so they can be reassembled in the relationship. Remove the driven gear from the pump body.

CLEANING AND INSPECTION:

1. Clean all parts thoroughly.
2. Inspect all pump gears for damaged teeth.
3. Inspect pump cover and gear pockets in pump body for scores.
4. Inspect governor body ring lands, if lands are damaged or worn thin, replace the complete governor assembly.
5. Check oil seal rings for freedom in grooves.
6. Both the G-1 plunger and G-2 plunger should have a free movement from .118" to .148".

NOTE: Thoroughly clean the governor and plungers in a good cleaning solution and if after cleaning these units the G-1 plunger (large) still sticks, replace the complete governor assembly. If only the G-2 plunger sticks, then the G-2 plunger and bushing assembly should be replaced.

7. Inspect the governor oil delivery sleeve, Figure 168, for ring scores.
8. Check governor plug for freedom in its bore.

REAR OIL PUMP REPAIR:

NOTE: If it is found necessary to replace the governor drive flange, rear oil pump and governor driven gear, pump body or rear oil pump shaft assembly, proceed as follows:

1. Grind off one end of the lock pins that attach the governor drive flange and the oil driven gear to the oil pump shaft.
2. Place the J-2183-1 Rear Oil Pump Rivet Set Anvil in a suitable vise and hold the oil pump so that the drive flange or gear pin indexes with the hole in the anvil. Using a pin punch drive out either pin, Figure 169.
3. Remove the governor drive flange.
4. Remove any burrs from shaft at the pin hole.
5. Drive out driven gear to pump pin. See paragraphs "1 and 2" above for procedure.
6. Remove any burrs, from shaft at driven gear pin hole and remove shaft through driven gear and pump body.
7. Clean pump thoroughly and check pump shaft and bushings for excessive wear.

NOTE: Pump bushings are not sold separately. Refer to your "Hudson Parts Manual".
8. Slide oil pump drive shaft with gear into pump end of body, Figure 170.

9. Slide driven gear over shaft with teeth of gear toward pump end of body then enter shaft into the governor end of body, Figure 170.

10. Line up holes in shaft and driven gear and install a new pin.

11. Using the S-2183-1 Anvil and the S-2183-2 Peening Tool, peen, ends of pin in shaft and gear, Figure 171.

12. Install governor drive flange in end of shaft and peen a new pin as outlined in operation 11.

CAUTION: Height of peened ends of pins must not exceed .070”.

13. Install oil pump driven gear. (Be sure Prussian Blue markings index.)

14. Install pump cover with four lock washers and mounting bolts. Tighten to 6-8 ft. lbs. torque.

15. Install the G-2 governor plunger and bushing assembly in governor body with slot in bushing for governor plunger stop up, Figure 172. Install and tighten, the attaching screws and lock washers.

13. While holding the G-2 plunger in, install the G-2 plunger stop with the two small holes up, Figure 173.
CAUTION: Stop must not extend above surface of governor body.

17. If necessary to install governor oil seal rings on governor body, check the ring gap by installing the ring in the oil delivery sleeve. Gap to be .001" to .007".

18. Install the governor oil delivery sleeve with the chamfered end next to the governor body. Install sleeve carefully so as not to damage or break the rings when compressing them into the oil delivery sleeve.

19. Position governor assembly on governor drive flange, lining up locating marks and install the two attaching bolts and lock washers. Tighten bolts to 6-8 ft. lbs.

20. Install the governor sleeve plug (8), Figure 167.

FRONT SERVO

DISASSEMBLY:

1. Remove bolts (12), Figure 174, holding the front band release cylinder (11) to servo body (4) and remove the front band release cylinder. Figure 175.

6. Remove the check ball and spring.

7. Remove the front band release piston assembly (10), Figure 174, from the release cylinder. Figure 176.
8. Remove the front servo piston assembly from the front servo body, Figure 177.

NOTE: Do not disassemble the servo piston as this piston is furnished as a complete unit.

9. Remove the pipe plug and spring retainer holding the 4 to 3 downshift valve in place, Figure 178. 10. Remove the 4 to 3 downshift valve from the servo body, Figure 179.

11. Remove the front servo piston assembly dowel pin from the servo body if the pin is loose, to prevent loss while cleaning.

CLEANING AND INSPECTION

1. Clean all parts thoroughly.
2. Inspect the servo body for scores and obstructed passages. Figure 180.
3. Inspect the servo piston assembly for scores, broken rings, freedom of rings in grooves and obstructed passages.
4. Inspect the front band release cylinder for scores.
5. Check the front band release piston for scores, broken ring and freedom of ring in groove.
6. Inspect the 4 to 3 downshift valve for scores or an obstructed orifice.
7. Inspect the front servo springs for distortion or collapsed coils. Booster spring free length 61/64". Retracting spring free length 1-33/64".

ASSEMBLY:

1. Install check ball spring, check ball and pump tube sleeve into servo body.
2. Install the 4 to 3 downshift valve into bore of servo body, Figure 181. Align slot with hole for spring retainer and install retainer.
3. Install and tighten screw plug over 4 to 3 valve.
4. Install the band apply piston dowel pin in servo body if previously removed.
5. Install the front servo apply piston assembly into servo body. Align slot in sleeve over dowel pin, Figure 182.
6. Install the front band release piston into cylinder, using care when compressing the ring.
7. Install the booster spring over the front band release piston.
8. Place the retracting spring retainer over the piston stem, on booster spring, Figure 183.
9. Install the retracting spring over piston stem.
10. Install the band release cylinder assembly on servo body. Cylinder should seat squarely on body before bolts are installed, Figure 184.
11. Install the two attaching bolts and lock washers. Tighten to 6-8 ft. lbs. torque.
REAR SERVO

DISASSEMBLY:

1. With the rear servo assembly installed in a suitable press, bring press ram down to rest on the rear servo spring retainer but do not distort retainer, Figure 185, and remove the two retainer to body bolts and lock washers (1), Figure 186. Use 1/2" wrench.
2. Release press slowly until springs are free.
3. Remove spring retainer (2), servo spring (3), compensator piston (4) and the two servo springs (5) and (6) inner and outer. Also see Figure 187.
4. Remove the accumulator body with the accumulator piston from the servo body.
5. Hold the accumulator body (8), Figure 188, on a vise equipped with soft copper jaws and using a brass drift, tap accumulator piston (7) through the accumulator apply spring (9) and accumulator body. See Figure 189 covering this operation.
FIGURE 187

1. Spring retainer bolts
2. Spring retainer
3. Rear servo spring
4. Compensator piston
5. Servo spring - inner
6. Servo spring - outer
7. Accumulator piston
8. Accumulator body
9. Accumulator apply spring
10. Booster spring
11. Booster piston
12. Servo body

FIGURE 188

6. Remove the booster spring and the booster piston from the servo body. Figure 189. Do not cock piston in bore.

FIGURE 189

CLEAN AND INSPECTION:

1. Clean all parts thoroughly in a good clean solvent.
2. Inspect the servo body for scores and obstructed passages. Figure 190.
3. Check the actuating lever for wear and free operation.
4. Inspect the booster piston (11), Figure 187, for scores, broken rings and freedom of rings in ring grooves.

5. Inspect the accumulator body (8), Figure 187, for score or obstructed passages. Examine check valve for damage, be sure check valve plunger is free.

NOTE: If check valve is broken, make replacement as follows:

A. Using a pin punch, drive out check valve rivet, Figure 191.

B. Remove check valve and plunger, Figure 192.

C. Clean all parts and oil passages thoroughly.

D. Install the check valve plunger.

E. Install the check valve with the notch in valve entered over groove in plunger.

F. Insert a new rivet through valve and into accumulator body, Figure 193.

D. Peen rivet.

E. Check installation by working plunger to be sure the plunger and check valve work freely.

6. Inspect accumulator piston for scores, damaged rings, freedom of rings in grooves or obstructed passage in stem of piston.
7. Check compensator piston for scores, damaged ring and freedom of ring in groove.
8. Inspect all springs for damage, distortions or collapsed coils. Rear servo spring free length 4-1/4", compensator piston servo spring inner 3-25/32", outer 3-15/32", accumulator apply spring 1-16/64", and booster spring 1-19/32".

ASSEMBLY:

1. Wipe all parts clean of cleaner solvent.
2. Install booster piston into the servo body; do not damage piston ring or scuff servo body bore.
3. Install booster spring (10), Figure 194, into booster piston (11).
4. Install the accumulator piston (7) into accumulator body (8). Do not damage piston ring or scuff body bore.
5. Install the accumulator apply spring (9) over the piston stem, (small tapered end seated against shoulder of piston stem). Accumulator piston should be supported on a wood block during this operation, Figure 194.
6. Install booster piston into the accumulator body. Install the accumulator body and piston into the servo body. Use care not to break piston rings during this operation.
7. Align bosses on accumulator body (8) with bosses on servo body (12), Figure 187.
8. Place the two servo springs inner (5) and outer (6) in the bore of the accumulator piston.
9. Install the compensator piston (7) over the two servo springs (4) and (5).
10. Install servo spring (3) and retainer with attaching bolts (1) and lock washers in position and place the complete assembly into a suitable press.
11. Slowly compress springs and tighten mounting screws.

CAUTION: Use extreme care during this operation to align compensator piston and oil seal ring to avoid breaking the oil ring.

12. After compensator piston has been entered satisfactorily, remove the assembly and tighten the two attaching bolts to 10 to 13 ft. lbs. torque.
13. Test operation of the rear servo by applying air pressure in the rear band release passage, Figure 190, while holding the reverse blocker piston passage closed. Booster piston will move upward and compress the springs.

CONTROL VALVE ASSEMBLY

DISASSEMBLY:

1. Place the control valve assembly flat on a clean paper for disassembling.

NOTE: Never grip the control valve body assembly in a vise or use force in removing or installing valves or plugs.

2. Move the inner detent control lever slowly counter-clockwise while holding a clean rag below the lever to catch the detent tension spring and detent steel ball.
3. Remove the manual control valve, Figure 195.
4. Remove the manual control shaft rubber seal and manual shaft seal spring washers from shaft, Figure 196.

5. Remove the three screws that hold the inner and outer valve bodies together, Figure 197.

6. Separate the inner and outer valve bodies and remove the valve body spacer plate.

7. Remove the three screws that hold the valve body rear cover to valve body and remove the rear cover and inner valve body rear plate, Figure 198.

8. Remove the three screws holding the front valve body plate to the front valve body and remove the plate, Figure 199.

9. Remove three screws holding the front valve body and remove the front valve body, Figure 200. Hold the front valve body and inner valve body together while removing the screws to avoid springs jumping out of place.
10. Remove the 1-2 regulator plug spring, 2-3 valve spring, 2-3 regulator plug spring and 3-4 valve spring, Figure 201.

11. Remove the three shifter valves.

**NOTE:** Valves should be free to move from valve inner body by pushing on opposite ends against governor plugs with finger pressure.

12. Remove the three governor plugs by bumping the inner valve body on palm of hand if necessary.

13. Remove the three regulator plugs from valve body.

14. Remove the three screws holding the detent ball retainer to the outer valve body and remove the retainer, Figure 202.

15. Remove three screws that hold the outer valve body front plate to outer valve body and remove plate, Figure 203.

16. Remove the compensator valve and detent plug from outer valve body, Figure 204.
17. Remove double transition valve and spring.
18. Remove "TT" valve, throttle valve spring and throttle valve.
19. Remove the stop pin, holding compensator auxiliary plug in place. Figure 205.

20. Remove the compensator auxiliary plug by inserting a 1/8" brass rod in the hole of the plug and use another small punch to push the plug from the outer valve body. Figure 206.

CAUTION: Do not allow the auxiliary plug to drop from the aligning brass rod as this is a short plug and may become lodged in the valve body.

CLEANING AND INSPECTION:

1. Thoroughly clean valve bodies and valve in a CLEAN solvent.

NOTE: All valve bodies and valves should be handled carefully during this cleaning process to insure against damage.

2. Inspect all valve bodies for scores in body bores and to see that they are free from burrs.
NOTE: Valve body and valve bores should be free of all scratches and scores. Burrs can be removed by the careful use of a fine crocus cloth.
CAUTION: This type of valve has sharp corners to prevent dirt from wedging between the valve and valve body. When removing any burrs, do not round off the square edges of valves.

3. With the valves and valve bodies both clean and dry, check each shifter valve, governor plug and regulator plug for free movement in their respective bores and operating positions.
NOTE: All valves can be assumed to be operating freely if they will fall of their own weight in their respective bores when the valve body is shaken slightly. Do not drop valves. All governor plugs are interchangeable. Likewise, the 2 to 3 and the 3 to 4 shifter valves are interchangeable. If when checking it is found that a shifter valve or a governor plug does not slide freely in one bore of the valve body, attempt correcting by trying it in a different bore.
NOTE: The manual control valve, between the inner and outer valve body assemblies, the throttle valve inside lever and shaft, shaft pin and shaft oil seal with spring washers, inside detent control lever assembly, detent ball and spring, inside valve lever shaft oil seal, flat washer and retainer pin are the only parts of the control valve furnished separately. If it becomes necessary to replace one of the other valves or one of the valve bodies (inner or outer) a complete valve body assembly may be replaced, or a complete outer valve body less the manual control valve may be replaced.

4. Check the fit of the throttle valve inside lever and shaft in the hub of the inside detent control lever and in the outer valve body. If the shaft binds in the hub or the shaft is excessively worn or the oil seal is missing or damaged the shaft and oil seal can be replaced as follows:
A. Drive out the throttle valve shaft pin, Figure 208.

NOTE: Support the valve shaft on a lead plate in a manner so as not to damage the detent control lever at the outer valve body during operation.

B. Install a new throttle valve inside lever and shaft through the outer valve body and detent lever and hub.

C. Install a new oil seal over valve shaft and into counterbore of detent lever sleeve.

D. Install oil seal retainer washer and shaft retaining pin. See "Note" above.

E. Check the throttle valve inside shaft for freedom of movement.
CONTROL VALVE ASSEMBLY

ASSEMBLY:

1. Carefully assemble the compensator auxiliary plug (7), Figure 207, into the outer valve body (6), using a small punch or a 1/8" brass rod to hold the plug in position and install the auxiliary plug pin (8), Figure 206.

2. Install the throttle valve (12) throttle valve spring (11), " T " valve (10) and detent plug (4). Check valve for free movement.

3. Install the compensator valve (5) with compensator spring (32) and double transition valve spring (33) and double transition valve (9). Check both valves for free movement in bores.

4. Position the outer valve body front plate (3) on the outer valve body and install the three attaching screws and lockwashers.

5. Install the detent ball retainer (16) on the outer valve body (6). Check to be certain that the inner throttle lever is inside of stop of the retainer (16).

6. Install the three screws attaching the detent retainer to the outer valve body.

7. Install the manual control valve (13). Make sure the manual control lever pin engages between the two bands at the end of the manual valve. This can be done as follows:

(a) Rotate the inside detent control lever counter-clockwise past the reverse position.

(b) Insert the manual valve detent spring (15) in bore of the detent ball retainer (16).

(c) Insert detent ball (14) over spring (15).

(d) Push ball (14) and spring (15) into bore of detent retainer (16) with your finger while rotating the manual control lever inner (34) clockwise into "Lo" position.

8. Install regulator plugs 1-2 (19), 2-3 (18), and 3-4 (20) in front valve body (17). Check plugs for free movement.

9. Install the three governor plugs (29) in the inner valve body (28). Check for freeness.

10. Install shifter valves 1-2 (26), 2-3 (25) and 3-4 (27) in inner valve body. Check valves for free movement.

11. Position the inner valve body plate (30) and valve body rear cover (31) on inner valve body (28).

12. Install and tighten the three attaching screws.

13. Install 1-2 regulator plug spring (23) in inner valve body (28).

14. Install 2-3 valve spring (22) and 2-3 regulator plug spring (21) in inner valve body.

15. Install 3-4 valve spring (24) in valve body.

16. Lay front valve body (17) and inner valve body (28) on a clean surface; line-up regulator plug springs in the inner body with the regulator plugs in front body. Compress springs with the front body and install the three attaching screws.

17. Position the front valve body plate (1) on front valve body (17) and install the three attaching screws. Be sure plate (1) does not extend over face of inner body (17).

18. Position the valve body spacer plate (2) on the inner valve body (28).

19. Position the outer valve body on spacer plate (2) and insert the four valve body to transmission case attaching bolts through both valve bodies and spacer plate to hold the spacer plate in position while starting and tightening the two inner and outer valve body attaching screws.

CAUTION: Make sure all assembly screws are tight in the valve body by double checking with a small screw driver.
20. Install the manual shaft seal inner washer with the small inside diameter over the manual control shaft with dish up, Figure 209.

21. Install the manual shaft seal outer washer with the large inside diameter over the manual control shaft with the dish down.

22. Install the rubber oil seal over the shaft with the lip of seal extending into the inside diameter of the outer washer.

TORUS CHECK VALVE

DISASSEMBLY FROM DRIVEN TORUS:

1. Bend locks of torus check valve retainer (d) away from attaching bolts (e) Figure 210.

23. Remove the two bolts (E), torus check valve (C) and torus check valve spring (B).

CLEANING AND INSPECTION:

1. Clean all parts thoroughly in a good clean solvent.
2. Inspect the face of the check valve (C) (bearing surface) for scores.
3. Check the inside bearing diameters of check valve for scores.
4. Check free movement of check valve over hub of driven torus member.
5. Check free length of spring (3-17/32").
6. Check end of planet carrier shaft for nicks or burrs that would damage or restrict the operation of the check valve.

ASSEMBLY:

To assemble; reverse procedure of removal.

TORUS COVER

INSPECTION:

1. Inspect inner and outer diameter of the torus cover oil seal hub for score marks.
2. Inspect grooved gasket surface for nicks or burrs. Two continuous ridges should appear on the sealing surface.
3. Inspect the splines of torus hub for wear or damage.
4. Check torus cover hub runout as follows:
   (a) Assemble the torus cover to the flywheel using four attaching bolts (two adjacent to the flywheel to torus dowel bolts and two 180° apart). Tighten to 20-25 ft. lbs.
   (b) Install the Torus Member Indicator Holding Tool J-4638 into the lower right hand flywheel housing attaching hole, Figure 211.
   (c) Install Dial Indicator Clamp with Indicator Extension Rod J-4659 to Holding Tool J-4638.
   (d) Assemble the KMO-30 dial indicator to Extension Rod J-4659 so that the hole attachment contacts the hub of the torus cover about 1/4" from edge of hub, Figure 211.
   (e) Rotate the engine with a suitable flywheel turning tool and observe hub runout which must not exceed .005".
   (f) If hub runout exceeds .005", rotate torus
cover 180° on the dowel pins and recheck. If torus cover runout is still excessive, check flywheel runout. If flywheel runout does not exceed .005", replace torus cover. If flywheel runout does not exceed .005" and torus hub runout exceeds .005", replace torus cover.

2. Inspect the flywheel gear teeth for damage.
3. Check flywheel runout with Dial Indicator KMO-30 mounted on J-4638 Indicator Support so that stem will contact the sealing surface just inside the row of torus cover bolt holes, Figure 212. Flywheel runout should not exceed .005" total indicator reading.

FIGURE 211

INSPECTION OF FLYWHEEL

1. Inspect the inner raised sealing surface to the flywheel for nicks or burrs. (This surface bears against the torus cover to flywheel gasket and forms a positive seal).

FIGURE 212

REFERENCE
ASSEMBLY OF INDIVIDUAL UNITS INTO TRANSMISSION CASE

1. Thoroughly clean the transmission case with a good CLEAN solvent.
2. Remove the oil pressure line pipe plug (located between the band adjusting screws).
3. Blow out all oil passages from under side of case to outside. See Figure 213.
4. Inspect transmission case for cracks.
5. Insert a wire or paper clip through both oil delivery sleeve holes to check for open passages into the opening between the oil seal grooves. Figure 214.
6. Check oil seal rings for freedom in grooves, examine grooves for damage.
7. Check oil delivery sleeve ring gap (.001" to .007").
8. Install the oil delivery sleeve with the dowel hole toward case and tighten cap with dowel of cap in one of the two oil holes in sleeve. Apply oil on each side of
the bearing cap. Apply air pressure to two clutch oil holes in side of case, Figure 215.

NOTE: If movement of oil on delivery sleeve is observed, leakage is indicated. Attempt correction by installing a new oil delivery sleeve. Recheck the new oil delivery sleeve in the same manner; if the new sleeve leaks, dress bearing cap down with fine emery cloth on a surface plate until sleeve does not leak. (Be sure to remove all traces of emery dust from bearing cap).

9. After inspection of sleeve has been proven satisfactory, remove the bearing cap and oil delivery sleeve from case.

10. Inspect the band adjusting screws and threads in case. Inspect lock nuts for damage.

11. Inspect both front and rear bands for burned or worn linings.

12. Inspect both steel bands for distortion or cracks.

13. Check strut on the rear band for alignment and free pivoting. The rear band is furnished with strut attached.

14. Check anchor ends of front band for broken-welds or worn sockets.

CAUTION: Do not pry either band open or distort band in any manner as they are surface-ground at the factory for drum fit.

15. Install the oil delivery sleeve over the planet carrier with long bearing up. Compress exposed oil delivery sleeve rings with Ring Compressor J-1537 and tap oil delivery sleeve into bore of front clutch drum with a rawhide hammer, Figure 216.
16. Install the rear clutch hub front snap ring into the second groove on the planet carrier. Figure 217.
17. Compress the exposed oil delivery sleeve rings with Ring Compressor J-1537, and install the rear drum assembly on planet carrier.
18. Install the rear clutch hub rear snap ring, Figure 218.

FIGURE 218

NOTE: Both the front drum and rear drum should be free to rotate under slight force. If either drum binds, the unit should be disassembled and the cause of the trouble corrected.

19. Remove the front and rear units from the Holding Fixture J-2187 and position the front band over the front of front unit drum so that the short anchor end will be positioned to fit over the front band adjusting screw when front and rear units are placed in the case. Install one KMO-145 Compressor to hold the front band on the front drum, Figure 219.

INSTALLING FRONT AND REAR UNITS IN CASE

1. Install front and rear units with planet carrier into transmission case by lowering front end of planet carrier into case first, Figure 220.

FIGURE 220

NOTE: The single hole in the oil delivery sleeve must be centered between the center bearing cap attaching bolt holes and the hole is facing up.
2. Remove the KMO-145 Compressor spring and position anchor end of band over front adjusting screw.
3. Install rear band on rear unit drum and position anchor end of band over rear adjusting screw.
4. Position center bearing cap over oil delivery sleeve with dowel registering with single dowel hole in sleeve. Lightly tap bearing cap in place.
5. Install a new center bearing cap lock plate under attaching bolts and tighten bolts to 40-50 ft. lbs. torque.
6. Bend lock plate up around bolts using large pliers.
   CAUTION: Do not use a screw driver to pry corners of lock plate up, as this may damage lapped edges of transmission case.
7. Install screw driver between the center bearing cap and rear clutch drum to
prevent the drum from moving forward. The screw driver should be placed at an angle to prevent damage to the oil delivery sleeve.

8. Remove the Rear Clutch Hub Holding Tool J-2174 from the rear drum.

9. Position the rear clutch hub rear thrust washer in the counterbore of the rear hub and retain with petrolatum, Figure 221.

10. Install the correct size selective washer in counterbore of output shaft and retain the washer in place with petrolatum, Figure 222.

NOTE: If main shaft did not have correct end clearance prior to disassembly, select proper washer to bring end clearance within limits of .004" - .015". Selective washers are furnished in the following eight sizes:

<table>
<thead>
<tr>
<th>MARK</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.055&quot; - .059&quot;</td>
</tr>
<tr>
<td>2</td>
<td>.063&quot; - .067&quot;</td>
</tr>
<tr>
<td>3</td>
<td>.071&quot; - .075&quot;</td>
</tr>
<tr>
<td>4</td>
<td>.079&quot; - .083&quot;</td>
</tr>
<tr>
<td>5</td>
<td>.087&quot; - .091&quot;</td>
</tr>
<tr>
<td>6</td>
<td>.095&quot; - .099&quot;</td>
</tr>
<tr>
<td>7</td>
<td>.103&quot; - .107&quot;</td>
</tr>
<tr>
<td>8</td>
<td>.111&quot; - .115&quot;</td>
</tr>
</tbody>
</table>

11. Install a new rear bearing retainer to transmission case gasket on the rear bearing retainer, align the holes and retain in place with petrolatum.

12. Install the main shaft in output shaft, meshing center gear with planet pinion.

13. Install the main shaft and reverse assembly into rear end of the transmission case, Figure 223, so that mounting bolt holes align.

NOTE: Revolve the output shaft and main shaft to facilitate meshing planet gears with the main shaft center gear and rear drum internal gear.

14. Just start the five rear bearing retainer to case attaching bolts and lock washers.

15. Position the reverse anchor in the transmission case and install the reverse anchor support bolt and lock, Figure 224. Do not tighten bolt.

16. Align the holes in reverse drive flange and rear drum and install six reverse drive flange bolts and lock washers.
Figure 225. After two bolts are entered finger tight remove screw driver.

CAUTION: Tighten the six bolts evenly to prevent distorting drive flange. While tightening bolts test for freeness by turning main shaft output shaft and front and rear unit drums.

17. Push or tap the rear bearing retainer against case, then tighten mounting bolts and reverse anchor support bolt evenly to 28-33 ft. lbs. torque. Turn up reverse anchor support bolt lock.

18. Tighten four rear bearing retainer to reverse internal gear support bolts to 28-33 ft. lbs. torque.

19. Test for freeness by turning main shaft, output shaft and front and rear unit drums.

INSTALLING FRONT PUMP AND FRONT DRIVE GEAR IN CASE

1. Position bronze thrust washer over planet carrier, Figure 226.

2. Position front oil pump cover gasket over front pump cover.

3. Install the front pump and front drive gear as an assembly over planet carrier. Align locating counterbore in pump cover with the counterbore in the transmission case.

4. Install pump cover locating washer in counterbore, Figure 227.

5. Install two front pump attaching bolts and tighten bolts to 10-12 ft. lbs. torque.

NOTE: Cover should protrude .003" to .015" out of case. If cover protrudes less than .003" add a pump cover gasket to allow cover to protrude within limits. After this check has been completed, loosen attaching bolts.
6. Install the bronze, then steel thrust washer over planet carrier, against front end of front drive gear. These washers were tied together during disassembly.
7. Install the snap ring holding thrust washers in place, Figure 228.

