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MAINTENANCE MANUAL

½ TON 4 x 4 CHASSIS

DODGE TRUCKS

built for

UNITED STATES ARMY

Contract Number W398-QM-DA-28

Model	Type of Vehicle
WC-42	Radio Panel

The service information contained in this manual is applicable only to the "Radio Panel" type Dodge 4 x 4 truck and its use, therefore, should be confined to this type vehicle.

CHRYSLER CORPORATION

Dodge Division • Detroit, Michigan

TM 10-1417

WAR DEPARTMENT

Washington, February 5, 1942

TM 10-1417, Maintenance Manual, Truck, ½-ton 4x4, Dodge (Model WC-42—"Radio Panel" type) published by the Chrysler Corporation, Dodge Division, is furnished for the information and guidance of all concerned.

(AG 062.11 (4/26/41) PC (C), June 10, 1941.)

By order of the Secretary of War:

G. C. Marshall
Chief of Staff

Official:

E. S. Adams
Major General
The Adjutant General

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MAINTENANCE MANUAL
FOR
UNITED STATES ARMY
DODGE 4 x 4 TRUCKS

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FOREWORD

TWO objectives have been considered in the preparation of this manual.

1. OPERATION AND CARE OF THE TRUCK: The manual contains practical and useful operating instructions and maintenance suggestions for the guidance of DRIVERS responsible for the operation of Dodge 4 x 4 Army Trucks. This information is written with the aim of promoting uninterrupted truck performance under different driving conditions encountered in Army Maneuvers.

2. REPAIRING THE TRUCK: The manual contains practical and workable mechanical instructions adequately illustrated with "action" pictures and "exploded" views. This information is for the use of the MECHANIC whose responsibility is to keep the truck in operation. The "Service Diagnosis" charts will also help the mechanic to analyze his problems before attempting a solution.

The contents of the manual are arranged in group sequence as indicated in the index in the right-hand margin of this page. Each group is divided into "Subjects" or Service Operations which are numbered consecutively throughout the manual. These subject numbers are used in order to make quick reference to related subjects. For example, in the Front Axle group, Subject 32, on page 18, refers to several other subjects which are related to the procedure of removing and installing a front axle housing.

The last group of the manual entitled "Service Standards" is a tabulated summary of adjustment specifications, dimensions of parts and name and type of units built by other manufacturers.

Special service tools mentioned throughout the manual are obtainable from the Miller Tool & Manufacturing Company, Detroit, Michigan.

The number (TM-10-1417) assigned to this manual appears on a Maintenance Number Plate attached to the compartment door on the instrument panel. See 2, Fig. 1. The Maintenance Number Plate also contains a number for the Parts List so that both the Maintenance Manual and the Parts List, applicable to the truck being serviced, can be easily identified by referring to the Maintenance Number Plate.