CHECK END CLEARANCE OF MAIN SHAFT:
1. Install Main Shaft End Play Guide J-2587 over main shaft and front planet carrier to support the main shaft.
2. Set up a dial indicator on transmission case using Dial Indicator Extension Rod J-1465, Figure 229.
3. Insert a screw driver between the front clutch drum and center bearing cap. This will hold the front planet unit forward.
Position the dial indicator so that the spindle of indicator rests against end of Tool 1-2587.
4. Move main shaft back and forth with Tool J-2587, Figure 229. End clearance should be .004" to .015". Be sure to get just float of main shaft.
NOTE: If end clearance is outside limits disassemble and install correct selective washer.
6. If clearance is within limits, remove the screw driver from between front clutch drum and center bearing cap.
7. Remove the dial indicator, extension and J-2587 End Play Guide.
8. Install the open type snap ring in groove on main shaft.
INSTALLING GOVERNOR AND REAR PUMP ASSEMBLY IN CASE

1. Position the large round governor weight to the front of transmission and locate one reverse drive flange attaching bolt up to provide clearance for pump and governor assembly to slide into transmission case, Figure 230.

2. Slide the rear pump and governor assembly into position in the transmission case and install two attaching bolts and lock washers but do not tighten.

INSTALLING CONTROL VALVE ASSEMBLY

1. Install the three oil delivery pipes into the three holes in the governor oil delivery sleeve and pull oil delivery sleeve out 1/8".

2. With inside detent control lever in "LO" position, push control valve assembly onto oil delivery pipes, Figure 231.

3. Lower control valve assembly into position and push the delivery sleeve in to bring control valve assembly against case.

4. Install four control valve assembly attaching bolts and lock washers. Tighten to 6-8 ft. lbs. torque.

NOTE: Be sure governor oil delivery sleeve is in place.

5. Recheck governor runout as outlined on Page 54.

INSTALLING REVERSE SHIFTER BRACKET AND CRANK ASSEMBLY AND SHIMS

1. Position retracting spring and roller on bracket assembly, Figure 232.

2. Assemble the bracket and shims to transmission case, Figure 233.

3. Install attaching bolts with lock washers. Tighten to 15-18 ft. lbs. torque.

4. Check backlash between the reverse internal gear and anchor as follows:
   (a) Install Reverse Gear Backlash Gauge J-2650 and a dial indicator as shown, Figure 234.
   (b) Place the inside detent control lever in reverse position.
   (c) Place screwdriver under the reverse anchor and pry lightly to restrict up and down movement.
(d) Rock the reverse gear by turning the main shaft and take the reading on dial indicator. Steel shims to be either removed or installed between reverse bracket and transmission case to obtain correct backlash of 0.016" to 0.049". To increase backlash add shims, to decrease remove them.

INSTALLED FRONT AND REAR SERVOS:

1. Install the front pump delivery pipe in front pump body, Figure 235.
2. Insert end of rear pump discharge pipe into hole in rear pump.
3. Position front servo with piston stem in socket on end of front band; place servo on front pump delivery pipe; enter rear pump discharge pipe into fitting in servo as servo is installed in case.
4. Enter front servo attaching bolts and lock washers. Do not enter more than 2 or 3 threads.
5. Place the rear servo in position, engaging the rear band strut with actuating lever while entering oil transfer pipe from front servo.
6. Enter rear servo attaching bolts, then tighten all four servo attaching bolts to 23-28 ft. lbs. torque.

1. Install front pump intake pipe to front pump, using a new gasket and attaching bolt locks, Figure 236.

CAUTION: Do not drop gasket, bolts or lock plates into case.

1. Tighten attaching bolts to 10-12 ft. lbs. torque. Bend locks up against flat of bolts.
2. Tighten the two rear pump attaching bolts to 15 to 18 ft. lbs. torque.
3. Tighten the two front pump attaching bolts with washers to 10-13 ft. lbs. torque.
NOTE: Cover should protrude .003" to .015" out of case. If cover protrudes less than .003" add a pump cover gasket to allow cover to protrude within limits.

ADJUST FRONT BAND:
1. Remove the pipe plug from the front servo using a 7/16" six-point socket. Loosen the \( \frac{1}{2} \) "hex" adjusting screw of gauge J-1693, until approximately \( \frac{1}{8} \)" of threads are exposed above gauge body. Install gauge, tightening by HAND ONLY, Figure 237.

2. Tighten the "hex" adjusting screw with fingers until the stem of gauge is felt to \textit{just} touch piston in the front servo.

\textbf{NOTE: Before tightening adjusting screw be sure band is lined up over drum.}

3. Using a 1/2" wrench, tighten this 1/2" "hex" adjusting screw six complete turns from the point where it was felt by hand that stem \textit{just} touched servo piston.

4. Tighten the front band adjusting screw until knurled washer on top of the band adjusting gauge is just free to turn.

5. Hold band adjusting screw and tighten band adjusting screw lock nut securely to 40-50 ft. lbs. torque.

6. Loosen the gauge adjusting screw at least six full turns and remove gauge. Install and tighten pipe plug.

ADJUST REAR BAND:
1. With rear band centered on drum, tighten band adjusting screw until actuating lever contacts face of gauge J-5071, Figure 238.

\textbf{CAUTION: Do not go beyond adjustment. If adjusting screw is accidentally turned beyond adjustment, loosen the adjusting screw two or three turns and repeat adjustment.}

2. Hold the band adjusting screw and tighten adjusting screw lock nut to 40-50 ft. lbs. torque.

\textbf{INSTALLING PRESSURE REGULATOR ASSEMBLY}
1. Inspect the pressure regulator valve, spring, rubber seal and gasket for damage.

\textbf{NOTE: The pressure regulator valve must have a free fit in the bore of the front pump body; "TV" plug must be a sliding fit in the regulator plug. End coils of regulator spring must fit freely over regulator valve, Figure 239.}

2. Install a new gasket and rubber seal on the pressure regulator plug.

3. Place a neoprene ring seal and copper gasket on the regulator plug, Figure 239.

4. Install the "TV" plug in the regulator plug (retain "TV" plug with heavy oil).
5. Locate regulator valve on seat in the front pump and install regulator plug assembly, tighten to 40-50 ft. lbs. torque.

**INSTALLING SIDE COVER AND OUTER SHIFT LEVER:**
1. Place a new gasket on side cover and retain in place with petrolatum.
2. Position side cover and gasket assembly over manual shaft.
3. Install the side cover attaching bolts with COPPER WASHERS finger tight. Shift cover to centralize manual shaft in hole and tighten bolts to 10-12 ft. lbs. torque.
4. Install outer shift lever. Tighten clamp bolt to 10-13 ft. lbs. torque.

**NOTE:** The throttle control lever should be installed on the throttle shaft after the transmission is installed in the car. This procedure will prevent accidental damage to the throttle lever.

**INSTALLING TRANSMISSION OIL SCREEN AND OIL PAN:**
1. Slide oil screen over front pump intake pipe and position over rear pump intake pipe.
2. Place new oil pan gasket on transmission case.
3. Position oil pan over gasket and align holes.
4. Start attaching bolts with lock washers to line up pan. Then tighten bolts to 10-13 ft. lbs. torque.
5. Install new oil pan drain plug gasket and tighten plug to 35-45 ft. lbs. torque.

**INSTALLING FLYWHEEL HOUSING TORUS COVE AND TORUS MEMBERS**
1. Install the transmission case to flywheel housing gasket against face of transmission, retain with heavy oil and align holes.
2. Install the flywheel housing on front face of transmission case and install the four attaching bolts and lock washers using case to prevent damage to gasket. Tighten bolts to 40-50 ft. lbs. torque.
3. Install the torus cover, aligning splines of torus cover hub with splines of the front drive gear. Push on torus cover evenly (without rocking cover) to prevent damage to the oil seal and rings.
4. Install the drive torus in the splines of the front planet carrier and install the snap ring, Figure 240.
5. Install the driven torus on the main shaft so that the hub seats against the open type snap ring.
6. Install a new main shaft nut, lock plate (ear over flat on torus hub and install the main shaft nut.
7. Move shift lever into the reverse position and tighten the mesh shaft nut using a torque wrench and a 1-7/16" socket. Tighten to 15-20 ft. lbs. torque.

8. Bend the lock plate against flat of main shaft nut.

9. Install the oil level indicator.

**NOTE:** The air cleaner in the oil level indicator cap, Figure 241, should be cleaned every 10,000 miles or twice a year.

---

![Image of air cleaner](image1.jpg)

**FIGURE 241**

**INSTALLING HYDRA-MATIC TRANSMISSION**

1. Raise car.
2. Thoroughly clean face of flywheel around complete bolt circle (A), Figure 242.

---

![Image of flywheel](image2.jpg)

**FIGURE 242**

3. Check flywheel pilot bearing retainer to be sure it is properly positioned.

4. Tighten flywheel to crankshaft attaching nuts (B) to 40-45 foot lbs. torque and turn up ears of flywheel nut retainer (D) against flats of attaching nuts.

5. Install a new gasket on face of flywheel. Gasket should be held in place with petrolatum. Do not use shellac or any other sealer.

**NOTE:** To provide a good seal it is very important that the gasket be in perfect condition and that flywheel gasket surface be free of all burrs.

---

![Image of transmission](image3.jpg)

**FIGURE 243**

6. Using Transmission Eye Bolt J-4660, Figure 243, lift transmission into position using a hydraulic jack with cradle and tilt table attached, and with handle of jack to rear of car, Figure 244.

---

![Image of transmission installation](image4.jpg)

**FIGURE 244**

7. While raising transmission with the hydraulic jack, guide the transmission main shaft pilot into flywheel pilot bearing.

**CAUTION:** Careful use of the hydraulic jack tilt table will eliminate scraping or damage to the flywheel when installing the transmission.

8. Lower engine into approximately normal position by turning the two adjusting screw nuts of the Engine Holding Fixture T-4651.

9. Position the torus cover on flywheel so that the dowel pins on flywheel and holes in torus cover (or punch marks on dowel and torus cover) correspond.
10. Push transmission forward until dowels of cylinder block and engine rear plate enters flywheel housing and dowels in flywheel enter into dowel holes of the torus cover.

11. Install the two upper flywheel housing bolts, Figure 245, and tighten finger tight.

12. Install the lower flywheel housing attaching bolts and tighten all bolts securely to 40-50 foot lbs. torque.

13. With the transmission still supported by the hydraulic jack, install torus cover to flywheel attaching screws.

NOTE: After all bolts are installed, tighten two bolts adjacent to the flywheel dowels to 12 - 15 foot lbs. and then tighten two bolts located 90° from dowels to 12 - 15 foot lbs. Then tighten all bolts in rotation to 20-25 foot lbs. Follow again with tightening all bolts in rotation to 26-31 foot lbs. Use a flywheel turning tool and a torque wrench, Figure 246.

14. Determine that torus cover drain plug is tight.

15. Install flywheel housing dust cover assembly and four attaching screws.

16. Install No. 3 cross member, Figure 247, start one bolt at each side to hold member in position. Install bolts (C) and (D), Figure 248, attaching No. 3 cross member to frame (both sides) but do not tighten bolts.
17. Install the engine rear support bolts (B), Figure 248, attaching rear insulators to No. 3 cross member (two each side). Tighten these bolts securely and then tighten bolts (C) and (D) (each side) securely.

18. Lower hydraulic jack to place transmission in its normal position.

19. Enter hand brake cable through hole provided in No. 3 cross member and install retainer (C), Figure 248.

20. Connect hand brake cable clevis (C) at support (E), Figure 249.

21. Connect hand brake cable lever return spring (D) at the hand brake cable lever (E).

21. Install propeller shafts and center bearing by reversing procedure of removal.

22. Connect speedometer cable at (A).

23. Remove Engine Holding Fixture J-4651 while transmission is supported with hydraulic jack. After support has been removed, release hydraulic jack.

24. Install left hand side engine rear stone guard assembly (4 self tapping screws).

24. Connect selector lever control rod assembly and recheck adjustment. See Pages 37 and 38.

24. Connect transmission throttle rod at side of transmission control lever and recheck adjustment pages 35 and 36.

25. Lower car and install valve cover breather pipe, pipe attaching bracket, starting motor.

25. Connect battery cable at starter motor and battery ground cable at battery.

25. Remove oil level indicator, Figure 71, and refill transmission as outlined on pages 41 and 42.
DIAGNOSIS AND TESTING

The procedures contained in this section are for use when testing a Hudson with Hydra-Matic for standard performance. Select the test required and perform it in manner recommended. This will lead to accurate diagnosis of the trouble and minimize the need for complete disassembly of the transmission. Transmission oil level must be checked and Hydra-Matic fluid added if required before any tests are conducted.

CHECKING OIL LEVEL:

1. Set hand brake lever tightly, start engine and allow to idle continuously for a minimum of two minutes after oil is hot.
2. Roll back front floor mat and remove transmission oil level indicator.
3. Place control lever in "N" position.
4. Remove all gravel, sand or lint from floor and around oil level indicator and remove indicator.
5. Wipe indicator and re-insert.
6. Remove indicator and note reading.

NOTE: Refer to Pages 41 and 42 for procedure for refilling.

ROAD TEST USING HYDRA-MATIC DIAGNOSIS GUIDE

The Hydra-Matic Diagnosis Guide for Hudson cars Page provides a uniform and systematic trouble diagnosis which is both accurate and thorough. During the road test place a check mark in the space provided after the various conditions when encountered.

The normal speeds at which the shifts should take place and Stall or Torque test specifications are listed on the Diagnosis Guide, Page 111.

Instructions for using the Diagnosis Guide are printed on page

The letters in the column headed "Possible Causes" refer to the units listed in the "Legend."
# Hydra-Matic Diagnosis Guide for Hudson Cars

**Important—Before Testing, Always—1. Check Oil Level—2. Check Engine Idle**

Date: ___________________________  R.O. No.: ___________________________

Owner: ___________________________  Tester: ___________________________

Mileage: ___________________________

## Hydra-Matic Shift Points in M.P.H. for Hudson Cars

See instructions on page 113 for using guide

### Upshifts

<table>
<thead>
<tr>
<th>Shift</th>
<th>Drive Range</th>
<th>L Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Minimum Throttle</td>
<td>Full Throttle</td>
</tr>
<tr>
<td>1-2</td>
<td>4-8</td>
<td>10-15</td>
</tr>
<tr>
<td>2-3</td>
<td>10-14</td>
<td>27-35</td>
</tr>
<tr>
<td>3-4</td>
<td>15-20</td>
<td>58-66</td>
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</table>

### Downshifts

<table>
<thead>
<tr>
<th>Shift</th>
<th>Drive Range</th>
<th>L Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Closed Throttle</td>
<td>Full Throttle</td>
</tr>
<tr>
<td>4-3</td>
<td>15-11</td>
<td>19-16</td>
</tr>
<tr>
<td>3-2</td>
<td>10-5</td>
<td>14-10</td>
</tr>
<tr>
<td>2-1</td>
<td>5-3</td>
<td>10-5</td>
</tr>
<tr>
<td>4-2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Stall Test

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal</td>
<td>Poor engine performance such as need of tune up, etc.</td>
<td>Transmission slippage or excessive torus coupling slippage. (Do not hold throttle open.)</td>
</tr>
</tbody>
</table>

With the engine at operating temperature, set control lever in D position. Fully apply hand and foot brake, and accelerate engine to wide open throttle.
### SHIFT CONDITIONS

<table>
<thead>
<tr>
<th>Shift Conditions</th>
<th>√</th>
<th>Possible Causes</th>
<th>Other Conditions</th>
<th>√</th>
<th>Possible Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too High</td>
<td></td>
<td>C-G-H</td>
<td>Excessive Creeping</td>
<td></td>
<td>B-O-P</td>
</tr>
<tr>
<td>Too Low</td>
<td></td>
<td>C-G-H</td>
<td>Slipping</td>
<td></td>
<td>A-C-D-E-F-G-I</td>
</tr>
<tr>
<td>Varies</td>
<td></td>
<td>C-F-G-H</td>
<td>Jumps out of Reverse</td>
<td></td>
<td>J-M-O-P-R-U-V</td>
</tr>
<tr>
<td>Hunting</td>
<td></td>
<td>C-G</td>
<td></td>
<td></td>
<td>C-N</td>
</tr>
<tr>
<td>Misses one or more shifts</td>
<td></td>
<td>G-H-O</td>
<td>No Drive Forward</td>
<td></td>
<td>A-C-D-F</td>
</tr>
<tr>
<td>Improper Throttle downshift</td>
<td></td>
<td>C-D-G-H-K</td>
<td>Locks up on reverse coast</td>
<td></td>
<td>E-I-M-X</td>
</tr>
<tr>
<td>Engine speeds up, band apply rough</td>
<td></td>
<td>C-F</td>
<td>Moves forward when in reverse</td>
<td></td>
<td>D-F-G-J-X</td>
</tr>
<tr>
<td>Rough downshift to 1st</td>
<td></td>
<td>G-J</td>
<td>Noisy</td>
<td></td>
<td>P</td>
</tr>
<tr>
<td>Violent Shifting</td>
<td></td>
<td>C-G</td>
<td></td>
<td></td>
<td>See Noise Section</td>
</tr>
<tr>
<td>Shifts above 2nd in low range</td>
<td></td>
<td>G-H</td>
<td>Crashes when shifted to reverse</td>
<td></td>
<td>B-C-G-J-N-S</td>
</tr>
<tr>
<td>No shifts—Stays in same gear</td>
<td></td>
<td>C-G-H</td>
<td>No drive in reverse</td>
<td></td>
<td>E-N-S</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Drives in reverse only</td>
<td></td>
<td>C-N-T</td>
</tr>
</tbody>
</table>

Always check causes in sequence given.

### LEGEND

<table>
<thead>
<tr>
<th>A</th>
<th>Oil Level</th>
<th>I</th>
<th>Front Servo</th>
<th>R</th>
<th>Oil Delivery Sleeve</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Engine Idle Speed</td>
<td>J</td>
<td>Rear Servo</td>
<td>S</td>
<td>Rev Shifter Bracket</td>
</tr>
<tr>
<td>C</td>
<td>Linkage</td>
<td>K</td>
<td>Front Oil Pump</td>
<td>T</td>
<td>Manual Detent Lever</td>
</tr>
<tr>
<td>D</td>
<td>Oil Pressure</td>
<td>L</td>
<td>Rear Oil Pump</td>
<td>U</td>
<td>Restriction in Oil Circuit</td>
</tr>
<tr>
<td>E</td>
<td>Serve Bands</td>
<td>M</td>
<td>Fluid Coupling</td>
<td>V</td>
<td>Excessive Oil Leak in Circuit</td>
</tr>
<tr>
<td>F</td>
<td>Pressure Regulator</td>
<td>N</td>
<td>Reverse Unit</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Control Valve Assembly</td>
<td>O</td>
<td>Front Unit</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Governor</td>
<td>P</td>
<td>Rear Unit</td>
<td>Y</td>
<td></td>
</tr>
</tbody>
</table>

### OIL LEAKS

<table>
<thead>
<tr>
<th>Where Noticed</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Flywheel &amp; Crankshaft Flange</td>
<td>Loose Flywheel to Crankshaft Bolts or Gasket</td>
</tr>
<tr>
<td>Fluid Coupling &amp; Flywheel or Fluid Coupling Proper</td>
<td>Flywheel to Torus Cover Gasket. Flywheel Sealing Area, Drain plug or Damper Rivets</td>
</tr>
<tr>
<td>Front of Transmission</td>
<td>Front Cover, Gasket, Front Oil Seal or Oil Seal Rings</td>
</tr>
<tr>
<td>Bottom Oil Pan</td>
<td>Oil Pan Gasket—Drain Plug Gasket</td>
</tr>
<tr>
<td>Side Cover Pan—or left rear corner of transmission</td>
<td>Side Cover Pan Gasket—Throttle and Manual Shaft seals Pressure line plug</td>
</tr>
<tr>
<td>Rear of Transmission</td>
<td>Rear Oil Seal—Rear Bearing Retainer Gasket</td>
</tr>
</tbody>
</table>

### NOISE

<table>
<thead>
<tr>
<th>Occurs Under Following Conditions</th>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral and all Gears whenever engine is running</td>
<td>Front Oil Pump</td>
</tr>
<tr>
<td>Neutral, 1st and 2nd Gears only</td>
<td>Rear Unit Planetary Gears</td>
</tr>
<tr>
<td>Neutral, 1st, 3rd and Reverse Gears only</td>
<td>Front Unit Planetary Gears</td>
</tr>
<tr>
<td>Reverse Gear, Acceleration only</td>
<td>Reverse Unit Planetary Gears</td>
</tr>
<tr>
<td>Reverse Gear, Deceleration only</td>
<td>Rear Unit Planetary Gears</td>
</tr>
<tr>
<td>Metallic scraping at front of transmission</td>
<td>Excessive Backlash—Torus Members</td>
</tr>
</tbody>
</table>
INSTRUCTIONS FOR USING THE HYDRA-MATIC DIAGNOSIS GUIDE

1. Before testing the car with this guide, Pages 111 and 112, check the transmission fluid for proper level, the engine running and its slow idle speed at 480-520, (with gearshift control lever in "N" position). Either of these items will cause many different irregularities in transmission operation.

2. While driving the car, be on the alert for any indication of any improper engine performance. If any, correct them before making final diagnosis.

3. The shift points shown in this guide are average and may vary slightly. One or two miles per hour either way is no cause for adjustment as long as the shifts are smooth.

4. The causes for these irregular operating conditions are necessarily general, pointing to the major assemblies. This permits the use of a concise two-page diagnosis form.

5. The various causes of any particular condition are listed in order of the trouble. Over one-fourth of these can be remedied by external adjustments, and over three-fourths can be repaired with the transmission in the car. Never order the transmission removed from the car until the "on car" repairs have been completed, or until visual inspection of the transmission after removal of the oil pan and side cover (oil sediment, excessive backlash, burned drums, etc.) definitely indicates the need for complete disassembly. ALWAYS CHECK THE CAUSES IN THE SEQUENCE LISTED.

6. The only exception to step 5 occurs when two or more conditions have one common cause; then fix that particular item first.

7. When checking linkage, always inspect rods and levers for wear as well as for proper adjustment, because worn linkage will never hold proper adjustment.

8. When checking for slippage, always use the "stall test" on page 110.

9. Obviously, the value of this diagnosis guide will be lost unless it is used properly. After the sheet has been filled out during the road test, the proper corrective measures for the repair order will be apparent. The sheet should then be attached to the shop copy of the repair order and remain with it throughout the shop, finally, accompanying it into the car records. This will enable the mechanic to know what specific condition his work is to correct and will provide definite information for future reference.
A predetermined test route should be established to save time and permit comparison of different cars over the same route. Where possible, the route should be laid out to include a hilly section to test for open throttle upshift, slippage and throttle downshifts, a level section for testing upshift points and a quiet section for testing the noise. When a chassis dynamometer is available, it may be used as a substitute for the road test.
Sometimes it is desirable to know which band is slipping. After making test with selector lever in "DR" position, place lever in "R" position and test again. If slippage still occurs, fault is with front band or both. If slipping does not occur, then all slippage is in the rear band.

CHECK CAUSE FOR SLIPPING UNDER "STALL TEST":

1. Set hand brake lever tightly.
2. Start engine and run at a speed equivalent to 20 MPH for approximately 1-1/2 minutes. Then, with engine IDLING, selector lever in the "N" position, check the fluid level in the transmission.
3. See that fluid is at the "Full" mark on the indicator.
4. After level has been checked, shut off engine and wait 10 minutes. Recheck fluid level with engine shut off. If after 10 minutes, the fluid level in the transmission has not raised more than 1/2 inch, the driven torus check valve and front pump relief valve are operating satisfactorily.
5. If check valve and relief valve are operating satisfactorily, adjust bands and test car using Diagnosis Guide, Pages 111 through 113.

TESTING "MAIN LINE" OIL PRESSURE

Use Pressure Checking Gauge J-2540 when checking oil pressure in Hydra-Matic transmission.

To check the oil pressure proceed as follows:
1. Remove accelerator pedal and front Floor mat.
2. Remove band adjusting screw floor hole cover.
3. Remove pipe plug from transmission case (between band adjusting screws). Use a 7/16" six point socket.
4. Screw gauge into transmission.
5. Start engine. With transmission oil warm, oil pressure should be from 75 lbs. to 90 lb s. at 1000 RPM. Move selector lever from "N" to "DR" "LO" and "R". Oil pressure should be equal in each position, Figure 250.

CAUTION: Apply both hand and foot brakes to keep car from moving during this test. Drive the car on the road noting pressure under operating conditions.

If a transmission fluid leak is detected, the following locations should be checked: Transmission fluid leaks can be divided into two groups, those which can be corrected without removing the transmission and those which require its removal.

The first group includes:
1. Torus cover drain plug.
2. Side cover bolts or pressure line pipe plug.
3. Side cover at manual shaft seal.
4. Oil pan bolts.
5. Oil pan drain screw.
6. Rear bearing retainer bolts and seal.
7. Pressure regulator plug gasket.

Fluid leaks at any of the above points are easily located and should be corrected no matter how slight they may seem.
Fluid leaks that require removal of the transmission from the car includes the following.

1. Crankshaft to flywheel seal and bolts.
2. Flywheel to torus cover.
3. Dampener rivets in torus cover.
4. Front oil pump cover screws.
5. Front oil pump cover casting (sand hole).
6. Front oil pump cover oil seal.
7. Front oil pump cover oil seal rings.
8. Front oil pump cover to transmission case.

Check for Fluid Leaks at Torus Cover and Flywheel.
1. Run engine until transmission fluid is at operating temperature.
2. Remove flywheel housing bottom cover.
3. Wipe fluid from flywheel and torus cover.
4. Place a clean piece of white or brown paper under flywheel and transmission.
5. Start engine and run at approximately 800 RPM for two minutes.
6. Stop engine and examine paper for fluid leaks.

Fluid leaks, if present will be indicated by a fine spray on the paper usually directly in line with the leak.
LOCATING FLUID LEAKS AT TORUS COVER AND FLYWHEEL:

If fluid leaks are indicated, examine flywheel and torus cover for fluid.

1. Fluid on the front face of the flywheel indicates a leak at the crankshaft to flywheel seal or bolts.
   
   Remove transmission, remove flywheel, replace seal, as outlined in Engine Section 3.