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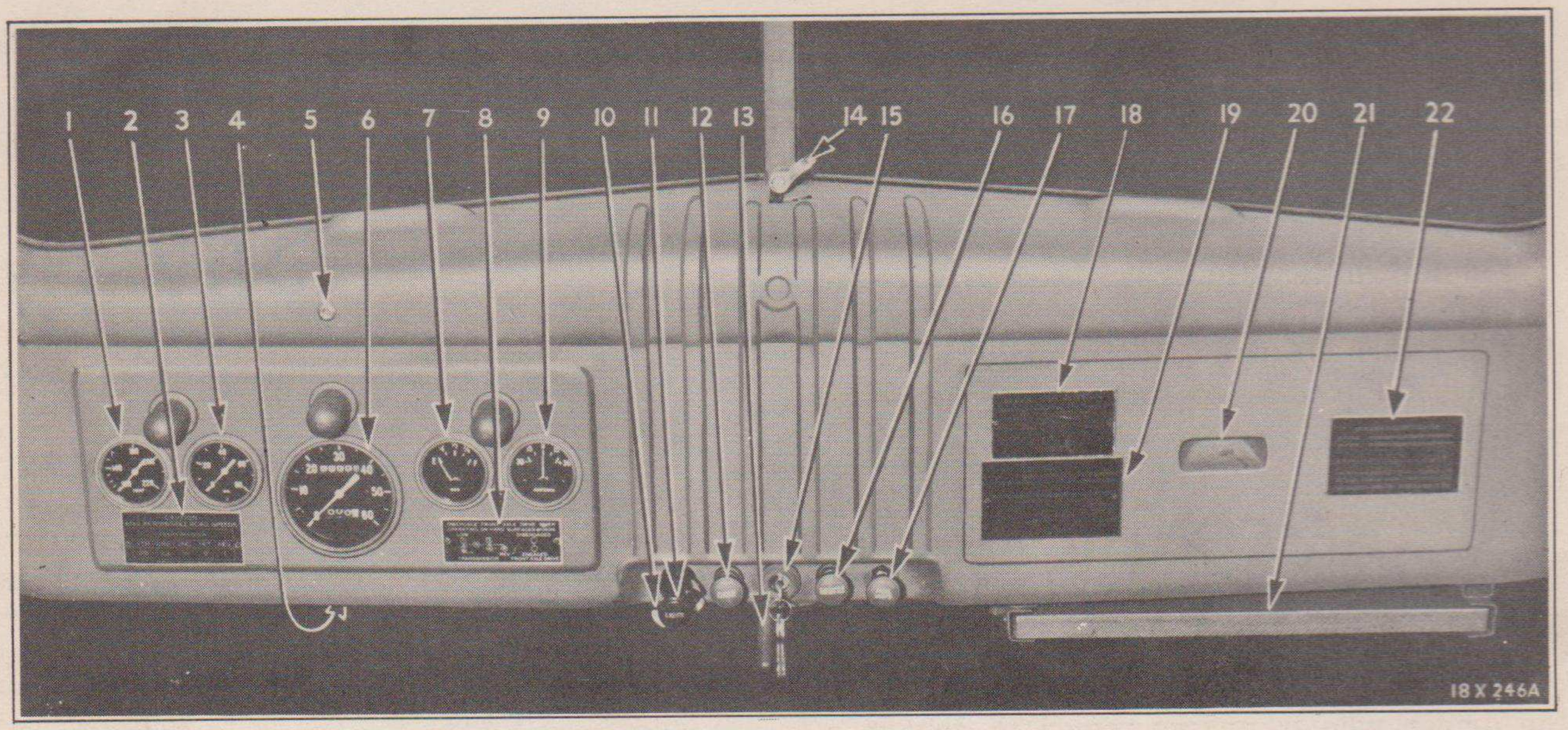


Fig. 1—Instrument Panel

Fig. 2—Front Compartment

OPERATING INSTRUCTIONS

It is important that the driver learn the location of each control lever, pedal and button before driving; then he will find the driving easier than trying to develop such knowledge while driving.

THE CONTROLS

The accompanying illustrations (Figs. 1 and 2) show the location of each control. By knowing the purpose of each control and how to use it, the driver who is unaccustomed to driving a Dodge 4 x 4 Army Truck will find it easier to follow the "Operating Instructions" contained in this section of the Manual.

1—Ignition Lock Switch

The ignition lock switch (15, Fig. 1), can be operated only when the key is inserted and turned to the right (clockwise). In this position the ignition and fuel gauge circuits are connected. The key cannot be removed unless the thumb piece of the key is vertical.

Keys

When the truck is shipped three identical keys are placed in a bag attached to the steering column. These keys will fit all locks used on the vehicle.

2—Choke Control

The choke control button, (12, Fig. 1), closes the choke when the control button is pulled "out" to the limit of its travel. Pull the choke control "out" when starting a cold engine and gradually push it in as the engine becomes warm. Always run the engine with the choke button pushed in after the engine has reached normal operating temperature. Excessive use of the choke causes a flooding condition in the engine and excess fuel works its way past the pistons into the crankcase diluting the engine oil. It also increases fuel consumption unnecessarily.

3—Hand Throttle

The hand throttle control button, (16, Fig. 1), is for use when starting the engine. It can also be used when starting the truck on steep hills where both feet are necessary to operate clutch and brake pedals. Pulling the button outward opens the throttle.

4—Accelerator Pedal

The accelerator pedal, (9, Fig. 2), is used to control engine speed with the foot while driving the truck.