NOTE: Do not confuse an engine oil leak at the rear main bearing with a flywheel fluid leak.

2. Fluid on the torus cover may be coming from the front cover oil seal rings (7), Figure 251, the front cover oil seal (6) or the dampener rivets (3).

3. If there is no fluid on either the flywheel or torus cover, the leak is at torus cover to flywheel (2).

   Tighten all bolts to 30 ft. lbs. torque and if leak continues, it is due to a broken gasket or insufficient or damaged sealing surface on the flywheel or torus cover. If damage cannot be corrected, install new parts.

   If all parts ahead of the front of transmission are dry and fluid leaks between flywheel housing and transmission, the leak may be caused by:
   (a) Loose pump cover screws (4), or damaged copper washers.
   (b) No sealer on pump cover screws.
   (c) Sand hole in pump cover (5).
   (d) Poor seal between front cover and case (8).

   To correct above cause of leak proceed as follows:
   1. Remove transmission from the car. Remove torus members and flywheel housing from transmission.
   2. If pump cover attaching screws are loose, it will be necessary to remove the pump, remove the three pump cover screws and the one pump body screw, seal the screws with Permatex No. 3 cement and tighten to 12 to 15 ft. lbs. torque. Damaged copper washers should be replaced.
   3. If pump cover screws are tight but have no sealer remove the pump and reseal all screws. Tighten to 12 to 15 ft. lbs. torque. Damaged copper washers should be replaced.

   4. If a sand hole is present in pump cover casting, replace complete front pump assembly.

   5. The front pump cover should protrude .003" - .015" out of transmission case with pump cover gasket in place. If pump cover protrudes less than .003", add a pump cover gasket to allow the cover to protrude within limits.

   TESTING FOR NOISES

   Hydra-Matic transmissions are relatively quiet in operation. However, they do make a certain amount of noise, as will any such unit when operating. One should become familiar with these before testing the transmission for noise. Tune the engine to run smoothly before testing for noise.

   FRONT OIL PUMP NOISE

   When noise is present it may be heard as a sharp shrill whine and is most noticeable when pump is under load. The pitch is steady when driving car and does not change like differential noise. Front pump whine may be heard with shift control lever in NEUTRAL and engine speed increased. To make a systematic check for front pump noise proceed as follows:
   1. With engine idling and selector lever in neutral, listen for whine.
   2. Raise engine speed gradually. Front pump whine, if present, may be more pronounced at a certain engine speed.
   3. Start the car in motion and increase car speed so that engine speed will be the same as when the whine was most pronounced. The front pump (if noisy will again be heard at the same engine speed as when the car was standing.
   4. Drive the car 25 MPH to 35 MPH; listen to pump whine.
      (a) Turn ignition key off.
      (b) Quickly move the selector lever into the neutral position. If whine was heard while shifting through all speeds, being loudest between 25 MPH to 35 MPH and disappeared when ignition was turned off (selector lever in neutral), the front pump is at fault.
REVERSE PLANET GEAR NOISE

Reverse planet gear noise, if present, will be heard in reverse, only when car is under ACCELERATION. In this case noise is in the reverse planet assembly.

NOTE: Due to the ratio of the reverse gears and engine speed when accelerating in reverse, it is doubtful that reverse gear noise will ever become objectionable. Reverse noise on DECELERATION ONLY, is caused by noise rear unit planet gears (see rear unit planet gear noise).

FIGURE 252

SCRAPING TORUS MEMBERS

Scraping torus members can be identified by a metallic scraping at the front of transmission. If this noise is present it may be caused by:

1. Main shaft nut not tightened.
2. Main shaft nut lock plate broken or not bent over. Either one of the above conditions may permit the driven members to strike the flywheel.

REAR OIL PUMP NOISE

(Cross Drive Noise)

Rear oil pump noise may be heard as a thigh pitched whine much like light axle noise, but not sensitive to throttle opening, drive, float and coast. REAR OIL PUMP WHINE in most cases will be heard at 20 to 35 MPH. It is seldom heard below 20 MPH. Rear axle whine may be audible at other speeds.

TESTS FOR REAR OIL PUMP (CROSS DRIVE) NOISE:

1. Drive the car to determine at what speed noise is heard.
2. After noise is first heard, increase car speed approximately 10 MPH above that point.
3. Move selector lever to neutral, turn off the ignition and coast down through the range in which noise was heard.

NOTE: With the ignition off, the front oil pump is not running. If noise is still present and was not sensitive to engine speed, the noise is in the rear oil pump.

If there is any doubt between axle noise and rear oil pump noise, the following test will eliminate the rear axle.

1. Disconnect the propeller shaft.
2. Lift right corner of front floor mat.
3. Remove transmission oil level indicator.
4. Place manual selector lever in "DR" range position.
5. Run engine to a speed where transmission shifts into 4th speed.

If noise is in the rear oil pump, it will be heard at approximately the same speedometer reading as when road testing the car. This test definitely eliminates the rear axle.

Inspection of the bronze driver gear can be made without removing transmission from car.

1. Remove rear oil pump and governor assembly as described in "Minor Repairs", Page 43.
2. Examine bronze drive gear for deep running groove on drive side of gear. If drive side of gear shows a deep running groove, remove the transmission, remove and disassemble reverse unit assembly and replace the bronze gear as outlined on pages 81 and 82.

TEST FOR REAR OIL PUMP INNER GEAR NOISE:

Rear pump inner gear noise is similar to cross drive noise but is heard in the form of a low growl and is usually heard at speeds above 35 MPH. If rear pump inner gears are noisy, the bushings may be worn permitting gears to contact bores in pump body. In this case, a new pump will need to be installed.
NOTE: Front pump noise is usually caused by the ends of the teeth on the drive gear interfering with the crescent, or by the omission of a 5/16” drill spot from the face of the pump cover.

REAR UNIT PLANET GEAR NOISE

Noisy rear planet gears may be heard as a low growl on idle which increases to a very high-pitched whine when engine speed is increased (selector lever in neutral).

TEST FOR REAR UNIT GEAR NOISE (CAR STANDING):

1. Drive car to a reasonably quiet spot. Stop car.
2. Move selector lever into neutral position.
3. Listen for noise with engine idling.
4. Accelerate engine to higher speed. Rear planet gear whine will increase to a very high pitch as engine speed is increased.

TEST FOR REAR UNIT GEAR NOISE (CAR IN OPERATION):

1. Move selector lever into "Lo" range position
2. Drive the car until transmission shifts into 2nd speed.
3. Accelerate and decelerate in 2nd speed. Rear planet gear noise will follow car speed and if present will be very noticeable in second gear.

NOTE: Open the front door and listen. Rear planet gear noise will seem to be transferred down the propeller shaft.

4. Move the selector lever back into the "DR" range position and again accelerate through the gears. Rear planetary whine, if present, will be heard in 1st and 2nd speed, and will disappear after transmission shifts into 3rd or 4th speed (rear unit is then in direct drive).

NOTE: Where no objectionable low growl in neutral is heard while engine is idling and only a very slight whine is heard when engine speed is increased, which disappears when selector lever is placed in "DR" range position, no attempt should be made to eliminate the slight whine.

The three units responsible for rear planetary noise are the "Sun" gear on the main shaft, rear planet pinions on the output shaft and the rear unit internal gear, Figure 253.

FIGURE 253

FRONT UNIT PLANET GEAR NOISE

Front unit planet gear noise is similar to front pump noise, but of a higher pitch. To test for front planet noise, start the engine, place the selector level in "LO" range position. Start the car in motion. If front planet gears are noisy, whine will be heard in first speed and disappear after transmission shifts into second speed. The cause is probably worn or nicked planet pinion gears, "Sun" gear, front drive gear, worn pinion needle bearings, or thrust washers, Figure 254.

FIGURE 254
TEST FOR BROKEN REAR SERVO CHECK VALVE

When the rear servo check is broken, the 3-1 shift is rapid and produces a severe clunk.

1. With the engine idling 480-520 RPM move selector lever from neutral to the "DR" range position. A broken check valve will cause rapid rear band application causing the car to lunge forward.

2. With transmission cold, drive car to a speed where transmission shifts into 4th (direct).

3. Coast to a stop. When the transmission is cold, no objectionable clunk will be noticeable during the 3-1 downshift.

4. Apply hand brake and foot brake.

5. With selector lever in "DR" range, speed up engine for approximately one minute to heat oil in transmission.

6. Make the same test as outlined under 2 and 3.

   If the 3-1 shift occurs at above 8 to 3 MPH and is severe, causing objectionable clunk, a broken rear servo accumulator check valve spring is indicated. No attempt should be made to eliminate a slight bump felt only when the transmission is cold and which disappears when the transmission is warm. See "Replacement of Rear Servo accumulator Check Valve" on page 87.

   If accumulator check valve is not broken check tightness of rivet. If rivet is loose replace valve and rivet as outlined on page 88. Check for free operation of plunger in body. If sticky, free up plunger.

TEST FOR MISSING OR STICKING TORUS CHECK VALVE OR FRONT PUMP RELIEF VALVE

A missing or sticking torus check valve will cause the engine to speed up excessively when starting away after the car has been standing.

A similar effect will be produced by the omission of a front pump relief valve or relief valve spring, or by the relief valve being stuck in the open position.

Determine the effectiveness of the torus check valve and pump relief valve by checking the rate at which fluid drains back from the coupling into the transmission.

1. Set hand brake lever tightly.

2. Start engine and run at a speed equivalent to 20 MPH for approximately 1-1/2 minutes. Then, with engine IDLING, selector lever in "N" position, check the fluid level in the transmission with the oil level indicator.

3. See that fluid is at the "Full" mark on the indicator.

4. After level has been checked, shut off engine and wait 10 minutes. Recheck fluid level with engine shut off. If after 10 minutes, the fluid level in the transmission has not raised more than 1/2 inch, the check valve and relief valve are operating satisfactorily. Should oil level be raised more than 1/2", the check valve or relief valve is not operating satisfactorily and should be replaced.
# SPECIFICATIONS

## RECOMMENDED TORQUE TIGHTNESS FOR BOLTS

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>Thread Size</th>
<th>Torque Ft. Lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Gear to Rear Drum</td>
<td>#10-24</td>
<td>3-4</td>
</tr>
<tr>
<td>Front Body to Inner Body</td>
<td>#10-24</td>
<td>3-4</td>
</tr>
<tr>
<td>Outer to Inner Valve Body</td>
<td>#10-24</td>
<td>3-4</td>
</tr>
<tr>
<td>Rear Cover to Inner Body</td>
<td>#10-24</td>
<td>3-4</td>
</tr>
<tr>
<td>Front Body Plate to Body</td>
<td>#10-24</td>
<td>3-4</td>
</tr>
<tr>
<td>Front Plate to Outer Body</td>
<td>#10-24</td>
<td>3-4</td>
</tr>
<tr>
<td>Governor Bushing Retainer to Governor Body</td>
<td>#10-24</td>
<td>3-4</td>
</tr>
<tr>
<td>Detent Ball Retainer to Outer Valve Body</td>
<td>#10-24</td>
<td>3-4</td>
</tr>
<tr>
<td>Front Servo Assembly</td>
<td>1/8 Pipe</td>
<td>6-7</td>
</tr>
<tr>
<td>Torus Cover Drain</td>
<td>1/8 Pipe</td>
<td>6-7</td>
</tr>
<tr>
<td>Case-Oil Pressure Take-Off</td>
<td>1/8 Pipe</td>
<td>15-18</td>
</tr>
<tr>
<td>Front Servo Assembly</td>
<td>1/4 Pipe</td>
<td>6-7</td>
</tr>
<tr>
<td>Front Pump Cover to Body</td>
<td>1/4-20</td>
<td>12 - 15</td>
</tr>
<tr>
<td>Intake Pipe to Front Pump</td>
<td>1/4-20</td>
<td>10-12</td>
</tr>
<tr>
<td>Governor Body to Drive Flange</td>
<td>1/4-20</td>
<td>6-8</td>
</tr>
<tr>
<td>Rear Pump Cover to Body</td>
<td>1/4-20</td>
<td>6-8</td>
</tr>
<tr>
<td>Control Valve Assembly to Case</td>
<td>1/4-20</td>
<td>6-8</td>
</tr>
<tr>
<td>Side Cover to Case</td>
<td>1/4-20</td>
<td>10-12</td>
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<tr>
<td>Servo Body to Cylinder</td>
<td>1/4-20</td>
<td>6-8</td>
</tr>
<tr>
<td>Blocker Piston Retracting Spring to Bracket</td>
<td>1/4-20</td>
<td>6-8</td>
</tr>
<tr>
<td>Gov. Plunger to Gov. Primary &amp; Secondary Weights</td>
<td>1/4-28</td>
<td>6-8</td>
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<tr>
<td>Outer Throttle Valve Lever Bolt</td>
<td>1/4-28</td>
<td>10-15</td>
</tr>
<tr>
<td>Torus Check Valve Retainer Bolt</td>
<td>1/4-28</td>
<td>6-8</td>
</tr>
<tr>
<td>Trans. Mainshaft Nut</td>
<td>7/8-16</td>
<td>30-35</td>
</tr>
<tr>
<td>Flywheel to Crankshaft Nut</td>
<td>3/8-24</td>
<td>40-45</td>
</tr>
<tr>
<td>Torus Cover to Flywheel Bolt</td>
<td>5/16-24</td>
<td>Special*</td>
</tr>
<tr>
<td>Flywheel Housing to Transmission Bolt</td>
<td>1/2-13</td>
<td>40-45</td>
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<tr>
<td>Flywheel Housing to Cylinder Block Bolt</td>
<td>7/16-14</td>
<td>40-45</td>
</tr>
<tr>
<td>Oil Pan to Transmission Case</td>
<td>5/16-18</td>
<td>10-13</td>
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<tr>
<td>Front Pump Cover to Transmission Case</td>
<td>5/16-18</td>
<td>10-13</td>
</tr>
<tr>
<td>Drive Flange to Rear Drum</td>
<td>5/16-18</td>
<td>10-13</td>
</tr>
<tr>
<td>Servo Spring Retainer to Body</td>
<td>5/16-18</td>
<td>10-13</td>
</tr>
<tr>
<td>Reverse Shifter Bracket to Case</td>
<td>5/16-18</td>
<td>15-18</td>
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<tr>
<td>Rear Pump to Case</td>
<td>5/16-18</td>
<td>15-18</td>
</tr>
<tr>
<td>Outer Shifter Lever</td>
<td>5/16-24</td>
<td>10-13</td>
</tr>
<tr>
<td>Front Servo to Case</td>
<td>3/8-16</td>
<td>23-28</td>
</tr>
<tr>
<td>Rear Servo to Case</td>
<td>3/8-16</td>
<td>23-28</td>
</tr>
<tr>
<td>Reverse Int. Gear Support to Rear Bearing Retainer Rear</td>
<td>3/8-16</td>
<td>28-33</td>
</tr>
<tr>
<td>Bearing Retainer to Case</td>
<td>3/8-16</td>
<td>28-33</td>
</tr>
<tr>
<td>Center Bearing Cap to Case</td>
<td>7/16-14</td>
<td>40-50</td>
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<tr>
<td>Reverse Anchor Support Bolt</td>
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<td>23-28</td>
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<tr>
<td>Band Anchor Stop Nut</td>
<td>1/2-20</td>
<td>40-50</td>
</tr>
<tr>
<td>Oil Pan Drain Screw</td>
<td>5/8-18</td>
<td>35-45</td>
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<tr>
<td>Pressure Regulator Valve Plug</td>
<td>1-1/16-16</td>
<td>40-50</td>
</tr>
</tbody>
</table>

*Tighten 2 Bolts Adjacent to Dowels to
Tighten 2 Bolts Located 900 From Dowels to
Tighten All Bolts in Rotation to
Tighten All Bolts in Rotation to
## THRUST WASHER - SPECIFICATIONS, LOCATION AND PURPOSE

The following chart covers in detail the specifications, location and purpose of the various thrust washers used in the Hydra-Matic Transmission, Figure 255.

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Part No.</th>
<th>O.D.</th>
<th>I.D.</th>
<th>Thickness</th>
<th>Material</th>
<th>Location and Purpose</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>304988</td>
<td></td>
<td></td>
<td></td>
<td>Steel I.D. tank</td>
<td>Between the bronze washer in front of the Front Unit Drive Gear and the snap ring on the Front Planet Carrier (Intermediate Shaft) behind the Drive Torus. Purpose--To act as a bearing surface for the bronze thrust washer.</td>
</tr>
<tr>
<td>B</td>
<td>394997</td>
<td></td>
<td></td>
<td></td>
<td>Bronze</td>
<td>Between the front of the Front Unit Gear and the steel washer A. Purpose--It takes the forward thrust of the Front Drive Gear.</td>
</tr>
<tr>
<td>C</td>
<td>304996</td>
<td></td>
<td></td>
<td></td>
<td>Bronze</td>
<td>Between the rear of the Front Drive Gear and the front of the Front Planet Carrier. Purpose--To take the rear thrust of Front Drive Gear. Also use--Between the rear of the Front Unit Center Gear and the steel washer (with locating flat) on the Intermediate Shaft. Purpose--To take the rear thrust of the Front Unit Center Gear.</td>
</tr>
<tr>
<td>D</td>
<td>304977</td>
<td></td>
<td></td>
<td></td>
<td>Steel I.D. tank</td>
<td>Between the snap ring on the Front Planet Carrier (Intermediate Shaft), in front of the Oil Delivery Sleeve and the bronze thrust washer behind the Front Unit Center Gear. Purpose--To act as a bearing surface for the bronze thrust washer.</td>
</tr>
<tr>
<td>E</td>
<td>304993</td>
<td></td>
<td></td>
<td></td>
<td>Bronze</td>
<td>Between the rear of the Rear Unit Clutch Drum and in front of the Rear Unit Clutch Hub. Purpose--To take the rear thrust of the Rear Clutch Drum and the forward thrust of the Front Planet Carrier (Intermediate Shaft). Also use--Between the rear of the Rear Clutch Hub and the front of the Rear Unit Center Gear. Purpose--To take the rear thrust of the Front Planet Carrier (Intermediate Shaft) and the forward thrust of the Main Shaft.</td>
</tr>
<tr>
<td>F</td>
<td>304960</td>
<td>2.247</td>
<td>1</td>
<td>.055</td>
<td>Bronze</td>
<td>Selective. Between the rear of the Main Shaft and the front of the Output Shaft. Purpose--To take the rear thrust of the Main Main Shaft. (Note: Main Shaft end play is controlled by this washer).</td>
</tr>
<tr>
<td></td>
<td>304961</td>
<td>2.247</td>
<td>1</td>
<td>.063</td>
<td>Bronze</td>
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<tr>
<td></td>
<td>304962</td>
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<td>.071</td>
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<td>304963</td>
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<td>1</td>
<td>.079</td>
<td>Bronze</td>
<td></td>
</tr>
<tr>
<td></td>
<td>304964</td>
<td>2.247</td>
<td>1</td>
<td>.087</td>
<td>Bronze</td>
<td></td>
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<tr>
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<td>2.247</td>
<td>1</td>
<td>.095</td>
<td>Bronze</td>
<td></td>
</tr>
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<td>1</td>
<td>.103</td>
<td>Bronze</td>
<td></td>
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<td>1</td>
<td>.111</td>
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<td></td>
</tr>
<tr>
<td>G</td>
<td>304911</td>
<td>2.591</td>
<td>1-11/16</td>
<td>.087</td>
<td>Bronze</td>
<td>Between the steel washer in front of the Reverse Center Gear and the Output Shaft. Purpose--To take the forward thrust of the Rear Drum and Internal Gear.</td>
</tr>
<tr>
<td></td>
<td>304945</td>
<td>2.7/16</td>
<td>1.499</td>
<td>.049</td>
<td>Steel</td>
<td>Between the front of the Reverse Center Gear and the bronze thrust washer behind the Output Shaft. Purpose--To furnish a bearing surface for the bronze thrust washer.</td>
</tr>
</tbody>
</table>
GENERAL SPECIFICATIONS

Main Shaft End Clearance .004"-.015"
Oil Seal Rings Installed Gap .005"-.010"
Except oil delivery sleeve rings .001"-.007"
Rear Pump Drive Gear Retaining Pin Height of penned end of pin must not exceed .070"

Transmission Case Front Pump Cover
With gasket in place and pump assembly installed in case, with attaching screws tight, front pump cover should protrude beyond front of case .003"-.015"
Reverse Internal Gear Backlash
When using tool 1-2587 as per instructions indicator reading must be .016"-.049"
Governor Runout
Governor runout, taken with governor, governor sleeve and oil valve assembly installed must not exceed .005"
Governor Flange Runout
Flange runout, taken with the governor removed, must not exceed .002"

Throttle Lever Location
With throttle lever installed (draw bolt tight) and lever moved to its extreme rear position dimension from rear machined face of transmission case to center of lever clevis pin hole must be 6-1/2"
Use Tool J-2195, See Page 35, Adjustments)
Torus Cover Hub Runout
When mounted on Flywheel, Torus Cover hub runout must not exceed .005"
Flywheel Runout
The facial runout of the gasket seal surface of the flywheel, when mounted on crankshaft, must not exceed .005"

Torus Member Clearance
Clearance between Drive and Driven Torus members when assembled .036"-.127"
does not include .015" facial runout of torus members

Front Pump Pressure
With engine running approximately 1000 R.P.M. and transmission selector lever in neutral, oil pressure should be 75-90 lbs.

Oil Capacity and Change Interval
Drain oil pan and torus cover and refill 11 qts
Drain, disassemble, assemble transmission and refill 12 qts.
Change transmission oil every 15,000 miles

Band Adjustment Interval
Initial band adjustment at 2,000 mile inspection. Thereafter no specific interval is established for band adjustment. Transmission bands should be adjusted any time malfunction indicates adjustment is necessary.

Rear Axle Ratio
All Hydra-Matic models 3.58-1
FIGURE 256

HUDSON ESSENTIAL SERVICE TOOLS FOR "HYDRA-MATIC" TRANSMISSION SERVICE

1. J-1354 Transmission Rear Bearing Retainer Oil Seal Installer
2. J-4651 Engine Support Fixture
3. J-2187 Front Planet Carrier Assembly Holder
4. J-2170 Front Pump Cover Oil Seal Installer
5. J-1693-A Front Servo Gauge
6. J-2174 Rear Clutch Hub Retainer Bracket
7. J-2541-A Transmission Holding Stand
8. J-4660 Transmission Lifting Eye Bolt
9. J-2995-1 Speedometer Drive Gear Installer
10. J-2587 Main Shaft End Play Guide
11. J-4638 Torus Member Indicating Holding Tool
12. J-4639 Flywheel Housing Indicating Support
13. J-2191 Speedometer Drive Gear Support
14. KMO-30 Dial Indicator Set
15. J-2650 Reverse Gear Backlash Gauge
16. J-5071 Rear Servo Gauge
17. J-2182 Transmission Ball Bearing Retainer Remover
18. KMO-145-1 Front Servo Holder and Compressor
19. KMO-629 Tension Wrench (0-50 ft. lbs.)
20. J-2184-A Front Pump Holder and Socket Set
21. KMO-630 Snap Ring Pliers
22. J-1537 Oil Delivery Ring Sleeve Compressor
23. J-1458 Transmission Main Shaft Snap Ring Remover
24. J-1465 Transmission Main Shaft End Play Checking Extension Rod
25. J-4659 Extension Rod for Dial Indicator Set
26. J-2183 Governor Flange and Pump Riveting Set
27. J-2540 Transmission Oil Pressure Checking Gauge
28. J-2544-1 Linkage Adjusting Pin
29. J-2195 Throttle Lever Checking Gauge
30. J-331031 Throttle Lever Bending Tool
31. J-2681-A Servo Band Adjuster
SECTION 12
PROPELLER SHAFT
SPECIFICATIONS

Front Shaft
Rear Shaft
Center Bearing
Center Bearing Support Cushions
Center Bearing Lubrication
Universal Bearings

One Universal
Two Universals
Annular Ball
Two - Rubber
Factory Sealed
Needle Roller

FIGURE 1

LEGEND

1. Universal joint
2. Propeller shaft (front)
3. Dust shield
4. Center bearing
5. Center bearing housing
6. Sliding Sleeve
7. Sliding Sleeve Nut
8. Universal joint
9. Propeller shaft (rear)
10. Grease fitting
11. Universal joint
12. Grease fitting
13. Center bearing cushion bolts (2)
14. Center bearing support cushions (2)

CENTER BEARING SUPPORT CUSHIONS

The mounting arrangement of the two center bearing support cushions varies when used on cars equipped with Hydra-Matic Transmissions as shown in Figure (1), all other models with standard transmission use the same conventional type mounting as previously used.

The arrangement of the cushions on Hydra-Matic equipped cars has the left cushion mounted on an approximate horizontal plane to absorb side motion of the shaft when shifts are taking place.

Do not attempt to use the mounting for Hydra-Matic equipped cars on cars with Standard Transmissions since no advantage is gained.
CONSTRUCTION

Propeller shafts of tubular construction with needle roller bearing type crosses and a sliding spline assembled on front of rear shaft to take care of telescoping due to rear spring action. No adjustments are provided to compensate for wear of any of the universal joint parts. Parts that show wear must be replaced.

The rear end of the front shaft is supported in a permanently sealed annular bearing contained in a malleable housing supported by rubber cushions.

The rear propeller shaft is connected by a sliding spline at the center bearing support.

Universal joints are provided with means if lubrication for the needle roller bearings by grease fittings and should be lubricated with 140 S.A.E. Mineral Oil regularly every 1,000 miles.

NOTE: Use adhesive tape or rubber band to keep journal bearings assembled to Universal journal when removing the propeller shaft.

7. Remove front shaft with center bearing and support attached, by sliding off splines of rear shaft.

8. Remove nuts, lock plates, "U" bolts, and disconnect universal joint at rear axle companion flange and remove rear propeller shaft.

9. Wash all joints, yokes, and bearings (except center bearing) in a cleaning solvent.

10. Check splines of all shafts and sleeve yoke for excessive wear.

11. Check yokes, journals, and bearings for damage or excessive wear.

NOTE: The bearing surfaces on the journal should be free of grooves of ridges.

INSTALLATION:

1. Raise rear propeller shaft and support front splined end of shaft on frame crossmember.

2. Connect rear shaft rear universal joint to carrier companion flange.

3. Lift front propeller shaft into position and attach nut on splined sleeve, insert center bearing support to frame bolt.