5—Starter Pedal Button

This foot button (8, Fig. 2), is for operation of the starting motor which cranks the engine. It is located above the accelerator pedal so that it can be easily reached for starting the engine.

CAUTION: Do not press the starter pedal with the gearshift lever in gear or while the engine is running. See Subject 20.

6—Clutch Pedal

Pressing the clutch pedal (4, Fig. 2), down to the floor board, disengages the clutch so that the transmission gears may be shifted.

7—Transmission Gearshift Lever

This lever (6, Fig. 2), controls the shifting of all gears in the transmission. The diagram in the illustration shows the different positions of the lever for various gear selections in the transmission.

CAUTION: Do not attempt to start the engine unless the gearshift lever is in neutral

Fig. 1—Instrument Panel

1—Heat indicator
2—Maintenance number plate
3—Oil pressure gauge
4—Speedometer trip mileage set stem
5—Headlight bright beam indicator light
6—Speedometer
7—Fuel gauge
8—Transmission shift diagram plate
9—Ammeter
10—Service light lock-out button
11—Service and black-out light switch
12—Carburetor choke control button
13—Cowl ventilator handle
14—Windshield lock handle
15—Ignition lock switch
16—Throttle control button
17—Instrument panel light switch
18—Speed caution plate
19—Serial number plate
20—Compartment door
21—Map board
22—Cooling system drain caution plate

Fig. 2—Front Compartment

1—Windshield wiper control knobs
2—Windshield adjusting arm lock nuts
3—Horn button
4—Clutch pedal
5—Brake pedal
6—Transmission gearshift lever
7—Headlight beam control foot switch
8—Starter pedal button
9—Accelerator pedal
10—Hand brake lever
11—Transfer case control hand lever

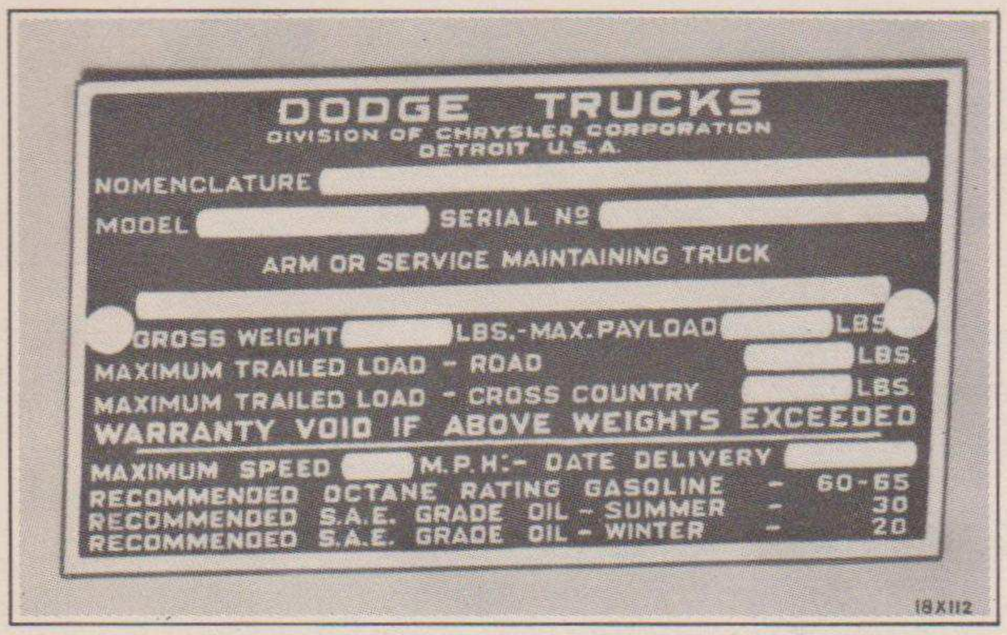


Fig. 3—Chassis Serial Number Plate

Attached to compartment door on instrument panel. Plate also contains other useful truck information.

position. See Subject 21 for further explanation of the gearshift lever.

8—Transfer Case Lever

This lever, (11, Fig. 2), is used to shift gears in the transfer case. When the lever is in the rear position (nearest the seat) the truck is in "four wheel drive." When the lever is in the forward position, the front axle is disengaged and engine power is applied only to the rear axle. See Subject 23.

9—Hand Brake Lever

The hand brake (10, Fig. 2), is used principally for holding the truck while parked. When parking on a grade, turn the front wheels off the straight-ahead position. The hand brake is released when the lever is in the extreme forward position and applied when moved back toward the seat. When pulled back, the lever will lock in position but may be released by pressing down the release button on top of the lever and pushing the lever forward.

10—Brake Pedal

The brake pedal, (5, Fig. 2), is used to slow down or stop the vehicle. See Subject 27.

11—Black-out Light Switch

All service lights and black-out lights are controlled by this switch (11, Fig. 1). When the switch is pulled out to the first position, the black-out lights, consisting of black-out headlights and black-out tail lights, are turned on, and the black-out signal light is operative.

By depressing the lock-out button, (10, Fig. 1), and pulling the switch to the second position, the service lights are turned on. In this position the service headlights and tail lights are turned on, the service stop light is operative and the instrument panel lights may be turned on or off by a separate switch. By pulling the switch to the third position, only the service stop light is operative.

12—Headlight Beam Control Switch

This foot switch, (7, Fig. 2), controls the high and low beams of the service headlights. (The switch operates only when the service headlights are turned on by the hand operated switch on the instrument panel.) Press the button with the foot to raise or lower the headlight beams. The switch locks each time the button is pressed. A red indicator, (5, Fig. 1), on the instrument panel is illuminated only when the high beam is turned on.

13—Black-out Lights

The black-out light lenses contain openings (Fig. 4), which cause the black-out light to appear as two lights when viewed from distances of 75 feet or less, by separating the source of light into two beams. When viewed from distances greater than 75 feet, however, the black-out light appears as one light.

The openings provided in the black-out light lens permit the driver of a vehicle to gauge the distance between him and another vehicle, when the black-out lights are in use. When the black-out light of a vehicle appears as two lights, the driver should proceed with caution, so that an emergency stop can be made, if necessary, in 75 feet or less.