NOTE: Do not tighten bolt or it will be difficult to connect front shaft universal at the transmission companion flange.

4. Connect front universal to transmission companion flange.

NOTE: Journal bearings must be compressed to allow edge of bearing to clear lip at edge of companion flange otherwise propeller shaft will not be in proper balance, Tool J-881-A will facilitate this assembly.

PROPELLER SHAFT
(FRONT AND REAR)

REMOVAL:

1. Raise car and place stand jacks.

NOTE: To separate shafts or remove center bearing remove the center bearing retaining nut.

2. Remove attaching bolt from the center bearing support to frame crossmember, Figure 1.

3. Remove attaching bolt from brake cable guard crossmember to center bearing support.

4. Remove cotter and clevis pin from one brake cable clevis.

5. Remove two bolts from brake cable guard crossmember to frame.

6. Remove nuts, lock plates, "U" bolts, and disconnect universal joint at transmission companion flange.
NOTE: The ears on the lock plates must be turned over against the flat of the lock nuts.

5. Tighten bolt in center bearing support.

6. Connect brake cable clevis.

7. All propeller shaft "U" bolt nuts should be tightened to 20 to 25 pounds torque.

8. Raise car; remove stand jacks, and lower car.

UNIVERSAL JOINTS

When disassembling the universal joints to inspect for wear, proceed as follows:

1. Remove the nuts and lock plates from the propeller shaft "U" bolts and remove the "U" bolts.

2. Remove two bearing assemblies.

NOTE: Do not allow the bearing cups to fall from the journal.

3. The two remaining bearings can now be removed by compressing their snap ring.

4. Use a light soft hammer and tap on one bearing carefully to drive out the opposite cup.

5. Tap on the end of the journal from which the bearing was just removed and remove the remaining bearing cup and rollers.

6. Wash all parts in gasoline and replace all worn parts.

ASSEMBLY:

1. Coat all bearing assemblies with viscous chassis lubricant.

2. Use new oil seals on the inner end of the journal.

3. Hold the yoke and journal so that one bearing assembly can be inserted from the bottom.

4. Hold the yoke and journal so that the other bearing assembly can be inserted from the bottom. The rollers in their race will not fall out if installed from the bottom.

5. Install the journal bearing race snap ring.

6. Install the other two bearing assemblies on the journal and compress them with the universal joint assembling Tool J-881-A, Figure 2.

7. Install the "U" bolts, lock plates and nuts.
If it is ever necessary to replace the propeller shaft center bearing, proceed as follows:
1. Remove the center bearing retaining nut from sliding spline at front end of rear shaft.
2. Remove center bearing mounting attaching bolt.
3. Disconnect universal joint at transmission companion flange.
4. Remove front shaft by sliding off splines.
5. Remove the center bearing and housing assembly from shaft.

**NOTE:** The center bearing is a press fit in the housing and may be removed and replaced without difficulty.

6. Remove the lock rings from either side of bearing and press bearing from housing. Use a tubular tool that clears the inner race and press against outside race only.

**NOTE:** For installation, reverse procedure of removal.

The specified torque for the center bearing companion flange bolt nut is 90-100 pounds.

**PROPELLER SHAFT CENTER BEARING SUPPORT CUSHION**

These cushions are furnished in two Degrees of Durometer hardness.
- Red moulded or painted red Standard Production 40 Durometer Hardness. Both cushions on all models with Standard transmissions.
- Black moulded 60 Durometer Hardness used on left side of mounting for models equipped with Hydra-Matic transmissions.

**TROUBLE SHOOTING**

**PROPELLER SHAFT**

**Excessive Vibration**
- Improper alignment of flanges
- Misaligned or sprung drive shaft
- Worn torque tube bushing
- Worn needle bearings in U-joint
- Worn splines on the shaft or companion flange
- Loose U-joint flange nut
- Shifted rear axle spring frame
- Excessive end thrust
- Careless braking
- Overloading the vehicle
- Too short shaft
- Improper lubrication

**Metallic Rattle, Click, or Growling**
- Lack of lubrication
- Worn universal joint seals
- Broken or worn universal joint bearings
- Worn universal joint cross
- Universal joint bearings not seated properly in flange or yoke
- Propeller shaft support mounting studs loose
- Propeller shaft support bearing worn, brinelled, or rough
- Loose intermediate flange
- Propeller shaft support improperly installed (upside down)

**UNIVERSAL JOINTS**

**Out of Balance**
- Loose flange nut
- Grease fitting interference
- Breakage
- Erratic driving and braking
- High angle drive
- Overloading
- Weak rear springs
- Misaligned drive shaft
- Misaligned rear axle
SECTION 13
REAR AXLE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Drive Gear and Pinion Back-lash</th>
<th>Wheel Bearings</th>
<th>Taper Roller Shim</th>
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REAR AXLE RATIOS

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CONSTRUCTION

The rear axle assembly is the semi-float- ing type with HypoidHelical gears mounted in a pressed steel banjo type housing with adjust- ments provided for all bearings, ring gear and pinion.

The drive pinion is supported by two tapered roller bearings which are held in a correctly spaced position by the pinion bearing spacer. Adjustment of the pinion and bearings are pro- vided for by a number of shims between the bearing spacer and the front bearing and between the front face of the pinion and the rear bearing. Oil leakage is prevented by a hydraulic type, inner spring oil seal of chrome leather.

The ring gear is mounted on the differential case flange by eight special alloy steel bolts. In order to insure quiet smooth operation the ring gear and pinion are supplied only in matched sets.

The differential case assembly is suspended between two tapered roller bearings, and is held securely by two carrier caps and four bolts.

The splined end of the alloy steel axle shafts engage in the differential side gears. The outer ends of the axle shafts are tapered and are pro- vided with keyways for attaching the rear wheel hubs, which are supported by adjustable tapered roller bearings pressed on the axle shafts. Side thrust from the wheels is transferred from one shaft to the other by hardened steel thrust buttons through the medium of the drive shaft thrust spacer.

Rear wheel bearings are adjusted for end play by shims inserted between the bearing caps and housing flange. Oil leakage at this point is pre- vented by pressure type chrome leather oil seals.

The axle housing is attached to the rear springs by means of "U" bolts and is insulated to eliminate road and tire noise by the use of rubber strips placed between axle and springs. The gen- eral construction of the rear axle may be seen in the illustrations which follow:
1. Drive shaft nut
2. Drive shaft nut washer
3. Drive shaft key
4. Adjusting cap bolt nut
5. Adjusting cap bolt nut lockwashers
6. Brake backing plate
7. Adjusting cap bolt
8. Wheel bearing cup
9. Wheel bearing cone
10. Axle housing
11. Spring mounting pad
12. Differential carrier gasket
13. Differential carrier to housing bolt lockwasher
14. Differential to housing bolt nut
15. Differential carrier to housing bolt
16. Differential carrier to cap assembly
17. Differential case left half
18. Drive pinion
19. Rear pinion bearing cup
20. Pinion bearing spacer
21. Front pinion bearing cup
22. Pinion oil seal
23. Rear axle companion flange
24. Rear axle companion flange nut
25. Rear axle companion flange washer
26. Drive pinion oil washer
27. Front pinion bearing cone
28. Rear pinion bearing cone
29. Rear pinion bearing shim
30. Differential pinion shaft locating screw
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<td>Differential bearing adjusting cap screw</td>
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REAR AXLE ASSEMBLY

REMOVAL

1. Jack up car, place car stands under body frame just forward of rear springs, See Figure 3.

NOTE: The construction of the Hudson Monobilt body incorporates a box frame to support the power plant, front suspension, rear springs and axle. This frame is an integral part of the body, and forms a solid one piece all steel body and frame assembly.

This new construction makes it necessary to support the body, by locating the stands under the body frame so that the rear axle will be suspended to permit removal and servicing of the rear axle unit.

2. Remove rear fender shields by lifting up lever (1) (front and rear) over and out away from lever retaining bracket (2) thus allowing the shield to drop, for removal, as shown in Figure 4.

3. Remove rear wheels.

4. Brace brake pedal at toe board, so that it cannot be depressed.

5. Disconnect brake line at rear axle tee and remove axle tee from axle.

6. Remove cotterpins (1) and clevis pins (2) that hold brake cable clevis to equalizing bar (3).

7. Unscrew brake cable clevis (4) from brake cable (6) remove locknuts (5) from brake cables as shown in Figure 5.
8. Loosen nuts (1) that hold brake cable housing clamp (2) to bracket (3) at #6 body cross member as shown in Figure 6. Loosen cable housing by twisting slightly and pulling toward the rear.

9. Remove nuts, lockwashers, and clips that fasten brake cable housing to rear springs, pull cables toward the rear, through guides and clamps at #6 cross member.

10. Remove nuts, locks and "U" bolts that attach propeller shaft to the rear axle companion flange. Lower propeller shaft using care to protect needle bearings from damage.

11. With roller jack pressure under the rear axle housing, disconnect lower end of shock absorbers.

NOTE: A rear lateral stabilizer is used as standard equipment. One end of this device is assembled to the frame side member and the other end to the rear axle housing. Its purpose is to control the horizontal movement of the body and car. It also prevents lateral shake of the axle under the car on rough roads.

IMPORTANT—The ends of the steel bar are cushioned in rubber and no lubrication should be applied to these points.

12. Remove nuts and washers holding the rear axle stabilizer bar to the rear axle and body frame side rail. See Figure 7.

13. Remove nuts, lockwashers, spring mounting clips, insulators and plates that hold rear axle to springs.

NOTE: The front end of the springs are attached to frame brackets with the pivot bolts cushioned in rubber. The rear ends are attached to the frame through threaded self-adjusting "U" type shackles operating in hardened steel threaded bushings.

IMPORTANT—Rear shackle bushings are right and left hand thread. Rubber seals should be replaced when replacing springs or shackles.

14. Remove rear spring shackles bushings at rear spring shackles, lower rear end of springs.

15. Axle can now be removed with roller jack out from under rear of car.

DISASSEMBLY

AXLE SHAFT

1. Remove cotter pin and nut from axle shaft.
2. Remove hub and drum by means of hub puller J-736 as shown in Figure 8. (Do not strike the end of the axle shaft to loosen the hub because of possible damage to the bearing and the center drive shaft thrust spacer).

3. Remove nuts and lockwashers which hold the rear wheel bearing adjusting cap and oil seal assembly to the backing plate and axle housing.

4. Remove adjusting cap and oil seal assembly and shims.

NOTE: It is important if shims are to be removed from both sides of the axle, that each set should be kept separate, and reassembled in their original location, in order that proper bearing adjustment is maintained. If an axle shaft, bearing, carrier or housing is to be replaced by another part, the axle shaft and play should be checked and corrected.

5. Remove axle shaft and wheel bearing, using axle shaft puller J-352. See Figure 9.

6. Remove bearing from axle shaft, using bearing remover J-358 H - 1 Holder and J-2641 Adapter, Figure 10.

7. Remove axle shaft inner oil seal, using tool J-943. See Figure 11.

NOTE: It is advisable to replace old oil seals with new seals in order to prevent leakage.
8. Remove wheel bearing adjusting cap oil seal, install a new seal using tool J-2159 as shown in Figure 12.

3. Place the head of the bolt in a vise and (using a soft hammer) tap the end of the axle shaft, removing the thrust button shank.

4. Clean out the thrust button hole.

5. Drive anew thrust button in the hole making certain it is firmly seated in the shaft.

DIFFERENTIAL CARRIER

DISASSEMBLY

1. Drain oil from differential.

2. Remove nuts and lockwashers attaching differential carrier to axle housing, lift out differential gear carrier assembly and place in holding fixture J-945 as shown in Figure 13.

3. Remove cotter pins and locks from differential bearing adjusting nuts.

NOTE: In order to save time, it is suggested that the bearing adjusting nuts be marked before removal (see arrow, Figure 13) so that they may be reassembled with approximately the same gear adjustment.
4. Remove differential bearing cap screws and lift out differential and ring gear assembly.

5. Remove differential bearing cones from case hubs using bearing puller tool, J-2158, See Figure 14.

---

**DRIVE PINION OIL SEAL REMOVAL**

NOTE: The pinion oil seal can be removed without removing the pinion gear. This operation can be performed on bench or under car with rear axle pinion oil seal remover J-2647 as follows:

1. With companion flange holding tool J-2637 and J-2971 deep socket remove the drive pinion nut and washer as shown in Figure 16.

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**NOTE:** Under no condition place a wedge between the ring gear and pinion teeth to lock pinion shaft while loosening the drive pinion nut.

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**DIFFERENTIAL GEARS**

1. Remove bolts which hold the ring gear to the differential case.

2. Press ring gear off the differential case flange.

3. Remove bolts and lockwashers from differential case. Separate the right and left hand case. See Figure 15.

4. All internal differential parts will then be loose and can be removed by hand.
3. Remove the three fingers from pinion oil seal remover body J-2647 and insert hook end of fingers under oil seal entering finger along spline groove of pinion. (Space hook arms equally on pinion splines.) Figure 17.

4. Install body of puller and screw on threaded ends of fingers and install lock nuts.

5. Turn puller screw until conical end of screw seats in pinion gear center, continue turning until oil seal is removed.

NOTE: Use rear axle pinion oil seal and pinion front bearing cone replacer J-2639 to install new oil seal. Figure 18, and reverse procedure of removal.

DRIVE PINION

NOTE: The differential assembly must be removed before the drive pinion can be removed.

REMOVAL

Follow the procedure as outlined in DRIVE PINION OIL SEAL REMOVAL, Items #1 and #2 and proceed as follows:

3. Pull out drive pinion, shims and bearing spacer, through rear end of differential carrier. See Figure 19.

4. Remove rear pinion shaft bearing, using bearing remover J-2640 as shown in Figure 20.

5. Remove drive pinion bearing oil seal with rear axle pinion oil seal remover J-2647, and lift out oil slinger and front bearing.
5. Remove drive pinion bearing oil seal with rear axle pinion oil seal remover J-2647, and lift out oil slinger and front bearing.

6. Remove front and rear drive pinion bearing cups from differential carrier, using remover J-2644 for front cup, Figure 21, and J-2645 for rear cup with handle T-872-5, Figure 22.

Due to the presence of moisture in the compressed air line, be sure that all water has been removed.

3. After cleaning, lubricate bearing with clean engine oil and inspect for wear, scoring and rough spots.

When the rear axle has been completely disassembled, gears, carrier and housing should be thoroughly washed. **NEVER INSTALL A DIFFERENTIAL GEAR CARRIER ASSEMBLY IN A DIRTY AXLE HOUSING.**

**DIFFERENTIAL PARTS**

Gears and pinions must be inspected for scored, chipped or broken teeth.

Check differential pinion shaft and if grooved or scored; replace.

Differential pinion thrust washers should be replaced if they appear damaged or worn.

### REAR AXLE OIL SEALS

Inspection of oil seals may be accomplished after axle has been disassembled. If the leather is scored so that a tight seal on shafts is impossible or the leather has become charred and hard, the seals should be replaced.

### AXLE REASSEMBLY

**DRIVE PINION**

1. Install front and rear drive pinion bearing cups in carrier using cup replacing Tool J-2943 for front cup, Figure 23, and J-2944 for rear cup, Figure 24.

Prior to inspection should be:

1. Rotate by hand in clean kerosene or gasoline, until free from grease and oil.

2. Dry out bearing with compressed air, diverting air through bearing while slowly rotating by hand, being sure that all foreign substance has been removed.

**NOTE:** Do not spin bearing with air pressure.
2. Place front drive pinion bearing shims and cone in carrier and insert oil slinger.

NOTE: It is important if shims are removed from both ends of the drive pinion that each set should be kept separate and reassembled in their original location, in order that proper bearing adjustment is maintained. Front bearing shims are available in .002", .003", and .004" thickness and should be selected to give the correct bearing resistance torque.

3. Install drive pinion bearing oil seal, using tool J-2639 as shown in Figure 18.

NOTE: When installing drive pinion bearing oil seal, use care, and be certain that the leather is in good condition--soft and pliable, soak thoroughly in SAE 20 engine oil prior to installation.

4. Install rear bearing shims (.002" and .003" thick) on the drive pinion shaft. See Note.

5. Slide rear bearing over pinion shaft with taper facing toward the front. Using rear pinion bearing replacer X-2643, seat bearing on pinion shaft, against shims. Figure 25.

6. Install bearing spacer.

7. Install drive pinion and, assembled parts in position in the carrier, inserting the forward end of the drive pinion thru shims, front bearing cone, oil slinger and oil seal.

8. Install companion flange on the drive pinion shaft, and assemble pinion shaft nut and washer.

9. Holding companion flange with flange hold-in g tool, S-2637 as shown in Figure 26, tighten pinion shaft nut with a torque wrench, to 200 foot pounds. Drive pinion shaft bearing resistance torque should then equal 17 to 32 inch pounds, Figure 27.
If the number of shims that have been used between the pinion shaft front bearing and spacer, do not give the recommended resistance torque, shims will have to be added or removed.

10. Insert cotter pin through nut and shaft and secure.

DISSERENTIAL

1. Place differential case assembly in "V" blocks to check side run out, using dial indicator KMO-30. Runout in excess of .002" indicates a sprung differential case and should be replaced.

2. Place differential side gears and thrust washers in right and left hand case respectively.

NOTE: Thrust washers .091" thick are used in production and .095" washers are available for service.

3. Assemble differential pinions, spacer and thrust washers on the differential pinion shaft, and place in the left hand half of the differential case, lining up the hole in the shaft, with the pin in the case.

4. Replace bolts and lock washers that hold right and left hand case together, being sure that the machining marks are in alignment and tighten securely.

5. Heat ring gear in hot water to 200° and install on differential case flange, tightening bolts to 50 foot pounds torque.

6. Two differential cases are used; one for the 3.58 ratio axle and the other for the 4.1 and 4.55 ratio axles. These cases are the same except for the machining dimensions shown. The 3.58 ratio case may be identified by the flange groove.
6. Install bearing cones on differentials case hubs, using differential side bearing replacer J-2646 as shown in Figure 29.

7. Place differential case assembly in carrier and assemble differential bearing adjusting nuts.

8. Install differential bearing outer races and caps in place and insert bolts and lockwashers, drawing them up finger tight. (Make sure the bolts and lockwashers are in good condition).

9. Turn the left hand adjusting nut to the right (clockwise) until no play can be felt between ring gear and pinion.

10. Turn the right hand adjusting nut to the right (clockwise) and draw it up tight, using differential bearing adjusting nut wrench J-972, See Figure 30.

11. Mount dial indicator, KMO-30 on the differential carrier flange. Turn left hand adjusting nut to the left (counterclockwise) one half notch. Turn right hand adjusting nut to the right (clockwise) one half notch.

**NOTE:** It is suggested that while this operation is being accomplished, the ring gear be rotated to allow the tapered bearings to seat properly.

12. Rest plunger of dial indicator on the outer edge of the ring gear tooth. See Figure 31. When moving the ring gear by hand, the back lash should be between .004" to .006". If the reading does not conform to recommended tolerances turn adjusting nuts one half notch at a time until desired reading is obtained.

**NOTE:** After setting the back lash tolerance, use a small brush and paint seven or eight teeth of the ring gear with red lead. Move the painted teeth of the ring gear over the pinion until a good impression of the tooth contact is assured. The impressions obtained on the gear teeth will be similar to those shown in Figure 32. With this illustration as a guide, make adjustments accordingly,

13. Tighten left bearing cap bolts. Turn right differential bearing adjusting nut to the right (clockwise) one full notch.

This additional tightening provides the necessary .008" to .012" "Spread" to the differential carrier for proper operation.

14. Tighten cap bolts securely on right differential bearing cap.
15. Assemble differential bearing adjusting nut locks, and secure the m with cotter pins.

16. Replace differential carrier in axle housing, using a new gasket. Be sure that all dirt, grease and foreign substance on the face of the flange has been removed in order that the new gasket may seat properly, thus eliminating possible oil leakage.

17. Assemble carrier to housing, pulling up nuts evenly and securely, using torque wrench to secure desired pressure of 35 foot pounds.

**AXLE SHAFT**

1. Replace axle shaft inner oil seals, using oil seal replacing tool J-2159, Figure 33.

2. Install rear wheel bearing cones on axle shafts.

3. Pack bearings with wheel bearing grease.

4. Place axle in housing, twisting slightly to engage splines in differential side gears and assemble wheel bearing cups on bearings.

5. Place bearing adjusting shims over axle and against backing plate.

6. Place adjusting cap over axle and secure with lockwashers and nuts.

7. Rotate axle shafts by hand to be sure bearings and cups are seated.

8. Clamp dial indicator gauge, K MO - 30 to backing plate, so that dial plunger rests against the end of axle shaft. Check end play, which should be maintained between .001" to .004". Adjust for correct amount of end play by adding or removing shims.
9. Place axle shaft key in keyway and install hubs and drums.

10. Install axle shaft washers and nuts, and tighten to 100 to 150 foot pounds with torque wrench. Insert cotter pin and secure.

11. Fill axle to proper level (bottom of filler plug, see Figure 34) with S.A.E. #90 E.P. Hypoid lubricant, through filler hole and replace filler plug.

**REAR AXLE ASSEMBLY**

**INSTALLATION:**

1. Using a hydraulic jack, wheel axle into position.

2. Attach rear spring to rear shackle, but do not install shackle bushings at this time.

3. Install spring mounting clips, plates, insulators, washers and nuts, and tighten to 65 foot pounds. Install lock nuts.

4. Install lower end of shock absorber, studs, flat washers and nuts.

5. Align springs and install rear shackle bushings.

6. Install rear spring shackle bushing lubrication fittings.

7. Install rear stabilizer bar at axle and body frame rail. (use a drift to align bushing at body rail bracket).

8. Attach brake cables to rear spring cable retaining clips and at #6 crossmember.

9. Place brake cables through guides at propeller shaft center bearing support cross-member, install lock nut and clevis to cables.

10. Attach brake cables to equalizer bar and check adjustment.

11. Connect rear axle tee to axle and attach rear wheel brake lines.

12. Install propeller shaft, tighten bearing "U" bolts to 25 foot lbs. and turn ends of locks against flat face of nuts. Make sure needle bearing cups are in place under retaining lugs.


15. Install fender wheel covers.

**LUBRICATION**

Rear axle lubricant should be checked at least every 1000 miles, and is to be maintained to the level of the filler plug.

The life of the rear axle gears and bearings can be prolonged if after the first 5000 miles the axle is drained and flushed out and new lubricant installed.

**NOTE: DO NOT USE KEROSENE OR GASOLINE FOR THIS OPERATION.**

This need only be done once. Refill axle with Hypoid E.P. lubricant (S.A.E. 90) manufactured by a reputable oil company.
16. Lower car and remove jacks.

MAINTENANCE

AXLE NOISE

Difficulties with universal joints, muffler roar, tire noises, wheel bearings, body drumming and etc., are at times improperly diagnosed as rear axle noise. Therefore, after checking all possible external causes, the following items on road test should be considered:

1. Select a level, asphalt or tarvia road as this type of road surface minimizes tire noise.

2. Drive car far enough to bring axle lubricant to operating temperature.

3. A heavy pitched continuous hum, which increases as the car speed is increased, is noticeable on acceleration between the speeds of 15 to 45 miles an hour, and is most pronounced between the speeds of 22 to 35 miles an hour indicates that:

   A. The axle shaft, drive pinion, or differential bearings are improperly adjusted.

   B. Differential ring gear and pinion tooth contact is improperly set.

   C. A pronounced knocking or clicking is caused by bearings that have "dug in" or brinnelled.

   D. Differential ring gear and pinion tooth contact is improperly set.

4. Coast noise will be more pronounced by allowing the car to coast from the speed of 45 miles an hour, through the speed range of 15 miles an hour, with clutch engaged and throttle closed; if the noise is heavy and irregular on the coast:

   A. Check condition of wheel bearings.

   B. Check drive pinion adjustment. If necessary, move pinion out away from ring gear, but never more than .006".

5. Bearings improperly adjusted, worn, scored, or rough will aggravate axle noises. Bearing noise may be distinguished from the previously mentioned type by:

   A. Very irregular drive noise on acceleration.

   B. Very rough and irregular coast noise on deceleration.

   C. Very irregular drive noise on acceleration.

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SECTION 14
FRONT SUSPENSION
SPECIFICATIONS

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<td>0-1/16&quot;</td>
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<tr>
<td>Pivot Pin Inclination</td>
<td>3°36&quot;</td>
</tr>
<tr>
<td>Spindle Pivot Pin Thrust Bearing</td>
<td>Ball</td>
</tr>
<tr>
<td>Wheel Bearing Type</td>
<td>Taper Roller</td>
</tr>
<tr>
<td>Wheel Bearing End Play</td>
<td>.001&quot; to .003&quot;</td>
</tr>
<tr>
<td>Tie Rod End Type</td>
<td>Plain Bearing</td>
</tr>
<tr>
<td>Tie Rod Adjustment</td>
<td>To Increase-Turn counter clockwise</td>
</tr>
<tr>
<td>Tie Rod Adjustment</td>
<td>To Decrease-Turn clockwise</td>
</tr>
<tr>
<td>Steering center arm bolt</td>
<td>Nut</td>
</tr>
<tr>
<td>Steering arm nut - tighten</td>
<td>#110 to 120# torque</td>
</tr>
<tr>
<td>LOWER SUPPORT ARM:</td>
<td></td>
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<tr>
<td>The lower support arms are responsible for the</td>
<td></td>
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<tr>
<td>vertical movement of the front suspension. They</td>
<td></td>
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<tr>
<td>are joined to the steering spindle support at the</td>
<td></td>
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<tr>
<td>outer end and to a pivot that is bolted to the #2</td>
<td></td>
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<tr>
<td>crossmember at the inner end.</td>
<td></td>
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<tr>
<td>The coil spring seat is riveted to the lower</td>
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<tr>
<td>support arm and the top of spring fits in a recess</td>
<td></td>
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<tr>
<td>of the #2 crossmember.</td>
<td></td>
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<tr>
<td>Two rubber bumpers are located on the front</td>
<td></td>
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<tr>
<td>suspension - one limits downward movement of the</td>
<td></td>
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<tr>
<td>upper support arm - the other limits upward</td>
<td></td>
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<tr>
<td>movement of the lower support arm.</td>
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<tr>
<td>BUSHINGS:</td>
<td></td>
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<tr>
<td>The pivot pins and steel bushings are threaded</td>
<td></td>
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<tr>
<td>and therefore securely bound together even though</td>
<td></td>
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<tr>
<td>excessive wear may take a loose fit.</td>
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<tr>
<td>Clearance between pins and bushings is from .012</td>
<td></td>
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<tr>
<td>to .026 to allow for lubrication adjustment and</td>
<td></td>
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<tr>
<td>free action.</td>
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<tr>
<td>LUBRICATION</td>
<td></td>
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<tr>
<td>Lubrication of threaded bushings must be thorough</td>
<td></td>
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<tr>
<td>and with the weight of the car off the bushings.</td>
<td></td>
</tr>
</tbody>
</table>
1. Lower support arm assemblies
2. Coil spring
3. Lower support arm pivot
4. Lower support arm pivot to frame belt
5. Lower support arm to spindle support pivot and bushing

6. Shock absorber anchor plate and attaching nuts
7. Front stabilizer bar
8. Stabilizer connectors
9. Brake backing plates
10. Steering arm nut

5. Remove lower support arm pivot to frame bolts (4), nuts and lockwashers.

6. Raise car, allowing coil springs to expand and remove the spring.

NOTE: Coil spring is under great pressure - Use care when removing coil springs.