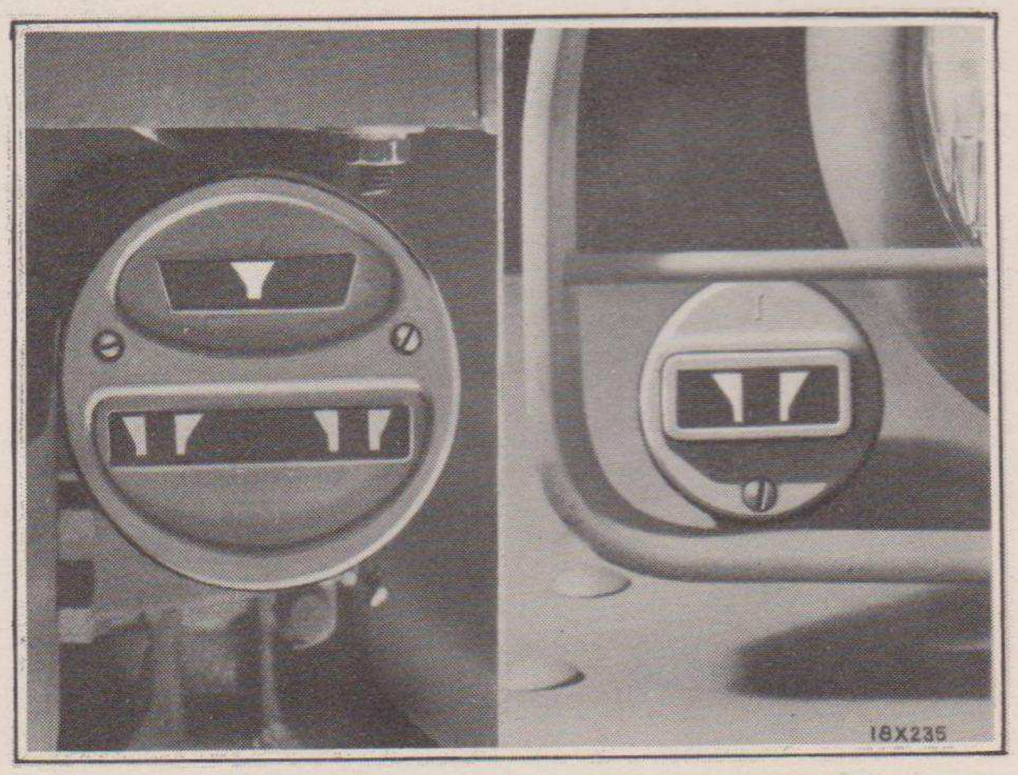


Fig. 4—Black-out Lights

14—Oil Pressure Gauge

The oil pressure gauge (3, Fig. 1), should register about 15 pounds pressure when the engine is running at slow idle speed, but at speeds above 30 miles per hour, the gauge should show from 30 to 45 pounds pressure.

If the gauge registers too low a pressure, especially at speeds above 30 miles per hour, or fluctuates between 0 and 45 pounds (except at slow engine speed) check the engine oil level immediately. If the engine oil is at the proper level and the gauge still registers too low a pressure, or none at all, report the condition at once to the motor officer.

15—Ammeter

The ammeter (9, Fig. 1), registers the rate of charge or discharge of the battery. In other words, it indicates the charging condition of the generator and the consumption of electricity in the system. When the electrical units are drawing more electricity than the generator is charging, the pointer on the ammeter will be on the negative (—) side of zero and when charging more than is being consumed, the pointer will be on the positive (+) side of zero. Electricity consumed by the starting motor is not registered by the ammeter. If, when all electrical units are switched off, the ammeter pointer registers on the negative (—) side of zero there is a leakage of electricity somewhere in the system, and the condition should be corrected at once.

While driving the truck, the ammeter hand may gradually approach zero. This indicates that the battery requires less current at that time and the voltage regulator is preventing overcharging. The ammeter should not show more than 10 ampere charge above 30 m.p.h. after the first 30 minutes of continuous driving. If it shows more than 10 amperes, with battery specific gravity of 1.275 or higher, the voltage regulator unit should be checked.

16—Heat Indicator

The heat indicator, (1, Fig. 1), shows the temperature of the water in the engine above 100° F. Never warm the engine quickly by running it fast just after starting. When driving, glance at the heat indicator occasionally to see that it does not register too hot. If it registers 200 degrees or more, the engine is too hot and should be stopped. Usually this is caused by insufficient water in the radiator, broken or loose fan belt. Whatever the cause of overheating may be, have the condition corrected before driving the truck.

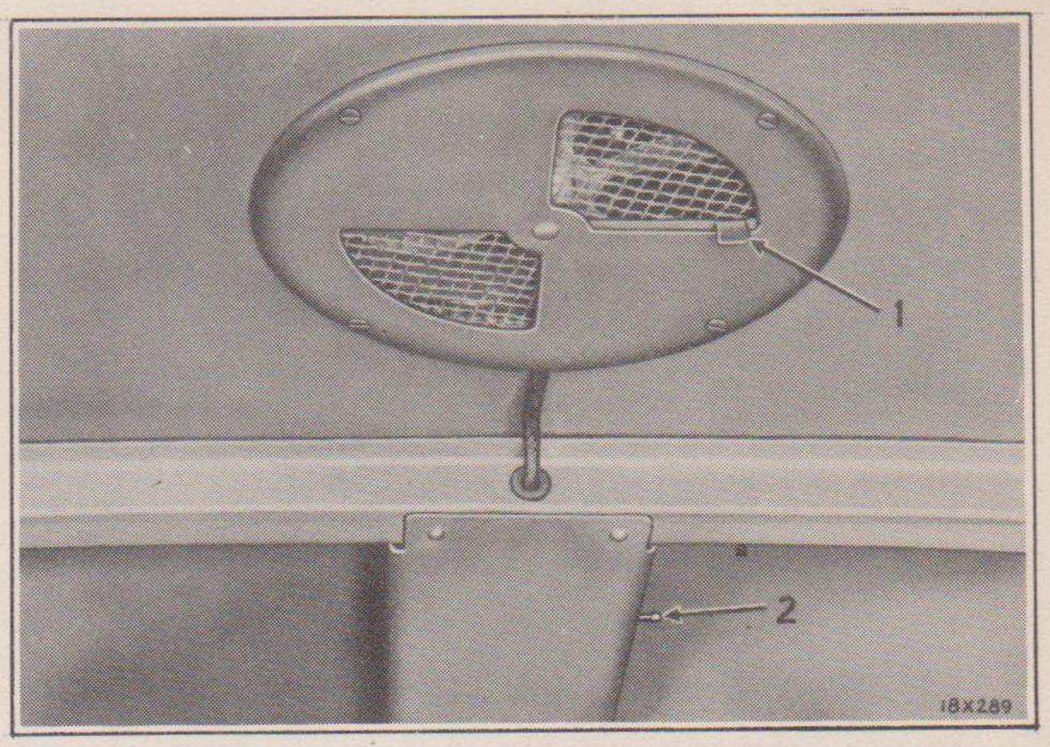


Fig. 5—Ventilator Fan and Switch Location
1—Ventilator shutter control tab 2—Ventilator fan switch

17—Fuel Gauge

The fuel gauge, (7, Fig. 1), operates when the ignition switch key is turned to the right (clockwise). It is electrically operated and indicates the level of the fuel in the tank. The letter "E" means empty, the letter "F" means full and "½" sign means half full.

18—Panel Body Ventilator

Mounted in the roof of the panel body, is an electrically driven ventilating fan which forces air from the inside of the body through a housing or shield installed on the top of the roof. Operation of the fan is controlled by a toggle switch just forward of the ventilator. See Fig. 5. The amount of air volume is controlled by a shutter built in the ventilator grille. It is operated by sliding the shutter.

OPERATING THE TRUCK

The instruments and controls with which Dodge U. S. Army Trucks are equipped are for the use of the driver in operating and keeping a constant check on the performance of his truck.

A good driver automatically makes certain checks before and during the operation of the truck. In so doing, he is aware of the general condition of the vehicle, helping him to keep his truck operating efficiently.

After learning the locations and purpose of these instruments and controls, the good driver will develop a systematic plan for checking the vehicle and then drive in a manner that will create for him the reputation of being a careful, dependable and safe driver.

(a) Before entering the truck, make a visual inspection of the tires to see that they are properly inflated.

(b) Check the oil level and cooling solution.

(c) Before starting the engine turn on the ignition switch key and check the fuel gauge to see that there is fuel in the tank.

(d) Make sure the gearshift lever is in the neutral position.

(e) Test the lights for operation; also the accelerator pedal for free movement.

(f) Test the brakes for operation to assure that there is plenty of braking on the pedal.

(g) Turn on the ignition switch key, depress the clutch pedal and start the engine as outlined in Subject 20.

(h) Immediately upon starting the engine check the oil pressure gauge, the ammeter and the temperature gauge.

(i) When the engine is warm push in the choke button.

(j) While driving the truck, a good driver will refrain from quick, jerky starts and unnecessary sudden stops.

All of the foregoing suggestions will help to increase the life of the vehicle and insure efficient, dependable and safe operation of the truck.

19—Breaking-in Speeds

The life of a truck depends largely upon the care it receives during the first 500 to 1500 miles of operation.

New engines should never be run at speeds equivalent to a truck speed of more than 25 miles per hour in direct drive during the first 500 miles of operation. During the next 1500 miles the speed may be gradually increased to complete the "breaking-in" process. The truck must not be driven at continued full speed nor should it be subjected to heavy load pulls during the first 2000 miles. Maximum power and speed should not be required from the truck until after it has been driven about 2000 miles. This mileage is necessary to make sure of all internal friction of the engine being minimized.

When starting any cold engine (whether new or not), care should be exercised during the warm-up period because lubrication is not as efficient when the engine is cold. Drive slowly until normal operating temperature is reached. The cause of damage to bearings and pistons in new engines as well as in engines operated at subnormal temperatures is due principally to extreme high temperatures of the frictional surfaces.

Avoid premature engine wear by giving the engine a chance to reach its normal operating temperature before subjecting it to heavy loads or maximum speed.