7. Remove stabilizer connector (8).

8. Remove outer tie rod end (13) Figure 2, from steering arm using Tool 3-2781.

9. Remove four bolts from brake backing plate and attach backing plate (9) under fender to protect brake hose.

FRONT SUSPENSION

REMOVAL (RIGHT OR LEFT):

1. Raise car and place stand jacks under inner ends of the lower support arms (1), Figure 1.

2. Remove wheel.

3. Remove shock absorber upper stud nut and palnut (30), Figure 5.

4. Remove shock absorber lower mounting nuts and washers (6) Figure 1. Turn shock absorber 1/4 turn and remove through opening.
FIGURE 2

1. Lower support arm assemblies
3. Lower support arm pivots
5. Lower support arm to spindle support pivot and bushings
11. Center steering arm
10. Remove upper support arm pivot to frame bolt nuts and lockwashers, (29), Figure 5.

12. Tie rod assemblies
13. Tie rod ends
14. Right and left steering arms
15. Drag link assembly
16. Pitman steering arm

11. Remove front wheel suspension assembly.

INSTALLATION:

1. Replace assembly and install upper support arm pivot (28) and bushing bolts (29) and tighten securely, Figure 5.

LEGEND FIGURE 3

17. #2 Frame Cross Member
18. Stabilizer
19. Stabilizer rubber bushings
20. Stabilizer bracket to frame bolt
21. Steering arm nut
22. Steering spindle support
23. Eccentric bushing
2. Install coil spring (2), Figure 1

NOTE: Flat end of spring must be at top. Bottom must rest in lower support arm spring seat. Be sure silencer is in upper spring seat.

3. Lower the car, which will compress spring and position lower support arm pivot (3) to frame cross-member.
4. Install lower support arm pivot attaching bolts (4) and tighten securely.
5. Install shock absorber.

6. Install stabilizer connector (8).
7. Install tie rod end at steering arm (13).
8. Install brake backing plate (9).
9. Install wheel assembly and lower car.

RIDING HEIGHT AND COIL SPRING SAG

When the car does not seem to be level and a check of the coil spring height is desired, place the car so that the front end is level crosswise, and then rock the car sidewise several times and allow the car to settle. This will remove any binding that might cause a dimensional difference.

Measure the distance from the top of the lower support arm rubber bumper seat to the bottom of the upper rebound bracket, which should be 4-1/4" each side, Figure 6.

If the two measurements vary more than 1/2" between sides, it is advisable to replace one or both coil springs.

The light and heavy coil springs may be identified by the part number stamped on the top coil of spring.
LOWER SUPPORT ARM PIVOT AND BUSHING

REMOVAL:

1. Jack front wheels clear of the floor.
2. Place stand jack under inner side of lower support arm.
3. Remove front and rear bushings of the lower support arm pivot (3), Figure 1.
4. Remove the four bolts (4) that hold lower pivot to front crossmember.
5. Remove pivot (3) from lower support arm.

INSTALLATION:

1. Install the lower support arm pivot (3), Figure 1.

NOTE: The lower support arms are identical on the right and left sides with the exception of the diameter of the threaded bosses through which the lower support bolt passes. The bosses that face the front of the car are threaded .010" larger than the ones at the rear. A 1/4 inch hole is punched in the top plate of the left arm assembly to distinguish it from the right arm which has no hole.

2. Install front coil spring.
3. Install lower support arm pivot to frame bolts.

NOTE: Use tool J-1052 to maintain the exact distance of 11-1/2" between the inner faces of support arm and the exact distance of 1-1/2" between the inner face of support arm and the center line of the nuts holding the pivot to the cross member. These distances must be maintained.

A .010" oversize lower support arm to support bolt bushing is available for wear of the steering spindle support.

4. Install shock absorber, mounting plate, rubber bushings, retainers and retaining nuts. Lower car to floor.
5. Adjust camber, caster, and tow-in.

STEERING SPINDLE SUPPORT LOWER PIVOT PIN AND BUSHING

REMOVAL:

1. Place a jack under the lower support arm (1), Figure 1, and raise the car.
2. Remove cotter key, nut, and washer from the lower supporting arm to spindle support pivot pin, (5).
3. Remove the lower pivot pin (5) and bushing.

INSTALLATION:

1. Install bushing in spindle support.
2. Hold the steering spindle support (22), Figure 1, squarely between the yoke of lower support arm (1), Figure 1.
3. Install the lower pivot pin (5) and index the pin so that the spindle support (22) is centralized between the inner faces of the lower support arm (1), Figure 1.
4. Install the washer, nut, and cotter pin.
5. Check caster, camber, and toe-in.

UPPER SUPPORT ARM PIVOT

REMOVAL:

1. Jack up car so that wheels clear the floor.
2. Remove wheel assembly.

3. Remove shock absorber stud nut and palnut (30), retainer, and rubber bushing, Figure 5.

4. Remove bolts from upper support arm pivot bracket to frame (29), Figure 5.

5. Remove lock screw from eccentric bushing.

6. Remove cotter key and nut from eccentric bushing pivot bolt (25).

7. Remove eccentric bushing and steering spindle support pivot.

8. Remove upper support arm and pivot assembly.

**NOTE:** To install, reverse procedure of removal, check caster and camber after installation.

---

**UPPER STEERING SPINDLE SUPPORT PIVOT AND BUSHING**

**REMOVAL:**

1. Jack up car so that wheels clear the floor.
2. Remove upper support arm pivot bolt.
3. Remove upper support arm pivot and bushing.
4. Screw bushing out of upper support arm and off the pivot arm.

**INSTALLATION:**

**NOTE:** The upper support arm pivot is self threading. The assembling of the upper support arm pivot and bushing requires special tool J-1860, Figure 8, to maintain a proper spread of the pressed steel support arm to insure proper tension on the threads of the pivot after the bushings have been installed.

1. Install the gauge tool J-1360, Figure 9, on the outer stud of the pivot.

   **FIGURE 9**

   Install the pivot so that it is central with the tool. Install the spreader tool J-1860 so that the two ends of the tool rest against the inner faces of the upper support arms and the flange of the support arms fits in the slots machined in the ends of the spreader tool. Turn the hexagon portion of the spreader tool until the gauge rests against outer surface of the arms. This will spread the arms 1/16".

   2. Just start the bushings on both ends of the pivot. Lubricate item with a tapping compound such as lard oil which will allow the bushings to cut their own threads in the support arm without scoring. Install the upper support arm pivot centering gauge J-1860 - 2. Thread the bushings into the support arm until the head seats tighten to 110 foot pounds. Remove both tools.

   **NOTE:** The upper support arm assembly must have free movement so that it is free to drop.
of its own weight, plus not more than a five pound pressure, from a horizontal position. It must have no perceptible shake. The pivot must not be rotated as this will throw the pivot off center with the support arm.

FIGURE 10

23. Eccentric bushing
25. Eccentric bushing pivot bolt
26. Upper support arm
28. Upper support pivot and bracket 36. Upper support arm pivot bushings 49. Eccentric bushing seals

**ECCENTRIC BUSHING**

**REMOVAL:**

1. Place a jack under lower support arm and raise the car off the floor.

2. Remove eccentric bushing lock screw and washer (24), Figure 11.

3. Remove cotter pin, nut, and eccentric bushing pivot bolt (25).

4. Remove eccentric bushing seals (49).

5. Remove bushing (23) from the steering spindle support and upper support arm.

6. Remove eccentric bushing from steering spindle support using upper support arm eccentric bushing adjusting wrench "KMO-366," Figure 12.

**INSTALLATION:**

1. Install eccentric bushing into steering spindle support (Hexagon head of bushing to the front).

2. Install eccentric bushing lock screw (24), but do not tighten.

3. Hold the steering spindle support in the center of the upper support arm and install the support arm pivot bolt. Turn the bolt until the head seats securely.

4. Install nut and cotter pin.


6. Tighten lock screw securely.

**NOTE:** Turning the eccentric bushing two complete turns 3/16" clockwise will give a plus 1° change of caster and two complete turns 3/16" counterclockwise will give a minus 1° change of caster.
Adjust the front wheel bearings before starting any check for wear in the pivot pin or bushings. Place one hand on top of the tire and the other hand on the bottom of the tire and pull with one hand while pushing with the other to determine the amount of play between the pivot pin and bushing. If there is an appreciable amount of movement due to excessive wear, the bushings should be replaced.

Wear at the spindle pivots is seldom confined to one side. It is therefore advisable to renew the parts on both sides.

NOTE: The pivot pin key seal is lead and is used with the key that holds the steering arm to the steering spindle. This key also holds the pivot pin and the lead seal prevents lubricant being forced down the outside of the pivot pin into the key way and then outside to cause loss of lubricant.

STEERING SPINDLE PIVOT BOLT EXPANSION PLUG AND RELIEF VALVE

A grease pressure relief valve, Figure 14, is fitted into the expansion plug at the bottom of the steering spindle pivot bolt.

This is to relieve excessive grease pressure (500 to 600 lbs. per square inch) that may be applied at the grease fitting at the top of the plug. This prevents grease from leaking out around the expansion plug and any possibility of the grease pressure blowing it out.

When lubricating spindle pivot pins, always continue supplying grease until it comes out of the valve.

RELIEF VALVE

INSTALLATION:

1. Assemble relief valve in the expansion plug.
2. Coat edges of expansion plug with white lead.
3. Using a short piece of tubing or hollow pipe
That will clear the relief valve, (place the pipe over the relief valve and against the plug); drive expansion plug into place.

**STEERING SPINDLE**

**REMOVAL:**

1. Jack front wheels clear of the floor.

2. Place stand jack under the outer side of the lower support arms (1), Figure 1.

3. Remove hub caps and dust caps.

4. Remove steering spindle cotter pins, nuts, spindle washer, and outer bearing cage.

5. Remove front wheel and brake drum assembly.

6. Remove the four bolts and nuts holding front brake backing plate (9), to spindle.

7. Remove brake backing plate and wire it to the frame, do not injure or disconnect the hydraulic brake hose.

8. Remove cotter key, nut and washer holding the steering arm (14) Figure 2 to the steering spindle (31), Figure 13.

9. Drive the steering arm out of steering spindle using tool J-1373.

10. Remove cotter pin, nut and lower support arm pivot, (5), Figure 1.

11. Remove eccentric bushing locking screw (24), Figure 4, and upper support arm outer pivot bolt bushing (27), Figure 4.

   Eccentric bushing will remain in steering spindle support.

12. Remove steering spindle (31) and steering spindle support (22) together, Figure 6.

13. Remove grease fitting at top of steering spindle.

14. After removing the grease fitting, insert tool J-479 through the hole at top of steering spindle and begin to drive pivot pin (32), Figure 13, out of spindle. This action will force out expansion plug and relief valve, Figure 14, at the bottom of spindle. Then insert the long driver tool J-479 and drive pivot pin out of spindle and spindle support.

   Remove steering spindle pivot pin carefully so that the 7 ball bearings will not be lost.

15. The removal of the steering spindle pivot pin separates the steering spindle from the steering spindle support.

   **NOTE:** To install, reverse procedure of removal, and lubricate inside of bushings and top of spindle pin with viscous grease.

**STEERING SPINDLE SUPPORT**

**BUSHING AND THRUST BALL CUP**

**REMOVAL:**

1. Hold steering spindle support (22), Figure 3, in a vise so that bushings can be forced out.

2. Drive thrust ball cup (upper bushing) out of spindle using a soft hammer.

3. Insert driver tool J-990, into the lower bushing and drive bushing out.

**INSTALLATION:**

1. Support steering spindle support in a vise so that bushing and thrust ball cup can be driven in.

2. Using tool J-990, install the thrust ball cup upper bushing. Have the top of steering spindle support well supported.

3. The bushing and thrust ball cup are hardened and ground and require no reaming after being installed. The thrust ball cup has the thrust washer for the ball bearings pressed into it.
STEERING SPINDLE SUPPORT

REMOVAL:

Proceed as outlined in "Steering Spindle Removal", items 1 to 15, inclusive.

INSTALLATION:

NOTE: To install, reverse procedure of removal.

STEERING ARM

REMOVAL:

1. Remove the cotter pin, castellated nut and washer from steering arm (14), Figure 2.

2. Remove tie rod cotter pin and castellated nut and rubber dust cover, and remove the tie rod using tool J-2781, Figure 15.

3. Remove steering arm using tool J-1373.

NOTE: To install, reverse procedure of removal.

Tighten the steering arm nut with a torsion wrench to 110 to 120 foot pounds.

CENTER STEERING ARM

REMOVAL:

1. Remove draglink (15), Figure 2 at front by backing off adjusting plug and ball seat.

2. Remove tie rod ends (13) from steering center arm (11) using tool J-2781.

CENTER STEERING ARM

INSTALLATION:

1. When installing new bearings in steering center arm bracket (E) space as shown in
Figure 17, apply pressure on outer race, on end carrying manufacturers name and part number.

2. If necessary to replace the steering arm pivot shaft, the new shaft should be pressed in place maintaining the 2.053” to 2.055” dimension as shown in Figure 1 before drilling the hole for the No. 5 taper pin (A).

3. The steering arm seal consists of a steel washer bonded to synthetic rubber, therefore, a separate retainer is not necessary.

4. When installing the seals the rubber lip faces to the casting as shown in cross-section Figure 17 and the spacers (C) and (G) positioned as shown.

5. The center steering arm pivot bolt nut (H) should be tightened to 50-60 foot lbs.

**TIE ROD ENDS**

Tie rod ends are the self-adjusting type. The ground steel bearing (45), Figure 18, is located between the stud (46) (which is prevented from loosening or rattling by the tension spring) and the tie rod end forging. A curved steel dust cover (48) makes a tight metal seal, but to insure this being as nearly dust proof as possible, a rubber seal (47) also seals the unit.

**TIE ROD**

**REMOVAL:**

1. Remove cotter pin and nut from both ends of the tie rod.

2. Using Tool J-2781 remove outer end. 3.

3. Using Tool T-2781 remove inner end.

**INSTALLATION:**

NOTE: Reverse process of removal. It is necessary to adjust toe-in when installing tie rods.

**TURNING PULL**

The amount of steering pull on the front wheels required to turn the wheels is measured in the following manner:

1. Disconnect the drag link and place roller plates under the front wheels.

2. Hook spring scale J-544-A over the tread of tire.

NOTE: Resistance pull should be not greater than (28) pounds. If greater pull is required, check for binding at spindle pivot pins and tie rod ends. Lubricate these points with viscous grease.

**STRAIGHTEN BENT PARTS OF FRONT SUSPENSION**

Heat treated parts should not be straightened if they are sprung more than 5°. Parts that are not heat treated may be straightened cold if they are not sprung more than 10°.

If parts are sprung more than these amounts, any attempt to straighten will show strains and cracks that may not be visible if attempted while cold. Straightening hot may result in over heating, making the steel soft and weak, while underheating makes the part brittle and easily broken.
DIAGNOSIS GUIDE

HARD STEERING:

CAUSES:

1. Low or uneven tire pressure.
2. Steering gear or steering connections adjusted too tight.
3. Insufficient or incorrect lubricant.
4. Too much caster.
5. Front springs sagged.
6. Frame bent or broken.
7. Steering spindle, steering spindle support, or steering arm bent.

REMEDY:

1. Inflate tires. (See Section 18).
2. Check steering system for binding. Lubricate, adjust as necessary.
3. Support arms bent or twisted. Check wheel alignment by testing camber, steering pivot pin inclination and caster. If support arms have been removed from the car, check specifications as shown in Figure 21. Replace arms - do not attempt straightening.
4. Check height of coil springs; measure distance from top of lower support arm rubber bumper seat to bottom of upper rebound bracket, which should be 4-1/4” each side (See Figure 6).

   If the two measurements vary more than 1/2” each side, it is advisable to replace one or both coil springs.
5. Check frame for proper alignment.
6. Check Steering spindle support and steering arm alignment, Figure 21. Replace if bent--do not attempt straightening.
EXCESSIVE PLAY IN STEERING SYSTEM

CAUSE:

1. Steering gear or steering connections either adjusted too loose or worn.
2. Steering spindle bearings worn.
3. Front wheel bearings incorrectly adjusted or worn.

REMEDY:

Refer to the respective sections of this manual for corrections of the above conditions.

STEERING ERRATIC WITH BRAKES APPLIED

CAUSE:

1. Low or unequal tire pressure.
2. Brakes incorrectly or unevenly adjusted.
3. Oil soaked brake lining.
4. Coil springs weak.
5. Insufficient or uneven caster.

REMEDY:

1. Inflate tires. (See Section 18)
2. Adjust brakes.
3. Replace lining. (Use genuine Hudson brake lining).
4. Replace springs or shim as necessary.
5. Steering spindle or spindle support bent. Refer to Figures 20 and 21.

CAR PULLS TO ONE SIDE

CAUSE:

1. Low or uneven tire pressure.
2. Oil soaked brake lining.
3. Shock absorbers not functioning or only partly operating.

4. Wheel bearings adjusted too tight.
5. Incorrect toe-in, unequal caster, or camber.
6. Coil springs sag.
7. Rear axle shifted.
8. Front frame bent or broken.

REMEDY:

1. Inflate tires. (See Section 18)
2. Replace brake lining.
3. Check shock absorbers for lack of fluid.
4. Check wheels for binding with front wheels off the floor. Adjust the bearings and lubricate.
5. Correct caster, camber, and toe-in. Check steering spindle, spindle support, or steering arm to determine if these parts are damaged. Refer to Figure 20.
6. Check riding height and replace springs if necessary. Refer to Figure 6.
7. Check rear spring clips and tighten as necessary. Rear spring center bolt should be checked to determine that it is not sheared. A distance from the rear spring pivot bolt to axle housing should be checked. This distance should be the same on both sides.
8. Check frame for breakage and proper alignment.
9. Adjust and tighten front stabilizer arms.

SCUFFED TIRES

CAUSE:

1. Tires incorrectly inflated.
2. Incorrect toe-in or incorrect toe-out on turns.
3. Wheels or tires out of true.
4. Steering spindle bearings worn.
5. Suspension arms bent or twisted.
6. Unequal caster.
7. Turning corner at high speeds and erratic driving.

**REMEDY:**
1. Inflate tires. (See Section 18)
2. Adjust tie rods to give proper toe-in and toe-out.
3. Check tire and wheel statically and dynamically.
4. Replace spindle pins and bushings as necessary.
5. Replace suspension arms if these are bent or twisted. Do not attempt to straighten. Refer to Figure 19 for specifications.
6. Adjust caster and camber. Refer to specification page.

**CUPPED TIRES**

*NOTE: Normal cupping of tires can be expected -- tires should be frequently interchanged on the car.*

**CAUSE:**
1. Tires incorrectly inflated.
2. Dragging brakes.
3. Wheels, tires, or brake drums out of balance.
   4. Steering spindle bearings or wheel bearings worn or out of adjustment.
   5. Steering spindle, spindle support, or tie rods bent.

**CAR WANDER**

**CAUSE:**
1. Low or unequal tire pressure.
2. Steering gear or connections loose or worn.
3. Steering gear or connections not properly lubricated or adjusted too tight.
4. Steering spindle bearings worn.
5. Wheels toe-in too much or toe-out in straight ahead position.
6. Improper caster.
7. Steering spindle or spindle pivot pin bent.
8. Rear axle shifted.
10. Steering gear not on high point.
11. Tread better on rear tires than on the front.

**FRONT WHEEL SHIMMY OR ROAD SHOCK**

**CAUSE:**
1. Low or unequal tire pressure.
2. Steering connections worn or incorrectly adjusted.
3. Wheels, tires, or brake drums out of balance.
4. Incorrect or unequal caster.
5. Shock absorbers not operating properly.
6. Steering spindle or tie rods bent.
7. Lack of lubrication.
8. Eccentric or bulged tires.

**WHEEL TRAMP**

**CAUSE:**
1. Wheels, tires, and brake drums may be out of balance.
NOTE: Wheels and tires should be balanced statically and dynamically.

2. Weak front spring.

3. Front shock absorbers not operating correctly.

4. Lack of lubrication in front suspension.

5. Front stabilizer not positioned correctly.

FRONT WHEEL ALIGNMENT

All of the five factors of front wheel alignment are inter-related, but each has a specific purpose. These control the front wheels and steering under varying conditions of weight and speed.

Should one of the angles get out of position, the relationship is destroyed. Each angle depends upon the proper setting of the others if the front wheels are to lead properly.

In making corrections to front wheel alignment, or installing new front wheel suspension parts, all five angles in both front wheels should be checked in the following order:

PIVOT PIN INCLINATION

Pivot Pin Inclination is the inward tilt of the steering spindle pivot pin at the top.

CASTER

Caster is the backward tilt of the steering spindle pivot pin usually measured in degrees.

CAMBER

Camber is the outward tilt of the front wheels at the top and usually measured in inches or degrees.

TOE-IN

Toe-In is the drawing together of the front wheels at the front.

STEERING GEOMETRY

Steering Geometry or toe-out on turns is controlled by the movement and angularity of the tie rods.

GENERAL INSPECTION

Before checking the alignment of the front wheels, the following operations should be performed in the order listed. A successful alignment job cannot be accomplished unless these inspection operations are performed. Should inspection reveal the necessity for removing, installing, or adjusting any part of the front wheel suspension, or steering, prior to aligning the front wheels, complete instructions will be found in the respective sections of the manual.

1. Inflate all tires to recommended pressure.

2. Check condition of tires (blowout patches, thin treads, vulcanizing, etc.). Changing the direction of tire rotation is recommended.

3. Wheel and tire turn-out, (wobble) or eccentricity.


5. Wheel balance.

6. Front wheel bearing adjustment.

7. Coil spring height.

8. King pin and bushing clearance.

9. Upper and lower support arm bushings.

10. Steering gear, adjusting points.

11. Shock absorber control.

12. Rear-springs and "U" bolts.

When checking front wheel alignment, the car should be placed on a level floor. The car should be empty, and any luggage or load should be removed from the trunk compartment.

NOTE: Always rock the car back and forth several times and allow it to settle.
This action will place the front springs and shock absorbers in their "Normal" position. Do not rock at the bumper, but at the side of the car.

Make sure the tire pressure is correct in all four tires and the car on a level floor.

NOTE: The car is under curb load when it is loaded with oil, water, spare tire, tools and a full tank of gasoline, but without passengers.

When the car is set to 4-1/4" Dimension at the front and 5-1/4" at the rear (curb height), the camber should be 1/2° to 1-1/2° positive. The total variation in camber between right and left side must not exceed 1/2°.

The correct pivot pin inclination is 3° 36'. If the pivot pin inclination and the camber are off, it is probably due to worn pivot pin bushings. If the camber is off the pivot pin inclination is correct, the spindle is bent. Camber should not be more than the specified 1-1/2°; however, a decrease in camber, if pivot pins are not loose in the bushing, is not detrimental to steering unless an actual reverse camber exists.

Positive caster is the tilting of the top of the pivot pin toward the rear of the car, while negative or reverse caster is the tilting of the top of the pivot pin toward the front of the car.

Positive caster imparts a trailing action to the front wheels while negative or reverse caster causes a leading action. The correct amount of caster helps to keep the front wheels in the straight-ahead position. When turning a curve, caster and king pin inclination act as a lever, assisting the driver in returning the front wheels to the straight ahead position.

No caster correction should be made until after the camber angle and pivot pin inclination angle have been checked.

NOTE: When checking the caster the wheels should be turned on their bearings to bring the high spot or that portion of the tire with the greatest runout toward the front or the rear.

The amount of caster a front end requires depends on the friction in the spindle pins, tie rod ends and the steering linkage. A well-lubricated car requires less caster than one infrequently lubricated.

Replace any bent parts and check the steering geometry whenever new parts are installed because new parts may affect the turning angle of the wheels.

Whenever the eccentric bushing is turned, the caster, camber, and pivot pin inclination must be checked as all three are affected.

NOTE: It is seldom necessary to turn the eccentric bushing over a half turn to obtain 1/2° for camber and this half turn should be all that is ever necessary for camber adjustment and give a minimum of caster change.

If camber is increased, pivot pin inclination is decreased and if camber is decreased, pivot pin inclination is increased.

NOTE: One complete turn of eccentric bushing changes caster 1/2°. Set caster to 1° preferred with 1/2° negative or 1/2° positive permissible, but in equal amounts on both wheels if possible, but never over 1/2° variation Right and Left. Set camber with the least possible change of caster. Set the camber to 1/2°.

TOE - IN

Toe-in is the setting or adjusting of the front wheels by means of tie rods, so that the distance between the wheels is less at the front than at the rear. Camber tends to cause the wheels to run out or separate at the front and sufficient toe-in is necessary to compensate this tendency and make the wheels run straight.

Accurate toe-in is of great importance in obtaining the maximum of tire life. Toe-in must be within definite limits of 0° to 1/16" measured at the wheel rim.
**PITMAN ARM ANGLE**

The proper location of the pitman arm in the straight ahead driving position is necessary in order to obtain the proper toe-out when turning to left or right. If the pitman arm angle is not correct on a turn, it changes the relationship of both front wheels to the extent that it will cause an excessive scuffing action between the tires and the road.

**CENTER STEERING ARM**

When making adjustment of the center steering arm using tool No. J-2953, Figure 22, centering and toe-in gauge, proceed as follows:

1. To install the gauge, remove the center steering nut.
2. Remove the front bolt from the center steering arm support bracket.
3. Install gauge clamp over the center steering arm.
4. Install gauge and insert bolt at front of gauge into the center steering arm support bracket.
5. Attach the female screw to the center steering arm shaft.
6. Adjust the gauge rods to contact both sides of front wheel evenly.

**NOTE:** The same procedure may be followed for opposite wheel. Any necessary adjustment can be made by turning both tie rods an equal amount to obtain the same dimensions between the front and rear wheels.

The center steering arm will now be centered and steering gear will be on the high point for a straight ahead position.

**TOE - OUT**

Steering geometry or toe-out on turns is controlled by the movement and angularity of the steering arms.

The toe-out is checked by turning the wheels to the right or left, locating the inside wheel in a definite position.

Toe-out must always be checked with the weight of the car on the wheels.

Front wheels must rest on full floating turn tables and the turning angles should read as follows:

- **Left Turn**
  - Left Wheel 30°
  - Right Wheel 25°
- **Right Turn**
  - Right Wheel 30°
  - Left Wheel 25°

The variation between the left and right wheel angle must not vary more than 30 minutes plus or minus.

When the front wheels are turned to the right or left, they separate, slightly at the front depending upon the amount of deflection from the straight ahead course. The wheel making the inside circle turns at a greater angle than the outside wheel, thus making toe-out necessary on curves. The amount of toe-out increases due to a change in angle between tie rods.

When steering arms are bent, wheels will not turn in proper relation on curves. This affects toe-out and results in excessive tire wear. Errors in setting of the outside' wheel are usually due to bent steering arms.
## REFERENCE

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**SECTION 15**

**STEERING GEAR**

**SPECIFICATIONS**

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<th>Type</th>
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<td>Ratios - 5A, 6A, 7A, 8A</td>
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<tr>
<td>4A</td>
<td>18.2 to 1.</td>
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<td>Needle.</td>
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<td>Tapered roller.</td>
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<td>High Point</td>
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<td>Lubrication</td>
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<td>Wheel Nut Torque</td>
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<tr>
<td>Gear Shaft Nut Torque</td>
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<td>Gear to Frame bolts</td>
<td>50 to 60 foot pounds.</td>
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**CONSTRUCTION**

The steering gear employs a worm gear and three tooth roller. The worm is pressed on the lower end of the steering column tube and operates on two tapered roller bearings. The three tooth roller operates on needle bearings. The gear shaft operates on two needle bearings separated by a bearing spacer in the shaft housing.

A leather oil seal at the end of the gear shaft protects the unit against loss of lubricant. A grease retainer tube is pressed into the worm cover to provide a passage for the horn wire and seal the lubricant in the housing.

Provisions for mechanically eliminating all play within the mechanism have been provided. There is no need of being forced to choose between a stiffly operating unit and one having lost motion, since adjustments can be set at the will of the adjuster at the most desirable point.

In this type of gear, the major adjustments are accomplished with the use of shims. The need for adjustment, however, should present itself only after considerable usage.

Before altering any adjustments, jack up front wheels of car and make sure that cause of complaint is not from some other looseness such as ball sockets, and so forth.

A thrust plate is assembled on the end of the gear shaft adjustment screw and fits into a slot in the end of the gear shaft. The adjustment screw is held in place by a lock plate and lock nut. Adjustment of the roller shaft for proper mesh with the worm gear is accomplished by turning the adjustment screw in the gear shaft cover.

Adjustment of the worm gear for end play is accomplished by removing or inserting shims between the worm cover and housing.
LUBRICATION

The steering gear is filled at the factory with S.A.E. 90 E.P. lubricant. This lubricant is satisfactory for all seasons. The steering gear filler plug should be removed and lubricant checked at each lubrication period.

STEERING WHEEL (WITH HORN RING)

REMOVAL:

1. Pry ornament and ring assembly (2), Figure 1, out of steering wheel spoke cover.

2. Remove three screws attaching horn ring insulator (3) to horn ring.

3. Disconnect horn wire at horn relay and remove insulator ring, contact cup (5) and wire.

4. Place the adapter (split ring J-739-10) around the jacket tube with the small diameter of the adapter under the steering wheel hub. Position the foot of the puller, J-739, around the outside (large) diameter of the adapter.

5. With the steering wheel nut partially threaded on the column tube, run puller screw down tight against the wheel nut to release the steering wheel.

NOTE: Always use a puller to remove steering wheel. Striking or wedging may damage worm thrust bearings or break the steering wheel.

INSTALLATION:

1. See that notch in main column tube is pointing down and centered. (This places steering gear at high point for straight ahead position.)

2. Place horn ring (10), Figure 1, over steering column jacket tube (9).

3. Place steering wheel and cover assembly in position on column with two spokes horizontal and third spoke straight down.

4. Insert horn wire, contact cup (5) and insulator (3).

5. Insert three long screws attaching insulator to horn ring and tighten until horn ring is snug against steering wheel.

6. Replace steering wheel nut and tighten to 20 to 30 foot pounds.

7. Attach horn wire and insert ornament and ring assembly.

STEERING WHEEL (WITH HORN BUTTON)

REMOVAL:

1. Disconnect horn wire at horn relay.

2. Push down on horn button (24), Figure 2, and rotate to release button from retainer and remove button.

3. Pull horn wire up slightly and push the wire sleeve into large opening of contact cup.

4. Lift out contact cup (23) and remove horn wire.

5. Remove steering wheel nut, horn button retainer, and lockwire.

6. Replace steering wheel nut but do not tighten.

7. Continue as for custom steering wheel.

INSTALLATION:

1. With notch in main column tube straight down, place steering wheel in position on tube with spokes straight across.

2. Install horn button (24) Figure 2, retainer, and lockwire.

3. Install steering wheel nut and tighten to 20-30 foot pounds.

4. Insert horn wire into steering column tube and through large opening in contact cup (23). Move insulator sleeve into small opening with flange of sleeve on top of contact cup.
FIGURE 1
Steering Gear (5A, 6A, 7A and 8A)

1. Steering wheel ornament
2. Steering wheel ornament ring
3. Horn ring insulator
4. Steering wheel spoke cover
5. Horn ring contact cup
6. Jacket tube spring
7. Jacket tube bearing
8. Jacket tube bearing spacer
9. Jacket tube
10. Horn ring
11. Direction Indicator cancelling pin
12. Direction Indicator cancelling pin spacer
13. Main column tube
14. Worm shaft upper bearing cup
15. Worm shaft upper bearing
16. Oil filler plug
17. Worm shaft lower bearing
18. Worm shaft cover
19. Worm shaft lower bearing cup
20. Worm shaft cover shims
21. Oil retainer tube
22. Oil retainer
23. Needle bearing
24. Bearing spacer
25. Needle bearing
26. Adjusting screw lock plate
27. Adjusting screw
28. Gear shaft nut
29. Gear shaft
30. Adjusting screw thrust plate
31. Adjusting screw lock nut
FIGURE 2
Steering Gear (4A)

1. Gear shaft nut
2. Gear shaft
3. Gear shaft cover
4. Adjusting screw thrust plate
5. Adjusting screw
6. Oil retainer
7. Needle bearing
8. Spacer
9. Needle bearing
10. Adjusting screw lock plate
11. Adjusting screw lock nut
12. Worm cover shims
13. Oil filler plug
14. Main column tube
15. Worm shaft cover
16. Grease retainer tube
17. Worm shaft lower bearing
18. Worm shaft lower bearing cup
19. Worm shaft upper bearing cup
20. Worm shaft upper bearing
21. Jacket tube
22. Direction indicator cancelling pin
23. Horn button contact cup
24. Horn button
25. Jacket tube bearing spacer
26. Jacket tube bearing
27. Jacket tube spring
5. Apply a small amount of water pump grease to head of horn wire terminal.

6. Place contact cup in position and install horn button.

7. Rotate button to lock in place.

FIGURE 3

JACKET TUBE BEARING

REMOVAL:

1. Remove steering wheel in accordance with instructions.

2. Remove jacket bearing spring and spacer.

3. Engage fingers of Bearing Puller J-2792 below the bearing and place locating pins in slots in head of puller, Figure 3.

4. Turn the center screw of puller against steering column tube and remove bearing.

FIGURE 4

INSTALLATION:

1. Start bearing into jacket tube by hand.

2. Using Replacer tool J-2952, Figure 4, drive bearing to a depth of 31/32" on cars without direction indicator. If car is equipped with direction indicator, drive bearing to a depth of 1-11/32" from top of tube.

3. Replace jacket bearing spacer and spring.

4. Replace steering wheel.

STEERING GEAR JACKET TUBE

REMOVAL:

1. Remove steering wheel.

2. Remove bearing spring and spacer.

3. Remove remote control tube bracket (upper). On cars equipped with direction indicator, remove direction indicator switch assembly.

4. Remove steering column bracket cap at instrument panel.
5. Loosen remote control tube bracket (lower) and jacket tube clamp at steering gear, and remove jacket tube.

**INSTALLATION:**
Reverse procedure of removal.

---

**FIGURE 5**

**STEERING GEAR**
(Chuck Assembly)

**REMOVAL:**

1. Remove left front wheel and fender side dust shield.
2. Remove left frame to cowl brace.
3. Remove steering wheel and horn wire.
4. Remove steering gear jacket tube.
5. Remove three bolts (7), Figure 5, attaching steering gear to side frame.
6. Remove key and plug from drag link (10) at pitman arm and disconnect drag link.
7. Slide steering gear forward on frame an rotate to the left until pitman arm is clean.
8. Remove steering gear through wheel opening in left front fender.

**FIGURE 6**

**DISASSEMBLY:**

1. Drain lubricant and mount assembly in a vise.
2. Using puller No. J-1374, Figure 6, remove pitman arm.
3. Remove gear shaft cover.
4. Cover serrations on gear shaft with waxed paper to prevent damage to oil seal and remove gear shaft and roller assembly.
5. Remove oil seal, needle roller bearings, and bearing spacer from gear shaft housing.
6. Remove worm gear cover and grease retainer tube assembly; use care to prevent damage to shims.
7. Remove lower bearing, bearing cup, worm and column tube assembly, and upper bearing.

**ASSEMBLY:**

1. Clean inside of steering gear housing and all parts before assembly.
2. Assemble upper bearing cup and bearing in
housing and install worm and tube assembly.

3. Install lower bearing and cup.

4. Install worm shaft cover shims and cover and grease retainer tube assembly. If grease retainer tube is equipped with silencer make sure silencer is installed on tube.

5. Install gear shaft needle roller bearings and spacer.

6. Turn high point notch on steering column tube straight down and install gear shaft and roller assembly.

7. Assemble thrust plate on adjusting screw into slot in roller housing and attach gear shaft cover and oil seal.

8. Place pitman arm on gear shaft and tighten to 125 to 140 foot pounds.

9. Check worm for end play. If end play exists, adjust by removing one worm cover shim at a time until end play is eliminated. Rotate column tube after each removal to determine if stiffness exists. Stiffness indicates removal of too many shims.

10. Check gear shaft for excess play. If pitman arm can be moved more than 1/32" without turning the steering column tube, remove gear shaft adjustment screw lock nut and lift lock plate clear of cover boss. (Check notch on steering column tube to be sure it points straight down.) Tighten adjusting screw just enough to remove play between gear shaft and worm. DO NOT TIGHTEN BEYOND THE POINT OF TAKING UP LASH. Replace lock plate and lock nut and tighten nut.

11. Replace felt washer on column tube at steering gear housing.

INSTALATION:

1. Install steering gear assembly on frame and insert but DO NOT TIGHTEN three bolts attaching steering gear to frame.

2. Install steering gear jacket tube. Tighten tube in bracket at instrument panel.

3. Tighten the three bolts attaching steering gear to frame to 50 to 60 foot pounds.

4. Loosen bolts attaching steering column bracket cap at instrument panel to allow column to shift to match position of steering gear and retighten bolts.

5. Replace horn wire and steering wheel with notch in column tube straight down and wheel spokes horizontal.

6. Replace frame to cowl brace, dust shield, and front wheel.

7. Check front suspension for stiffness by placing front wheels on roller plates and attaching spring scale to tire thread. Maximum pull required to turn wheels with drag link disconnected is 28 pounds.

8. Set front wheels in straight ahead position and attach drag link to pitman arm. (See "Drag Link Adjustments", page 15-9).

9. Fill steering gear housing with S. A. E. 90 E.P. Lube oil.

PITMAN ARM

REMOVAL:

1. Remove key and plug from drag link at pitman arm and disconnect drag link (10), Figure 5.

2. Disconnect battery cable at starting motor solenoid and disconnect starter switch wire from solenoid.

3. Remove starting motor attaching bolts and remove starting motor assembly.

4. Remove nut (1), Figure 5, and lockwasher attaching pitman arm to steering gear.
5. Install jaws of Puller J-1374, Figure 6 on inner shoulder of pitman arm and turn puller screw tight against gear shaft to remove pitman arm.

**NOTE:** Always use puller to remove pitman arm. Any other method will damage adjustment mechanism.

**INSTALLATION:**

1. Install pitman arm on gear shaft. Tighten to 125 to 140 foot pounds.

2. Set front wheels and steering gear in straight ahead position. (See "Drag Link Adjustment", Page 9).

3. Adjust drag link if necessary and attach to pitman arm.

4. Install starter motor.

**GEAR SHAFT ASSEMBLY**

The gear shaft and roller assembly may be removed for replacement of assembly, roller bearings, or grease seal without removing steering gear from the car.

**REMOVAL:**

1. Remove side dust shield.

2. Remove starter motor battery cable and switch wire and remove starter motor.

3. Remove pitman arm from gear shaft, with puller No. J-1374. (Always use puller to remove pitman arm.)

4. Remove gear shaft cover and adjustment screw assembly.

5. If oil seal is not to be replaced, cover serrations on gear shaft with waxed paper to protect seal.

6. Remove gear shaft, needle bearings and bearing spacer.

7. If oil seal is to be replaced, remove oil seal.

**INSTALLATION:**

Reverse procedure of removal and tighten gear shaft nut to 125 to 140 foot pounds.

**DRAG LINK**

The drag link on all models is of the same construction at each end. However, the rear end has a shim adjustment for setting front wheels in the straight ahead position (A and B), Figure 7. Drag link assembly used on Pacemakers differs in length and angle from drag links used on other models.

**REMOVAL:**

1. Remove drag link dust covers.

2. Remove key and plug from drag link at pitman arm and disconnect drag link.

3. Remove key and plug from drag link at center steering arm and remove drag link.

**INSTALLATION:**

1. Set front wheels and steering gear in straight ahead position and attach drag link to center steering arm. (See Drag Link Adjustments.)

2. Adjust drag link if necessary and attach drag link to pitman arm.
ADJUSTMENT:

1. Check steering wheel for correct position on steering column tube. (With notch on steering column tube straight down, spokes of steering wheel should be horizontal.)

2. Remove nut from bottom of center steering arm pivot and remove bolt from front of steering arm bracket.

3. Install gauge No. J-2953, Figure 8, with gauge clamp on the center steering arm.

4. Attach female screw of gauge to center steering arm pivot and insert bolt at front of gauge into steering arm bracket.

5. Check front wheels for proper toe-in, which should be from 0 to 1/16". (If toe-in is incorrect, adjust tie rods.)

6. Place arms of gauge against tire as shown in Figure 8 with both arms at equal height on the tire.

7. Turn wheel until front and rear arms of gauge are of equal length.

8. If steering wheel spokes are not horizontal with gauge in this position, disconnect drag link at pitman arm and interchange shim packs (A and B), Figure 7, until horizontal position of spokes is attained, and attach drag link.

9. Remove gauge and replace nut on center steering arm pivot. (Before re-using elastic stop nut, strike the face of the nut a sharp blow with a hammer to compress the stop and provide a new seal.) Tighten to 50-60 foot pounds.

1. Replace bolt in front of center steering arm bracket.

STEERING GEAR INSPECTION AND ADJUSTMENT

Elimination of excess play or stiffness in steering gear operation may be accomplished by external adjustment of the steering gear. Do not attempt to correct erratic action of front wheels by adjustment of the steering gear. Such action as indicated by shimmy or steering wheel fight should be corrected at the front suspension.

Before making steering gear adjustment, raise the front wheels and make sure no lost motion exists in the tie rod ends, steering arms, or center steering arm and pivot.

WORM BEARING END PLAY INSPECTION:

Excess end play in the worm bearing is indicated by an up and down movement of the steering column tube. This condition may be checked as follows:

1. Raise front wheels off the floor.
2. Check steering column jacket tube clamp at steering gear housing and tighten securely if loose.

3. Turn steering wheel about one turn to the right from straight ahead position.

4. Place one hand around the jacket tube with side of finger barely touching lower edge of steering wheel hub.

5. Have a helper shake the front wheels hard sidewise.

6. End play is indicated if the steering wheel hub moves away from or against the finger.

WORM BEARING ADJUSTMENT:

If end play exists in the worm bearing, the following adjustment is necessary:

1. Disconnect drag link at pitman arm.

2. Remove left frame to cowl brace.

3. Loosen the four worm cover bolts about 1/8”.

4. Use a knife to separate the top shim. (Use care not to damage remaining shims.)

5. Remove one shim at a time and retighten cover.

6. After each shim is removed turn steering wheel through entire radius to determine if any stiffness exists.

7. If stiffness is felt, replace shims until steering wheel turns freely.

8. Attach drag link to pitman arm and replace frame to cowl brace.

STEERING GEAR ALIGNMENT:

Steering gear misalignment is indicated if stiffness exists in steering gear that cannot be eliminated with worm cover shims without resulting in excess worm bearing end play. Align steering gear as follows:

1. Disconnect drag link from pitman arm.

2. Loosen three bolts attaching steering gear housing to frame and allow housing to shift to angle determined by attachment of steering column to bracket instrument panel.

3. Retighten frame bolts to 50-60 foot pounds.

4. Loosen bolts attaching steering column bracket instrument panel and allow bracket to line up with steering column. Then tighten bolts.

4. Connect drag link to pitman arm. ROLLER MESH INSPECTION:

Improper mesh of roller with worm gear is indicated by excess free play or stiffness in the steering wheel. Inspection for proper mesh should not be made until worm bearing endplay and gear alignment have been checked and corrected if necessary. If free play or stiffness continues, check mesh of roller with worm:

1. Disconnect drag link pitman arm.

2. Turn steering wheel to straight ahead position.

3. Shake pitman arm to determine amount of lost motion. If lost motion exceeds 1/32”, adjust roller for proper mesh.

4. Attach pitman arm to drag link.

ROLLER MESH ADJUSTMENT:

1. Disconnect pitman arm from drag link.

2. Remove left side dust shield.

3. Turn steering wheel to straight ahead position.

4. Remove roller shaft adjustment screw lock nut and lift lock plate clear of boss on housing.
5. Tighten roller shaft adjustment screw just enough to eliminate lost motion pitman arm. (It is better to leave a slight amount of play - not in excess of 1/32” - than it is to tighten too much.)

6. Replace lock plate against cover in locked position and replace and tighten lock nut.

7. Replace dust shield and connect drag link to pitman arm.

IMPORTANT NOTE:

Before connecting drag link to pitman arm, place the front wheels on roller plates and attach spring scale to tire tread. Maximum pull required to turn wheels any point in the turning radius is 28 pounds. Any excess pull indicates a binding in the front suspension that should be corrected to achieve proper functioning of steering mechanism.

CENTER STEERING ARM

REMOVAL:

1. Remove drag link front by backing off adjusting plug and ball seat.

2. Remove tie rod. ends (13) from steering center arm (11) using Tool J-2781.

3. Remove the 3 bolts attaching the center steering arm bracket (42) to the No. 2 cross-member, Figure (9).

4. Remove the center pivot nut (41) and remove the center steering arm and pivot as an assembly. The needle roller bearing and inner race is press fit and can be removed with a suitable arbor press.

NOTE: When installing the bearing, apply pressure on bearing race on end carrying manufacturers name and part number.

CENTER STEERING ARM

INSTALLATION:

Steering center arm installation is the reverse procedure of removal. Tighten the steering center arm bolt nut with a torsion wrench to 70 foot pounds and note the following:

1. When installing new bearings in steering center arm bracket (E) space as shown in Figure 10, apply pressure on outer race, on end carrying manufacturers name and part number.

2. If necessary to replace the steering arm pivot shaft, the new shaft should be pressed in place maintaining the 2.053” to 2.055” dimension as shown in Figure 10 before drilling the hole for the No. 5 taper pin (A).

3. The rubber seals consist of a steel washer bonded to synthetic rubber therefore a separate retainer is not used.
When installing the seals the rubber lip faces to the casting as shown in cross-section Figure 10 and the spacers (C) and (G) positioned as shown.

5. The center steering arm pivot bolt nut (H) should be tightened to 50-60 foot lbs.

**TROUBLE DIAGNOSIS**

**HARD STEERING**

- Excessive caster
- Excessive, positive or negative chamber
- Bent, worn king pin
- Spring spindle
- Broken frame
- Sagging, broken spring
- Weak rear springs
- Low tire pressure
- Binding steering assembly
- Insufficient lubrication

**LOOSE STEERING**

- Worn steering linkage
- Weak springs in drag link
- Worn king pins, bushings
- Improper steering adjustment
- Worn tie rod ends
- Worn sector shaft bushing

**WANDER OR WEAVE**

- Insufficient caster
- Incorrect toe-in adjustment
- Worn king pins, bushings
- Worn front wheel bearings
- Tight steering assembly
- Loose spring shackles

**SHIMMY**

- Too much caster
- Loose king pins
- Loose drag link arm
- Loose steering gear
- Low tire pressure
- Unequal inflation
- Loose wheel bearings
- Misaligned drag link
- Sagging or broken springs
- Worn tie rod ends

**ROAD SHOCK**

- Unequal caster
- Excessive caster
- Weak coil springs
- Bent steering arm (right or left)
- Bent drag link
- Defective shock absorbers

**SIDE PULL**

- Unequal caster Bent steering arm
- Bent, broken frame
- Tight king pins Weak rear springs
- Uneven tire inflation
- Oil-soaked brake lining
- Sagging front spring

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### SPRINGS, SHOCK ABSORBERS, AND STABILIZERS

#### SPECIFICATIONS

**SPRINGS**

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<td>54&quot; - 1-3/4&quot;</td>
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<tr>
<td>Free Height</td>
<td>14-5/16&quot;</td>
<td>Number of Leaves Including Rebound Leaf</td>
<td>8</td>
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<tr>
<td>Covers</td>
<td>Optional All Models</td>
<td>Metal</td>
<td></td>
</tr>
<tr>
<td>Shackles</td>
<td>Optional All Models</td>
<td>Silent 'U' Threaded</td>
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</tr>
<tr>
<td>Spring Eye Dimension</td>
<td>Optional All Models</td>
<td>870</td>
<td></td>
</tr>
<tr>
<td>Spring Load Markings and Part Number</td>
<td>Optional All Models</td>
<td>Head of Center Bolt</td>
<td></td>
</tr>
</tbody>
</table>

Identification of the coil springs may be determined by part numbers stamped on top coil.

**SHOCK ABSORBERS**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Mfr.</th>
<th>Code</th>
<th>Compressed Length</th>
<th>Extended Length</th>
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</thead>
<tbody>
<tr>
<td>Front - Light Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>303060</td>
<td>Monroe</td>
<td>1-8-10-(4)-10-10-H1</td>
<td>7-3/4&quot;</td>
<td>12&quot;</td>
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<tr>
<td>303062</td>
<td>Delco</td>
<td>22-1-10-(4)-10-10</td>
<td>7-3/4&quot;</td>
<td>12&quot;</td>
</tr>
</tbody>
</table>

| Front - Heavy Scale | | | | |
| 303061 | Monroe | 0-10-10-1044-10-10-J-5 | 7-3/4" | 12-1/16" |
| 303063 | Delco | 0-10-1044-10-10-H1 | 7-25/32" | 12-1/32" |

| Front - Extra Heavy Scale | | | | |
| 302431 | Monroe | 1C6-G1 | 7-13/16" | 1-15/16" |
| 301637 | Delco | 934-E-1C6/D-2 |

**Usage - (Front)**

- **Light Scale** - Part numbers 303060 Monroe and 303062 Delco used on all models less heavy scale springs - Front and Rear.
- **Heavy Scale** - Part numbers 303061 Monroe and 303063 Delco used on all models with Heavy Scale Springs - Front and Rear.
- **Extra Heavy Scale** - Part numbers 302431 Monroe and 301637 Delco Optional.
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Mfr.</th>
<th>Code</th>
<th>Compressed Length</th>
<th>Extended Length</th>
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</thead>
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<tr>
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<tr>
<td>300351</td>
<td>Monroe</td>
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<td>13-3/16&quot;</td>
<td>21-15/16&quot;</td>
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<td>301241</td>
<td>Delco</td>
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<td>21-15/16&quot;</td>
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<tr>
<td>301768</td>
<td>Monroe</td>
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<td>13-3/16&quot;</td>
<td>21-15/16&quot;</td>
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<tr>
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<td>Delco</td>
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<td>21-15/16&quot;</td>
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<tr>
<td>301638</td>
<td>Delco</td>
<td>941Y-2B6-J1</td>
<td>13-11/32&quot;</td>
<td>21-13/16&quot;</td>
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<tr>
<td>302431</td>
<td>Monroe</td>
<td>6C10-C1</td>
<td>13-11/32&quot;</td>
<td>21-13/16&quot;</td>
</tr>
</tbody>
</table>

**Usage - (Rear)**

**Light Scale**--Part numbers 300351 Monroe and 301241 Delco used on all Models Less Heavy Scale Springs - Front and Rear, and Rear Only.

**Heavy Scale**--Part numbers 301768 Monroe and 301770 Delco used on all Models With Heavy Scale Springs - Front and Rear and Rear Only.

**Extra Heavy Scale**--Part numbers 301638 Delco and 302431 Monroe. Optional on all Models

---

**FIGURE 1**

**RIDING HEIGHT AND COIL SPRING SAG**

When the car does not seem to be level and a check of the coil spring height is desired, place the car so that the front end is level crosswise and then rock the car side-wise several times and allow the car to settle. This will remove any binding that might cause a dimensional difference.

Measure the distance from the top of the lower support arm rubber bumper seat to the bottom of the upper rebound bracket, which should be 4-1/4" each side, Figure 1.