20—Starting the Engine

Before starting the engine, make sure that the transmission gearshift lever is in neutral position.

If the engine is cold proceed as follows:

(a) Disengage the clutch.

(b) Pull out choke button full distance of its travel.

(c) Turn on ignition (turn key to right, clockwise) and step on starting motor pedal, keeping it engaged until engine starts. After engine starts, gradually push in choke button to give proper operation.

Under extreme cold starting conditions it is advisable, to insure good starting, to pull out the hand throttle control button to give approximately one-third throttle opening.

CAUTION: Do not pump the foot accelerator before or during starting, as this will cause difficult starting.

If the engine is warm proceed as follows:

(a) Disengage the clutch.

(b) Turn on ignition switch and step on starting motor pedal, keeping it engaged until the engine starts.

Under extreme hot starting conditions it is advisable, to pull out the hand throttle to give approximately one-third throttle opening.

CAUTION: Do not pump the foot accelerator before or during starting as this will cause difficult starting.

21—Driving the Truck

The position of the transfer case control lever, (11, Fig. 2), *does not* alter the following recommended procedure of shifting transmission gears when driving the truck. See Subject 23 for instructions covering the engagement and disengagement of front wheel drive by use of the transfer case control lever.

(a) Press the clutch pedal, (4, Fig. 2), down to the floor, then move the transmission gear shifting lever to 1st or 2nd speed forward position, (6, Fig. 2), depending on the condition of the terrain. Next, press the accelerator, (9, Fig. 2), to speed up the engine a little and at the same time gradually relieve pressure on the clutch pedal. This engages the clutch and starts the truck moving. When the clutch is fully engaged (no pressure on the foot pedal), press the accelerator until the vehicle attains the desired road speed.

(b) With the vehicle in motion, press the clutch pedal to the floor and release the accelerator at the same time. Then move the transmission gearshift lever to neutral position and relieve pressure on the clutch pedal to allow the clutch to engage, leaving the gearshift lever in neutral. This synchronizes the engine and transmission speeds. Next, depress the clutch pedal and move the gearshift lever to the next higher speed position, engage the clutch and press the accelerator.

Shifting transmission gears by this method is known as "double-clutching." With a little practice, the average driver can accomplish an easy, smooth and noiseless shift in any transmission gear position.

(c) To shift into reverse, depress the clutch pedal and move the gearshift lever to the position shown at 6, Fig. 2. Then release the clutch pedal, and press the accelerator pedal at the same time until the desired speed is attained.

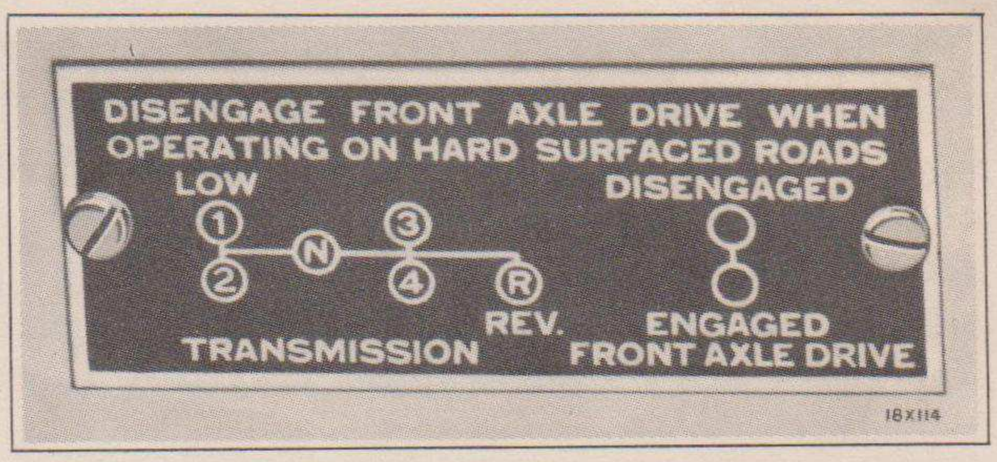


Fig. 6—Transmission and Transfer Case Shift Diagram Plate

Transmission gearshift lever positions are shown on a plate which is attached to the instrument panel. This plate is shown in Fig. 6.