If the two measurements vary more than 1/2" between sides, it is advisable to replace one or both coil springs.

The light and heavy coil springs may be identified by the part number stamped on the top coil of spring.

**FRONT COIL SPRINGS**

**REMOVAL:**

1. Raise the car and place stand jacks under inner ends of the lower support arms.

2. Remove wheel.

3. Remove shock absorber upper stud nut and pal nut.
REAR SPRINGS

Rear springs are long leaf, semi-elliptical design. The front ends are attached to frame brackets with pivot bolts cushioned in rubber. This eliminates noise and allows for increased riding comfort through reduction of torque and brake reaction shock. (No lubrication is required at this point).

FIGURE 3

The rear ends of the springs are attached to the body frame rails through threaded, self-adjusting "U" type shackles operating in hardened steel, threaded bushings. The bushing threads are protected from road splash and dirt by rubber sleeve seals retained in position by the shoulders of the shackles. These seats are installed on the "U" shackle before inserting them shackles in them bushings.

Rubber cushions and retainers are used between them spring mounting pad and spring to reduce road noise to a minimum.

The rear springs of passenger models are fitted with metal covers, which prevent road dirt from getting between them spring leaves and avoid them necessity of adding lubricant for several thousand miles.

REMOVAL:

1. Jack up them rear axle on a roller jack and place stand jacks under them chassis frame side rails.
2. With jack pressure under existing housing disconnect lower end of shock absorber

3. Remove brake cable to spring retaining clip.

4. Remove the rear spring shackle bushing at rear spring eye and shackle.

5. Remove rear spring front bolt, nut, and bushing.

6. Remove rear spring to axle clip nuts, washers, clip plates, and clips.

7. Remove spring from car.

2. Open the locking seam using a 60° flat nose chisel and light hammer.

3. Use a screwdriver and pry the locking edge of cover (top) up off the lower edge and remove cover.

4. Remove the spring from loading fixture and clamp the spring in a vise so that the spring leaf center bolt is outside of the jaws of the vise.

5. Unscrew the shackle threaded bushing.

6. Remove the two leaf clip bolt nuts and spacers at the outer ends and cut the two inner clips off. Remove the center bolt and nut.

7. Open the vise and disassemble the spring.

REAR SPRING COVERS

REMOVAL:

The steel spring covers are in two sections (front and rear) and felt strips are used at each MI end to seal the spring against water and dirt and to retain the lubricant.

When necessary to replace a spring it is possible to remove and reinstall the old covers. Use care in removing the cover. Do not destroy the locking seams.

To remove covers, proceed as follows:

1. Place the spring in a loading fixture and jack up against middle until spring is on a horizontal plane.

NOTE: A spring loading fixture can be made with a piece of heavy channel iron, as a base, having pivoted arms on each end. Drill 6-9/16" holes in upper ends of arms. Use loose 1/2 inch rods or bolts to slide through these holes and eyes of spring.

Bolt fixture to a bench and place a jack between spring and the base of fixture. Then raise jack until main leaf of spring is straight. A socket which fits top of jack and bottom end of spring center bolt will prevent jack slipping off spring.

2. Open the locking seam using a 60° flat nose chisel and light hammer.

3. Use a screwdriver and pry the locking edge of cover (top) up off the lower edge and remove cover.

4. Remove the spring from loading fixture and clamp the spring in a vise so that the spring leaf center bolt is outside of the jaws of the vise.

5. Unscrew the shackle threaded bushing.

6. Remove the two leaf clip bolt nuts and spacers at the outer ends and cut the two inner clips off. Remove the center bolt and nut.

7. Open the vise and disassemble the spring.

REAR SPRING ASSEMBLING:

The leaves should be lubricated with viscous chassis lubricant and assembled in their proper order with a piece of 5/16” rod passing through the center bolt hole of each leaf.

1. Clamp the loose assembly in a vise a n d draw the leaves together, keeping them in alignment as the vise is tightened.

   The bracket for holding the brake cable clip is assembled under the second from front leaf clip.

2. Use two new box type leaf clips, bolts, nuts, and spacers.

3. Insert the center bolt and tighten the nut. Use the original leaf clips that are riveted to the bottom spring leaf at outer ends.

4. Install the spacers, bolts, and nuts.

REAR SPRING COVER

INSTALLATION:

1. Place spring in loading fixture.

2. Install cover assembly in place and close locking seam.
NOTE: Use "C" clamps to hold cover in place during locking operation and reform locking edge at cover to approximately a 60 angle with pliers wherever necessary to facilitate final locking.

3. Hammer down the locking edge carefully, work from the center bolt hole and flatten toward each end.

NOTE: Use a slightly curved steel plate between hammer and cover to prevent denting.

REAR SPRING

INSTALLATION:

1. Place rear spring in position on the rear axle mounting pad.

2. Insert one end of the rear spring shackle through the main leaf eye after placing the rubber dust seals in place on the shackle and start the threaded bushing on shackle. (DO NOT TIGHTEN).

3. Install the front end of the spring with rubber bushings in place and attach spring bolt with the spring bolt rubber bushing on the bolt.

4. When proper alignment is obtained, attach nut and tighten.

NOTE: When tightening the mounting bolt, the rear spring should be mounted so that there is no unnatural twist set up in the rubber bushings. Squeaks at rear spring front mounting bolts can be corrected by loosening nuts on rear spring front bolts and loading car with two or more passengers before pulling nuts up tight. No lubrication is required.

5. Install spring pads, mounting clips, nuts, and washers, and tighten nuts to 55-75 lbs. torque.

NOTE: It is important that spring clips be inspected at regular intervals and kept tight to insure against spring breakage. Tighten spring clip nuts to 55-75 lbs. torque.

6. Finish tightening the rear shackle nut.

7. Install brake cable retaining clip on top of spring.

8. Attach lower end of shock absorbers to spring mounting pads.

9. Lubricate the spring shackles.

10. Lower car and remove jacks.

The right hand rear spring shackle has right hand threads on both upper and lower ends and the left hand rear spring shackle has right hand threads on the upper and left hand threads on the lower end.

The lower left hand shackle bushing is left hand thread and has an identification groove 1/16" wide on the head.
NOTE: The shackle having the left hand thread has a single forging mark at the shoulder.

If the zerk fitting is removed and replaced for any reason it must not be turned into the tapped hole so tightly as to cause the zerk fitting to bottom on the end of the shackle and thus loosen the plug that is in the end of the shackle bushing.

**LUBRICATION:**

The frequency of lubrication depends upon driving conditions and mileage. Lubrication will usually be required more frequently in hot climates than in cold climates.

Necessity of lubrication will be evidenced by stiff riding and squeaks.

Use only viscous chassis lubricant at fittings and at covers.

Spring covers have a 3/16" hole on the underside through which the lubricant can be forced without removing springs or spring covers.

**NOTE:** Always take the weight of the car off the springs while lubricating. This action will tend to separate the leaves allowing the lubricant to flow between them.

**SHOCK ABSORBERS**

Direct double acting hydraulic type shock absorbers are used at the front and rear. The front shock absorbers are mounted axially within the front coil springs and are cushioned at the upper and lower ends in rubber grommets.

The rear units are identical in construction to the front units, except that eyes are fitted at the upper and lower ends instead of studs and are also cushioned in rubber. At the upper end they are attached to the frame cross member, while at the lower end they are assembled to the rear spring clip plates.

Both the front and rear shock absorbers are non-serviceable and are not interchangeable to either front or rear position.

Resistance calibration is different in front and rear shock absorbers and is properly set at the factory.

The principles of operation are the same in the present shock absorbers as previously used shocks. The fluid permits satisfactory operation at temperatures as low as -40° F. The units are permanently sealed with improved synthetic rubber seals designed to keep the fluid in and the dirt out. Double acting resistance is employed with the proper combination of orifice and blow-off control to give a finely balanced ride without further adjustment. Defective units must be replaced.
Shock absorbers are available in either standard control or heavy duty control (optional) on all models of passenger cars.

The extra heavy duty control is available for commercial use, station wagons, or as an additional option on passenger car models.

Refer to the specifications which head up this section for models and control desired.

NOTE: All shock absorbers have the part number and code stamped on the outside of the shock absorber body.

SHOCK ABSORBER NOISE

When checking for noise, first determine that the noise is coming from shock absorbers and not from other sources.

Check the front shock absorber top nut with its palnut and that rubber bushings are tight and in good condition, also that the cap screws and nuts at the bottom of the front shocks are tight.

Noise that may develop in the rubber grommets can be eliminated by replacing the grommets, and if the fit is tight, use a small quantity of liquid soap at assembling.

FRONT SHOCK ABSORBER

REMOVAL:

1. Jack up car and remove wheel.
2. Remove nut, palnut, and rubber bushing at the top of the shock absorber.

NOTE: Use an offset screwdriver to prevent the stem from turning and a 9/16" open end wrench to remove the nut.

1. Remove the two cap screws holding the shock absorber lower support plate to the lower support arm.
2. Turn the shock absorber a quarter turn and remove.

NOTE: To install, reverse procedure of removal. Check condition of grommets.

REAR SHOCK ABSORBER

REMOVAL:

1. Remove lower stud nut and washer at rear spring clip plate.
2. Remove upper mounting bolt, nut and flat washers.
3. Remove shock absorber.

NOTE: To install reverse procedure of removal.

Shock absorber inspection procedure is as follows:

1. Remove units from car.
2. Check condition of grommets and replace if worn.
3. Mount shock absorber in a vise being careful that the larger tube is at the upper end. Move up and down by hand. After six or eight strokes, the unit should be primed. A noticeable lag or lack of resistance is an indication of a faulty unit which should be replaced.

FRONT LATERAL STABILIZER

Stabilizer control is by a specially designed bar which is attached to the frame side members. The ends of the bar are directed toward the rear to form lever arms.

The lever arms are attached to the stabilizer bar connectors which in turn are attached to the lower support arm.

The stabilizer is mounted in rubber bushings, and requires no lubrication.
REMOVAL:

1. Remove nuts and lockwashers from bottom of stabilizer connectors.
2. Remove two bolts from brackets to frame (each side) and remove stabilizer.

NOTE: To install, reverse procedure of removal and make sure the stabilizer bar is properly centralized.

FIGURE 7

REAR LATERAL STABILIZER

A rear lateral stabilizer is used as standard equipment. One end of this devise is assembled to the frame side member and the other end to the rear axle housing. Its purpose is to control the horizontal movement of the body and car. It also prevents lateral shake of the axle under the car on rough roads.

The ends of the steel bar are cushioned in rubber and no lubrication should be applied to these points.

REMOVAL:

NOTE: Rear axle stabilizing bar removal is started at the rear axle end of the stabilizing bar.

1. Remove the palnut and hex nut, Figure 7, the rubber cushion, and washer.
2. Loosen the inside nut and back off on the threads of the bolt.
3. Push the cushion and washer up on the stabilizer bar and remove cushion spacer.
4. At the frame end remove the palnut and the hex nut.
5. Remove the cushion, the washer, and the spacer.

1. Push the stabilizing bar toward the stabilizer bracket and remove the end of the bar from the frame.

NOTE: Do not lose or destroy the rubber grommet in the frame for the stabilizer bar guide rod (welded to the bar).

1. Pull the bar toward the frame stabilizer bracket and out of the stabilizer bracket.

INSTALLATION:

NOTE: Rear Axle Stabilizing Bar Installation is started at the frame end.

1. Have the inside nut at axle and well up on the bar and the cushions and washers in place at both ends.

2. Push the bar through axle bracket and then put frame end in place with cushion and washer and locating guide rod in the rubber grommet in the frame.

3. Place the outside cushion, spacer, and washer on the frame end of the bar and install the hex nut.

4. Tighten the nut and install the palnut.

5. Spin companion or palnut with smooth face first onto bolt until it touches the nut.

6. Then tighten the nut not over one quarter to one third more in order to lock it. The shoulder on the bar rests against the cushion spacer and frame and allows the bar to pass through frame far enough to install nuts and tighten them in place. This locates the bar in position.

7. Place the outside cushion, washer and spacer on the axle end of the bar and install the outer nut. (The nut tightens the spacer against a shoulder on the bar).

8. Screw the inside locking nut and rubber cushion down on the threads and against the axle bracket.
HYDRAULIC BRAKES

Brake equipment on all models is of the four wheel "Bendix Hydraulic" consisting of a master cylinder operated by an adjustable link from the brake pedal, four double piston wheel cylinders mounted on the brake backing plates and all connecting tubing. All models use the single anchor, two shoe Duo Servo action brake.

MECHANICAL BRAKES

Mechanical brakes on rear wheels only. Should the hydraulic system become inoperative for any reason, continued pressure on the foot brake pedal causes the pedal pull rod (1) Figure 1 and link (2) to slide forward on anchor pin (3) pulling play link (4) and brake control lever (5) forward, transmitting mechanical braking power through cables (6) to the rear brake shoes.

To prevent operation of the mechanical brakes during the normal hydraulic operation, also to make certain proper action of the mechanical brakes, a clearance of 1-1/4" must be maintained between body of clevis pin (3) and rear end of slide link (2) as shown in Figure 1.

HAND BRAKE

Hand braking is through a pull type pistol grip, self locking, hand control unit mounted below instrument panel.

The handbrake can be applied much easier, by depressing the brake pedal in the ordinary way and at the same time pulling upward on the hand brake lever. This relieves the load on the hand brake cables, in expanding the shoes against the brake drums and eliminating any possibility of a vacuum being created in the rear wheel cylinders, which might draw air into the hydraulic system past the rubber cups behind the pistons as the shoes are manually expanded.

BRAKE MASTER CYLINDER

The brake master cylinder is a combined supply tank and master cylinder. It maintains a constant volume of fluid in the system at all times and regardless of heat or cold conditions causes expansion or contraction. It acts as a pump during bleeding operations.

The piston (13), Figure 2, is returned to a released position much faster than the fluid returns into the master cylinder through the outlet.

A momentary vacuum will exist in the cylinder barrel and additional fluid drawn into the system from the reservoir through drilled holes in the piston (13) and past the lip of the cup (15). The brake shoe retracting springs exert a pressure on the fluid sufficiently strong to lift valve (18) off its seat and permits fluid from the lines to return to the master cylinder. Excess fluid is returned by port (16) into the reservoir, filling the cylinder for the next brake application.

FIGURE 1

1. Brake pedal pull rod clevis
2. Brake pull rod slide link
3. Brake pull rod slide link retainer pin
4. Play link assembly
5. Hand brake cable lever
6. Rear brake cable
7. Brake pedal rod
8. Brake pedal lever
9. Hand brake cable
10. Brake pedal to master cylinder clevis
11. Brake pedal lever shaft
12. Brake pedal to master cylinder push rod
13. Master cylinder attaching bolts
14. Master cylinder assembly
15. Master cylinder outlet fitting
16. Master cylinder stop light switch
17. Pedal pull rod to guide hanger spring
18. Brake control lever to guide hanger spring
19. Front brake hose assembly
20. Front brake hose to frame assembly
21. Frame tee to left front hose tube
22. Front frame tee
23. Master cylinder to frame connector tube
24. Hand brake cable lever guide plate
25. Rear brake cable clevis
26. Rear axle tee to left rear wheel tube
27. Rear axle brake tee
28. Rear axle tee to right rear wheel tube
29. Brake shoe to anchor pin spring-rear
30. Brake shoe hold down spring and retainer
31. Rear brake hose
32. Rear brake cable support bracket
33. Brake tube connector
34. Hand brake cable lever return spring
35. Hand brake cable lever toggle assembly
36. Cable lever pivot plate slide brace
37. Cable lever pivot plate and brace
38. Frame tee to right front hose tube
39. Brake shoe to anchor pin spring-front
40. Brake cable lever strut
41. Brake adjusting screw
42. Brake adjusting screw spring
43. Hand brake mounting bracket
44. Hand brake lever grip
45. Hand brake ratchet rod housing
46. Hand brake ratchet rod
47. Hand brake inner ratchet rod stabilizer
48. Hand brake ratchet rod stabilizer spring
49. Hand brake outer ratchet rod stabilizer
50. Brake pedal push rod
51. Hand brake cable clevis
52. Clevis pin
It is necessary that rod (5) which is attached to the brake pedal operating rod, be adjusted for clearance where it seats in piston (13) so that there is 1/4” free movement of the brake pedal pad before the pressure stroke starts. Cup (15) is thus permitted to be clear of port (16) when piston (13) is in its released position.

**NOTE:** If this port is not cleared by the piston, the compensating action of the master cylinder will be destroyed and the brakes will drag.

**FIGURE 2**

1. Filler cap
2. Filler cap gasket
3. Reservoir cover screws
4. Reservoir cover
5. Reservoir cover gasket
6. Push rod
7. Push rod guard strap
8. Push rod guard
9. Piston stop plate lock wire
10. Piston stop plate
11. Piston cup secondary
12. Master cylinder body
13. Piston
14. Inlet port
15. Piston cup primary
16. Outlet port
17. Piston spring
18. Check valve

Secondary cup (11) prevents fluid from leaking out of master cylinder into boot (8). The supply tank filler cap (1) can be reached by raising the front floor mat and removing three self-tapping screws and lifting off the round floor cover.

**FIGURE 3**

NOTE: Master cylinder should be kept at least one half full of Hudson Hydraulic Brake Fluid. The filler cap and master cylinder should always be cleaned of all dirt and grit before removing the cap. Grit in the fluid will cause scoring of the cylinders and possible plugging of lines and ports

**BRAKE DRUM DUST SHIELD**

The brake drum dust shield is a press fit on the drum and is also staked in 4 equally distant places to the drum.

**MASTER CYLINDER**

**REMOVAL:**

1. Disconnect stop light wires at stop light switch (16) Figure 1 and brake tubes at rear of master cylinder connector (15).

2. Remove one bolt attaching master cylinder frame bracket to frame rail and disconnect clutch pedal pull back spring.

3. Remove cotter key and clevis pin (10) attaching master cylinder push rod (12) to pedal (8) and remove push rod (12).

4. Allow master cylinder (14) and bracket assembly to swing down and remove the two bolts (13), nuts and lockwashers attaching master cylinder to bracket.
5. Remove master cylinder

REPAIR:

1. Thoroughly clean exterior of cylinder before disassembling.

2. Remove filler plug (1) Figure 2 and drain fluid.

3. Remove push rod guard strap (7) at pushrod and remove push rod (6) and guard (8).

NOTE: Do not use gasoline, kerosene, or carbon tetrachloride for cleaning solution. Use clean alcohol. Keep the parts free from mineral oil of any kind.

Remove lock wire (9). This will allow removal of piston (13), piston cups (11) and (15), spring (17), and check valve (18) for inspection and replacement, if necessary.

DISASSEMBLING:

1. Wash master cylinder parts in clean alcohol.

2. After washing, dip all parts in "Hudson Hydraulic Brake Fluid" for lubrication.

3. Install check valve (18) and piston return spring (17).

4. Install primary cup (15) piston assembly (13) and piston stop plate (10).

NOTE: Always use new rubber cups.

5. Snap piston stop plate lock wire (9) in its groove. Assemble push rod guard (boot) (8) and push rod (6) in place and install strap (7).

INSTALLATION:

1. Install master cylinder bracket and insert the two 3-1/2" long bolts (13) Figure 1 through bracket and master cylinder housing and tighten securely.

2. Attach the two brake tubes to master cylinder connector (15) and stop light switch wires to stop light switch (16).

3. Install master cylinder push rod assembly (12) to brake pedal lever (8) and insert clevis pin (10) and cotter pin. (Turn ends of cotter pin).

4. Insert the bolt attaching the master cylinder bracket to frame (located between master cylinder and frame).

5. Attach clutch pull back spring to master cylinder bracket.

6. Refill master cylinder to required level with Filler Bottle J-713 using "Hudson Hydraulic Brake Fluid".

NOTE: After removing master cylinder of any brake hose connections, it is always necessary to bleed the hydraulic brake lines to expel any air that may have entered the system. See "Bleeding Brakes" Page 7.
WHEEL CYLINDERS (FRONT)

REMOVAL:

1. Remove wheel and hub and drum.

2. Disconnect brake hose at frame bracket.

3. Using tool KMO-526, remove brake shoe retracting springs (39) Figure 1 by placing large end of tool over the anchor pin with the disengaging lug in the opening of the spring hook, rotate the tool 90 degrees and pull outward, Figure 5.

4. Remove the two wheel cylinder attaching screws.

5. Remove the connecting links between cylinder pistons and brake shoes. Wheel cylinder and hose maybe withdrawn as a unit.

To Install, Reverse Procedure of Removal.

NOTE: When installing the brake shoe retracting springs, use KMO-526 Replacer. Position small end of tool over anchor pin, place spring hook over shaft of tool and pry spring into position, Figure 6.

WHEEL CYLINDERS (REAR)

NOTE: Use same procedure as shown for "Front Cylinder Removal & Installation" except item #1.

DISASSEMBLY:

1. Remove cylinder end guards (2), Figure 4.
2. Remove pistons (3).
3. Remove piston cups (4).
4. Remove piston cup springs (5).

Check condition of rubber parts, and the cylinder bore for scratches or pits. Cylinder walls that are scratched or pitted should be honed or replaced.

ASSEMBLY:

1. Wash wheel cylinder and parts in clean alcohol.
2. Dip wheel cylinder and all parts in "Hudson Hydraulic Brake Fluid" for lubrication.
3. Assemble as shown in Figure 4.

NOTE: The wheel cylinder screws should be tightened with torque wrench J-1300 at 12 foot pounds.
FRONT BRAKE

DISASSEMBLING:

Whenever servicing the mechanical section of the brakes, such as replacing springs or shoes, and it is not necessary to disturb the wheel cylinders; proceed as follows:

1. Install Wheel Cylinder Clamp KMO-145 on wheel cylinders as shown in Figure 7 to prevent the piston seals being forced out of position.
2. Remove the brake shoe to anchor pin springs (3) and (5).
3. Press in and turn hold down spring cups (6) and remove cups, springs and pins on both shoes.
4. Remove shoes.
5. Remove adjusting screw (8).
6. Disconnect adjusting screw spring (9).
7. Thoroughly clean away all traces of rust and apply a coating of "Bendix Lubriplate" to the shoe ramps on the backing plates, shoe ends and all other frictional points.

To install shoes, reverse procedure of disassembly. Position anchor pin as described in "Major Brake Adjustment", Page 11.
REAR BRAKE

DISASSEMBLING

The disassembly and reassembly procedure of the rear brake is the same as for the front brakes, except for the removal of brake shoe lever to shoe pin (11), Figure 8, brake shoe cable lever (10), and cable lever strut (13).

After the brake shoe to anchor springs (3) and (5) have been taken off, remove nut and take out pin (11). Strut (13) and spring (14) will drop out of place. Disconnect end of brake cable from brake shoe cable lever.

To reassemble, reverse procedure of disassembly.

BLEEDING BRAKE LINES

Air in the braking system seriously impairs braking efficiency resulting in soft, spongy pedal action. It must therefore, be removed by bleeding the lines if the fluid level has been allowed to get too low or any part of the braking system has been disconnected or replaced.

NOTE: The bleeding operation should be performed at only one wheel cylinder at a time and repeated at other wheel cylinders if necessary. Start at left front wheel and proceed to Right front, Left rear, and Right rear if required.

CAUTION: Do not depress brake pedal while the brake drums are removed unless a bleeder valve has been opened for bleeding brake lines. Remove dirt around filler cap before removal for inspection of fluid level.

NOTE: If there is any doubt as to the grade of brake fluid present in the system, flush out entire system with a good grade of clean alcohol.

1. Fill "Master Cylinder Filler Bottle J-713" with Genuine "Hudson Hydraulic Brake Fluid."

2. Put nozzle in master cylinder reservoir and open filler bottle valve before starting. This will keep master cylinder reservoir half full of fluid during bleeding operation.

3. Remove screw, Figure 9, from end of bleeder valve and attach bleeder tube J-628. Insert free end of bleeder tube into a clean pint jar partly filled with brake fluid.

4. Unscrew bleeder valve, Figure 9, three fourths of a turn and depress foot pedal by hand, allowing pedal to return to released position slowly. This gives a pumping action which forces fluid through the tubing and out at the wheel cylinder carrying with it any air that may be present.

5. After the brake pedal is depressed, it must be allowed to return slowly, otherwise air may be drawn into the system.

NOTE: The free end of the bleeder hose must be kept below the surface of the fluid in the pint jar.

Watch the flow of fluid from hose and when all air bubbles cease to appear, the bleeder screw should be closed tightly before taking the bleeder hose out of the container of fluid.
Fluid withdrawn to any bleeding operation should not be used again.

Replenish fluid in the master cylinder after each cylinder is bled. If filler bottle J-713-C (filler and threaded adapter) is used, this constant check on the master cylinder is not necessary because of its large capacity and the fact that the quantity is easily watched.

If the master cylinder is drained during the bleeding operation, air will enter the system and the bleeding will have to be done all over again at all four wheels.

When bleeding operation is completed the master cylinder must be refilled. Check fluid level in master cylinder every 1000 miles.

**BRAKE FLUID**

Hydraulic brake fluid must have a high boiling point to prevent evaporation and to prevent any tendency to vapor lock, yet at the same time a good brake fluid must remain fluid at cold temperatures.

There are some types of brake fluid that are composed of ethyl alcohol and castor oil; cellosolve and castor oil; alcohol, water, and glucose with some chromate added to retard corrosion; mineral oil; anti freeze alcohols with no castor oil added.

Brake fluids of the above types are all harmful because Ethyl alcohol has a lower boiling point than HUDSON BRAKE FLUID, causing it to vaporize more rapidly and increasing the tendency to produce a vapor lock in the lines.

Cellosolve has a rather severe action on rubber parts and should not be used for that reason.

Water and glucose is worthless as water will corrode the metal parts of the system and glucose forms a sticky mass when exposed to air and has no lubricating qualities.

Mineral oil, in even the smallest quantity, should never be used. The slightest trace of mineral oil will destroy the sealing qualities of the two rubber piston cups in two or three days. Never wash any hydraulic brake parts in gasoline as even the slightest amount of mineral oil present in gasoline will affect the rubber parts.

Hudson Brake Fluid mixes with other brake fluids recommended by automobile manufacturers. However, do not mix Hudson Brake Fluid with any fluids containing glycerine, sugar, glucose, mineral oil or water.

**ADJUSTMENT**

**HAND BRAKE LEVER ADJUSTMENT**

With the hand brake fully released, the brake cables should permit the anchor ends of the rear brake shoes to rest on the anchor pin; if not readjust as follows:

Pull hand brake grip two notches from full release. There should be 1/8" clearance between the hand brake cable lever (5) and end of slot in lever guide plate (24). If not adjust hand brake cable clevis (5) until 1/8" clearance is obtained.

Pull rear brake cables (6) tight adjust devises so that clevis pins just enter holes in toggle (35). All slack should be removed when clevis pins are in place and hand brake applied two notches.

Check engagement of hand brake ratchet rod lock springs. Replace worn or broken springs.

**BRAKE PEDAL ADJUSTMENT**

The brake pedal lever (8) Figure 1 should have between 1/4" to 3/8" free play; this free play is the movement of the pedal lever (8) before the master cylinder push rod touches the master cylinder piston.

This adjustment is important to assure that the master cylinder piston returns to its normal position, otherwise the brakes will drag.
To adjust; loosen the pedal link clevis nut and remove clevis pin (52). Turn the pedal link rod clevis (1) to increase or decrease the length of the pull rod (50).

Tighten the pedal link clevis nut - lubricate linkage and recheck pedal free-play.

**PEDAL PULLER**

To adapt the J-2795 Brake and Clutch Pedal Remover for the "A" series pedal rods it will be necessary to add a horseshoe washer 1/4" thick with a slot milled in the washer. The opening in the washer must be large enough to enter over remover adapter; for specifications see Figure 10.

**FIGURE 10**

**BRAKE PEDAL**

**REMOVAL:**

1. Raise front of car and place stand jacks.
2. Remove nut and shakeproof washer holding pedal rod to brake pedal lever assembly.
3. Use puller J-2795 and remove pedal rod.
4. Disconnect clutch pull back spring.
5. Remove clevis pin and cotter key and disconnect clutch adjusting rod.
6. Disconnect brake follow up linkage.
7. Disconnect master cylinder push rod.
8. Remove bolt holding bracket at rear of master cylinder.
9. Remove clutch operating lever held by woodruff key and lock bolt.
10. Remove master cylinder push rod.
11. Remove lock ring at brake cross shaft with snap ring pliers KMO-630.
12. Remove master cylinder and brake pedal cross shaft brace.
13. Remove clutch cross shaft support bracket and clutch cross shaft assembly.
14. Remove brake pedal lever assembly.

**INSTALLATION:**

1. Install brake pedal lever on brake cross shaft.
2. Install clutch cross shaft and bracket assembly.
3. Install master cylinder and brake cross shaft brace.
4. Install brake cross shaft lock ring.
5. Install master cylinder push rod, boot, clevis pin and cotter pin.
6. Install bolt at master cylinder support bracket.
7. Install clutch release lever, align with key and tighten bolt.
8. Install clutch adjusting rod, clevis pin, and cotter pin.
9. Install brake follow up rod and make necessary adjustment.
10. Hook up brake follow up, brake pull back, and clutch pull back-springs.
11. Install brake pedal arm, nut and washer. (Align arm with pedal before tightening nut.) Adjust pedal for proper clearance.
12. Lower car and remove jacks
PEDAL PUSH ROD ADJUSTMENT

There must be a clearance of 1-1/4" between the rear side of retaining pin (3) and end of slide link (2) as shown in Figure 1.

This adjustment is important in order to obtain the proper mechanical follow-up to the hydraulic operation of the rear brakes. The safety factor of having mechanical brakes following the hydraulic brake action is lost unless this adjustment is checked on every car, whenever brake work or inspection is done.

REAR BRAKE CABLES

REMOVAL:

1. Raise car and place on jacks.
2. Remove cotter pins, clevis pins, that hold brake (25) Figure 1, clevises to toggle (35).
3. Unscrew brake cable clevises (25) and nuts from cable ends.
4. Disconnect clamp (32) that holds cable to #6 body crossmember.
5. Remove nuts, washers and clips that fasten brake cable to rear springs.
6. Remove rear brake cable dust cover at backing plate.
7. Remove rear brake drums.
8. Disconnect end of brake cable from cable lever at brake shoes.
To Install, Reverse Procedure and Lubricate Cables.

LINKAGE LUBRICATION

A thin film of chassis lubricant should be applied to parking brake cable connections, brake eccentrics, anchor links and all moving or possible friction contact points.

A film of lubriplate should be placed on the brake shoe support ledge on the backing plate so as to combat rust and insure free brake shoe action.

NOTE: This lubrication should be done at time of brake adjustment, with hubs and drums removed and with brake cylinder clamps in place. Slide the brake shoes away from the backing plate.

MINOR BRAKE ADJUSTMENT

NOTE: Brake drum should be at approximately room temperature when making brake shoe adjustments. If brakes are adjusted when the drums are hot and therefore expanded, the shoes may drag when the drums cool and contract.

1. Jack up all wheels clear of the floor.
2. Check and remove end play in wheel bearings if necessary.
3. See that parking brake lever is in the fully released position.
Check parking brake cables connecting to the rear brakes to insure that the cables have not been adjusted so short that the shoes have been moved off at their anchor in pin seal (in other words, the brakes are partially applied).

4. The brake pedal shank should not have more than 1/4" clearance with the brake pedal in its fully released position.

5. The brake control lever should be against its stop when the push rod is 1-1/4" from its rear face to the front end of the push rod.

Check the anchor pin nut with a torque wrench to make sure it is tight. It should check 65-75 foot pounds.

NOTE: If an anchor pin nut is found loose, reset the anchor according to instructions under "Major Brake Adjustment".

6. Remove adjusting hole cover from the backing plate, Figure 12. Expand the brake shoes by turning adjusting screw. Move handle of Brake Adjusting Tool J-1028 as shown in Figure 13, until the brake drum can just be turned by hand, then back off adjusting screw moving handle of Tool J-1028 approximately 14 notch-es.

NOTE: Make this adjustment at all four wheels. The brake drum should turn freely and if there is a heavy drag between shoes and drum, reset the anchor pin as given under "Major Brake Adjustment".

7. Reinstall the adjusting hole covers in the backing plates.

8. With the hand brake fully released, the brake cables should permit the anchor ends of the rear brake shoes to rest on the anchor pin. If shoes do not rest on anchor pin, readjust the cables as follows:

With the hand brake grip two notches from full release, 1/8" clearance should exist between hand brake cable lever (5) Figure 1, and end of slot in lever guide plate (24). If not - adjust hand brake cable clevis.

9. Pull rear brake cables tight and adjust ends so that clevis pins just enter holes in toggle (22). All slack should be removed when clevis pins are in place and hand brake applied two notch-es. Releasing hand brake will provide proper slack in cables.

Examine hand brake ratchet rod lock springs to see that they engage properly in the rod ratchet. Replace springs if worn or broken.

10. Pull cables tight and adjust the ends so that the clevis pins just enter the holes in the toggle (35), Figure 1.


12. Reinstall wheels and lower the car.

Test for operation on a level road. Do not test on the side of a crowned road.

NOTE: Lubricate brake cables with viscous chassis lubricant.

MAJOR BRAKE ADJUSTMENT

A complete brake adjustment is necessary when a minor adjustment fails to give satisfactory results or when replacing shoe and lining assem-blies.

1. Jack up all wheels clear of the floor.
2. Remove wheels.
3. Check linings for wear and loose rivets. Inspect linings for metal or foreign particles that may be inbedded in the surface and remove any that are found.

Shoe and lining assemblies having linings soaked with lubricate or Hydraulic brake fluid should be replaced. They cannot satisfactorily be cleaned.

NOTE: Use wheel cylinder clamp KMO-145 if brake shoes are to be removed. This clamp prevents the piston being forced out of the wheel cylinder either from the natural back pressure in the hydraulic system (combined with the spring pressure between the cups), or by an accidental movement of the brake pedal. Piston ejection would cause loss of fluid and allow air to enter the hydraulic system, necessitating bleeding the system.

4. Inspect each drum braking surface and rebore the drum if necessary.

Remove only sufficient metal to provide a smooth and true surface. If excess material is removed, the drum may be weakened to the extent that erratic braking and lining wear may result.

5. Disconnect hand brake cables at the toggle (35) Figure 1.

6. Thoroughly clean shoes and brake plates with a steel wire brush. All brake frictional points should be thoroughly cleaned after which a thin coat of lubriplate should be applied at these points.

7. Clean the exposed portion of all hand brake cables and then pull the cables through conduit from the wheel end to expose that part of cable that is sheathed by the conduit. Clean this portion of the cable and lubricate freely with viscous chassis grease. Figure 10.

8. Push cable into conduit and after the shoes have been reinstalled, connect the cable to the shoe cable lever (5), Figure 1, leaving the adjustable yoke ends (25) of cables disconnected from toggle (35).

9. To connect brake cable to shoe operating lever move cable return spring (12) away from cable end and place end into groove at the end of operating lever.

After the cable is in place allow the cable return spring to return against the lever to hold the cable in place.

10. Inspect backing plates for looseness and tighten if necessary.

NOTE: When newly lined shoes are installed it will be necessary to back off on the adjusting screw to provide clearance for drum installation. After rear shoes are in place, attach the cable end to the rear brake lever, but do not connect front end of cable.

11. Lubricate the front wheel bearings by applying a milled sodium soap base lubricant to the bearings and races only (3 ounces is sufficient).

Excessive looseness at front or rear wheel bearings should be corrected.

12. Before installing the front wheel hub and drum, remove any excess grease from inside the hub to prevent grease leakage onto the brake assembly.

13. Check the level of lubricant in the rear axle housing. This should not be above the lower edge of the filler plug hole. Too high a level will cause lubricant leaks at the rear wheel oil seals.

14. After installing hubs and drums, insert a pry between the linings of the secondary shoe and the drum (through drum feeler gauge hole) and move the shoe assembly until the primary shoe is against the opposite side of the drum. Figure 13. The primary shoe can be pried against the drum by inserting the .015” feeler gauge between the adjusting screw end of secondary shoe lining and the
shoe lining and the drum and then spreading the shoes by rotating the adjusting screw.

NOTE: The secondary shoe is always toward the rear and the primary shoe toward the front of the car.

15. Insert a .015" feeler gauge between the secondary lining and the drum and check the clearance between the lining and the drum at each end of the secondary shoe.

16. A clearance of .015" at each end of secondary shoe with the primary shoe against the opposite side of the drum indicates a good anchor pin and adjusting screw positioning. This will give a .0075" clearance between lining and drum all around.

NOTE: If a .015" clearance cannot be obtained at both ends of the secondary shoe by rotating the adjusting screw, the anchor pin must be adjusted.

CAUTION: Do not back the nut off too much as this would result in moving the shoes out of position when re-tightening the nut.

NOTE: To reduce the clearance between the lining and the drum at the anchor end of the secondary shoe, move the anchor pin away from the center.

To reduce the clearance at the adjusting screw end, move the anchor pin toward the center.

NOTE: After moving the anchor pin it will be necessary to pry the primary shoe against the drum by inserting a pry between the lining of the secondary shoe and drum (through the drum feeler gauge hole) and move the shoe assembly until the primary shoe is against the opposite side of the drum. The primary shoe can be pried against the drum by inserting the .015" feeler gauge between the adjusting screw end of the secondary shoe lining the drum and then spreading the shoes by rotating the adjusting screw.

17. Insert the .015" feeler gauge between the secondary shoe lining and drum and check the lining to drum clearance at each end of the secondary shoe. The clearance should be .015" at both ends of the secondary shoe.

18. Tighten the anchor pin nut to 65-75 foot pounds torque.

Make sure that the anchor pin does not move during the tightening operation by again checking the secondary shoe clearance after tightening the nut.

19. At the rear wheels only, tighten the adjusting screws until the wheels can hardly be turned by hand. Be sure that parking brake lever is applied approximately two notches or 1/8" at brake control lever (5) from the fully released position.

20. Adjusting parking brake cable so that all cable slack is removed when the cable is connected.

22. Replace adjusting screw hole covers in the backing plate and feeler gauge hole cover on the drum at all four wheels.

23. Install wheels and tighten wheel attaching bolts.

24. Install hub caps.

TROUBLE SHOOTING

BRAKE PEDAL GOES TO FLOORBOARD

Cause -

1. Normal wear of lining.

2. Improperly adjusted brake shoes.

3. Leak in hydraulic system.

4. Air in hydraulic system.

5. No fluid in system.

Remedy -

1. When it is necessary to pump the pedal several times before the brakes take hold, it is an indication that the brake linings are worn and that it is necessary to set the shoes closer to the brake drums.

2. Shoes should be set to .015" clearance. See "Major Brake Adjustment".

3. A connection leak in the hydraulic system will allow the brake pedal to go to the toe board gradually.

   A cup leak does not necessarily result in any loss of the travel of the pedal but will be shown by a loss of fluid in the master cylinder.

   If no leaks are found at the wheels or connections, remove master cylinder and check the bore for scores or scratches.

4. Air in the hydraulic system will cause a springy or rubbery action of the pedal. Should a sufficient quantity of air be allowed to get into the system, the pedal will go to the toe board under normal pressure.

   In this case the hydraulic system should be bled.

5. The master cylinder should be checked for fluid. If the tank ever becomes empty, air will get into the hydraulic system making a bleeding operation necessary.

ALL BRAKES DRAG

Cause -

1. Mineral oil in system.

2. Porthole in master cylinder is closed.

Remedy -

1. The use of any oil having a mineral base (engine oil, kerosene, gasoline, etc.) will cause the rubber piston cups in master and wheel cylinders to swell and distort, making them useless, and it is necessary to replace all piston cups. Brake hoses will become swollen and plugged and should be replaced.

   NOTE: The system will have to be thoroughly flushed out with clean alcohol and then refilled with "Genuine Hudson Hydraulic Brake Fluid".

2. The porthole (16) Figure 2 must not be blocked by the piston cup not returning to its proper release position. Refer to "Brake Pedal Adjustment".

ONE BRAKE DRAGS

Cause -

1. Brake shoe return spring is weak.

2. Brake shoe set too close to the drum.

3. Wheel cylinder cups distorted.

4. Loose wheel bearings.

5. Dirt in the brake line.
1. Replace brake shoe return spring.

2. Readjust brake shoes to .015" clearance. See "Major Brake Adjustment".

3. See "All Brakes Drag".

4. Adjust wheel bearings.

5. Remove dirt and flush out entire system with alcohol and then refill with "Hudson Hydraulic Brake Fluid".

**CAR PULLS TO ONE SIDE**

**Cause -**

1. Lining on one wheel grease soaked.

2. Brake shoes set incorrectly.

3. Brake backing plate loose on axle.

4. Brake linings have different friction qualities on different shoes.

5. Improperly inflated tires.

6. Caster of front wheels is incorrect.

7. Loose wheel bearing.

8. Dirt in lining or drum scored.

**Remedy**

1. Oil or greased - soaked linings cannot be saved by washing or cleaning. Replace the linings with "Genuine Hudson Lining".

2. The construction of the braking system will cause a slight pull or drift to one side in cases where a brake shoe is set too close on a front wheel. Adjust brake shoes as outlined in "Major Brake Adjustment".

**NOTE:** A rear wheel brake that is set too close will not cause this pull or drift, but will make one of the rear wheels lock and slide before the other.

3. Loose backing plate will allow the brake assemblies to shift on their locating bolts which determine the exact centers and any shift causes an unequal brake efficiency. Tighten backing plates and readjust shoes.

4. Different makes of brake linings are built to reach a certain aim of the manufacturer and the mixing of two different makes of linings on any of the wheels will very possibly give what is known as "Hard Pedal Action" on another shoe and these shoes may be on one wheel or different wheels.

   Genuine Hudson Lining sets are supplied in a package together with rivets. The primary shoe lining is moulded and the secondary shoe lining is woven. The linings are accurately ground and carefully inspected to assure you of the "Hudson Standard of Service Material".

5. Check front tires for proper inflation and approximate equal wear.

6. Check front wheel caster. Refer to the "Front Suspension Section #14".

7. Adjust wheel bearing.

8. Remove dirt or foreign matter from face of the lining. Seriously scored brake drums should be replaced.

**BRAKE PEDAL ACTION SPRINGY OR SPONGY**

**Cause -**

1. Brake shoes improperly adjusted.

2. Air in hydraulic system.

**Remedy -**

1. Adjust Brakes - See "Major Brake Adjustment".

2. Air in hydraulic system. Bleed system. Refer to "Bleeding Brake Lines".
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SECTION 18
WHEELS AND TIRES
SPECIFICATIONS

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WHEEL AND TIRE BALANCE

Wheel and tire balance is essential to prevent uneven tire wear and high speed wheel tramp, both of which contribute to poor handling, riding discomfort and excessive wear in steering gear and front end parts.

Tires and tubes are balanced at time of assembly to car at the factory.

The tire side walls are marked with a red dot to indicate the position in which the valve stem should be placed in order to preserve the original balance.

Tire wear or tire repair will, however, affect the balance. This is relatively unimportant on rear tires but very important on front tires.

Although tires and wheels are balanced when they leave the factory, subsequent tire wear causes them to go out of balance. To maintain proper balance and assist in prolonging tire life, it is the tire manufacturers' recommendation that the wheel and tire assemblies be check for balance every 2,500 miles and whenever a tire is repaired or recapped.

BALANCING THE WHEEL AND TIRE

Wheel balance is the equal distribution of weight of the wheel and tire assembly around the axis of rotation (static balance) and through the center line of the wheel and tire (dynamic balance).

There are two ways in which every wheel must be balanced--
Statically-- Figure 1
Dynamically-- Figure 2

Wheel unbalance is the principal cause of tramp and contributes to other steering difficulties.
Due to irregularities in tread wear, caused by sudden brake applications, misalignment, low inflation pressure, or tube and casing repairs, a casing and tube can lose its original balance.

If the action of the front wheels cause a disturbance at the steering wheel, the first items to check are air pressure and the balance of the tire and wheel.

**STATIC OR STILL BALANCE IS THE EQUAL DISTRIBUTION OF THE WEIGHT OF THE WHEEL AND TIRE ASSEMBLY ABOUT the axis of rotation in such a manner that it has no tendency to rotate by itself regardless of the position of the wheel and tire.**

Static unbalance of a wheel causes a hopping or pounding action (up and down) which leads to road tramp, high speed shimmy and excessive tire wear.

Wheels may be statically balanced on the steering spindle of the car, although the use of an accredited wheel balancing fixture will facilitate the operation.

**NOTE:** If wheels are checked on steering spindle, brakes must be fully released so that they do not drag and impede free rotation of the wheel.

Static unbalance of a tire and wheel causes the heavy portion (3) to go to the bottom as in Figure 1 and to obtain a true static balance, weights will have to be added on the rim opposite the heavy portion that went to the bottom. Gradually move the weight apart, equal distances from starting point until wheel i s in balance.

**NOTE:** The wheel is in balance when it will stand in any position without rotating of its own accord.

To balance the wheel and tire assembly a piece of putty may be used instead of fastening the regular weights onto the rim. The quantity of putty may be added to or reduced until the static balance is obtained, as in Figure 1.

The putty can then be weighed and balanced weight or weights attached permanently to the rim to correspond to the weight of the putty. The sum of the weights of section (1) and (2) is equal to the sum of the weights of section (3) and (4), Figure 1. The weight, therefore, is equally distributed about the axis of rotation. The weight at (2) being balanced by the weight at (3). However this wheel is not in dynamic balance because section (1), Figure 1 is lighter then section (2) and section (4) is lighter than section (3).

**NOTE:** Dynamic or running balance requires a wheel to be first in static balance and to also run smoothly at all speeds on an axis that passes through the center line of the wheel and tire and is perpendicular to the axis of rotation.

**NOTE:** The wheel assembly must be clean and free of all dirt, weights, etc. The tire must be in good condition; properly mounted with the balance mark on the tire lined up with the valve stem in the tube. Bent wheels must be replaced or straightened before being balanced. Tire valve caps must be in place.

The wheel and tire is in static balance as shown in Figure 1, however, with reference to the center line, section (1) is lighter than section (2), also section (3) is lighter than section (4).

**NOTE:** Special shop equipment is required to determine the amount it is out of balance and where correct weight should be added without disturbing its static balance.

This wheel when started spinning, will cause a center line through the weights at (2) and (3) to attempt to get at right angles to the rotation axis, Figure 2, which exerts a force on the wheel to try to obtain a new center line and thus change the axis of rotation. The wheel in spinning, therefore, tries to equalize the weight at (2) and (3) by moving the center line first in one direction and then in another, causing the wheel to try to rock first in one direction.
and then another, producing a wobble or shimmy which increases with high speeds.

Weights must be added to (1) and (4), Figure 2 to equal the weight in sections (2) and (3), and in Figure 2 the weight is evenly distributed about both the axis of rotation and the center line of the wheel. This wheel is statically and dynamically balanced.

NOTE: The rear wheels may be balanced by the same method used for front wheels. Rear wheels which are not in correct static balance may cause a vibration of the body and front end of the car when driving at high road speeds.

TIRE INFLATION

Maintaining proper tire pressure is the most important factor in obtaining maximum tire life, proper car handling, and best riding qualities.

Tire air pressure increases due to road contact and internal friction. The air pressure may increase considerably after hard driving during hot weather. For this reason tire inflation and pressure checking should always be done when the tires are cold.

Ordinarily tire pressures should be checked at least once a week. However, if the car is driven extensively, they should be checked every day.

Tire valve caps should be finger tight to prevent loss of air which may be escaping from a leaky valve and also precludes the possibility of dust and dirt getting into the valve. Replace missing valve caps promptly.

Keep tires inflated to the following pressures:

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<th>Size</th>
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FIGURE 3

MINIMIZING TIRE WEAR

To obtain maximum tire life, it is important to change tire positions at intervals of from 2,500 to 3,000 miles, Figure 3. This involves placing the left front tire and wheel assembly on the left rear hub, moving the right front assembly to the spare wheel position, right rear to left front, left rear to right front and the spare to the right rear hub. Switching the tires in this manner changes their direction of rotation and equalized the wear over 5 tires instead of 4.

TIRE WEAR

Tire wear, although actually more rapid on rear tires, is usually more uniform than on front tires. The rear tire treads are flexed (distorted) in one direction while the engine is driving the car and in the opposite direction when the brakes are applied which accounts for their even wear.

The front tire treads are flexed in the same direction when the car is being driven as when the brakes are applied. This tends to cause spotty wear, particularly if there are any crosswise lines in the tread design. When the tread consists wholly or partially of blocks, this wear is usually first noticed as a high point or ridge at the back of the block as it rests on the ground.
This high or unworn portion is forced down into the tread groove, when the brakes are applied, while the forward portion of the block, being backed by the remainder of the block, stands up and is subjected to the braking action and wears more rapidly.

If this condition is allowed to continue it will sooner or later (depending upon driving speed and severity of brake application) develop into a wavy or spotty wear. If changed to reverse the tire rotation, the tire wear will become uniform and in most cases remain so. However, under fast driving and severe brake usage the original conditions may again develop but this time on the reverse side of the tread blocks, making a second change necessary.

Do not be too hasty in diagnosing uneven tire wear as improper front wheel alignment as there are other conditions which can be much more readily checked and which may be the cause.

The following conditions should always be checked when uneven tire wear is encountered and in the order listed.

1. Tire pressure.
2. Wheel bearings.
4. Wheel and tire balance.
5. Front wheel alignment.

WHEEL BEARINGS
Loose or worn wheel bearings, permitting the wheel to wobble, will cause scuffing of tires or even permit brakes to drag intermittently.

FRONT WHEEL BEARING ADJUSTMENT
1. Jack up the wheel so that it will revolve.
2. Remove outer and inner hub caps.
3. Remove cotter pin and turn nut to the right sufficiently to insure that parts are properly seated and then back off the nut until a slight drag is felt when turning the wheel by hand.
4. Loosen the nut sufficiently to allow the wheel to turn freely.
5. Insert cotter key and clinch it.
6. Install inner and out hub caps and lower car to the floor.

BRAKES
Dragging brakes and particularly with eccentric drums will cause spotty wear. Be sure the brake backing plates are mounted securely on the spindles.

If the above checks fail to reveal the cause of the tire wear, a complete alignment test should be made.

WHEEL AND TIRE RUN-OUT
Wheel and tire assemblies which are eccentric or run-out excessively will cause premature tire wear.

Lateral run-out or trueness of the wheel can be checked with a gauge and a piece of chalk.

The allowable run-out or eccentricity is 1/16". More than this should be corrected.

Mark the spot on the wheel or tire were the most run-out occurs and if it is found necessary to check caster or camber, the place where the chalk mark is should be placed toward the front of the car, and in checking toe-in it should be placed at the top of the tire.

DISMOUNTING TIRES
Deflate the tube completely. Stand on the tire with both feet to force the bead away from the rim. Push the valve stem back into the tire. With two tire tools inserted about eight inches apart between the bead and the rim, BE CAREFUL NOT TO PINCH THE TUBE WITH THE TOOLS. With one tool in position, move the other tool around the rim and remove the remainder of the bead. Then remove the tube.
Stand wheel in upright position with inner bead in rim well. Apply liquid soap around both sides of rim. Insert both tire tools between bead and rim and pry tire out of rim.

**MOUNTING TIRES**

Coat both beads of tire with liquid soap to help slide them over the rim. Inflate tube just enough to round it out, then insert it in the tire. Place the tire on the wheel, carefully guiding valve stem into the hole in the rim. Push the inner bead over the rim and into well at valve stem and force balance of bead over the rim. It may be necessary to force a small remaining portion of the bead over the rim with the tire tool.

Insert the tire tool between outer bead and rim at a point opposite the valve stem and work bead over the rim. Leave tool in place and work other tool around bead and force remainder of the bead over the rim. **BE CAREFUL NOT TO DAMAGE THE TUBE WITH THE TOOL.**

Inflate tire slowly, carefully checking beads to see that they both are seating properly on the rim. The tire may be centered by bouncing it a few times. Inflate tires to recommended pressure, 26 lbs. front and 24 lbs. rear.

**TIGHTENING WHEEL HUB BOLTS**

Whenever a wheel has been removed it is important to make certain all wheel hub bolts are securely tightened before releasing car. Tighten to 60-65 lbs. torque. Tighten hub bolts equally while the wheel is clear of the floor, then lower car to floor and check hub bolts again and tighten to specified torque. All hub bolts are right hand thread.

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