22—Maximum Permissible Road Speeds

Dodge Army trucks are equipped with a governor which limits the maximum permissible road speed of the vehicle. The maximum permissible speed depends on the position of the transmission gearshift lever, as indicated on the plate shown in Fig. 7. This plate is attached to the instrument panel of the vehicle.

CAUTION: Do not permit the truck to exceed maximum road speeds in any gear when driving downhill, because excessive engine speed developed under such conditions might cause damage to engine bearings, pistons, valves, etc.

23—Driving the Truck in Four Wheel Drive (Front Axle Engaged)

The purpose of Four Wheel Drive is to permit maximum traction at all four wheels when driving on icy roads, through snow or mud or over rough unimproved terrain. On smooth, level, hard surfaced roads, and all ordinary conditions, the front axle drive should be *disengaged.*

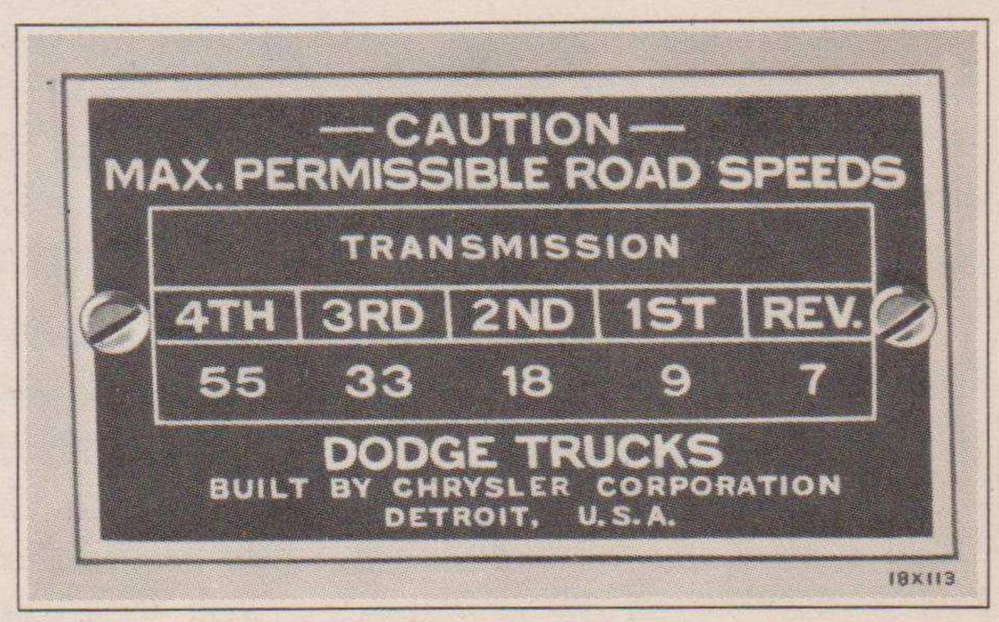


Fig. 7—Maximum Permissible Road Speeds Caution Plate

It is recommended that Four Wheel Drive (front axle engaged) be used below speeds of 25 miles per hour when driving conditions are such that maximum traction is needed at all four wheels. At higher speeds (above 25 miles per hour) the front axle should be disengaged and the driving force applied only to the rear wheels.

The control lever for engaging and disengaging the front axle drive is located in the driver's compartment, (11, Fig. 2). This lever operates the gears in a transfer case at the rear of the transmission. When the lever is moved to the forward position, the front axle is disengaged; when moved to the rearward position, the front axle is engaged for Four Wheel Drive. The positions of the control lever are shown on the plate illustrated in Fig. 6.

When shifting gears in the transfer case to engage or disengage Four Wheel Drive, the vehicle should be moving at a speed not exceeding 25 miles per hour. Shift the control lever in the desired direction with the clutch engaged and with the engine under mild acceleration. If resistance is felt mid-way in the shift, let up on the foot accelerator and complete the shift.

24—Driving Up or Down Steep Grades

When driving down a steep grade, shift into lower transmission gear ratios to cause the truck to drive the engine instead of the engine driving the truck. This will reduce the amount of brake application required. It may be necessary on very steep and long down-grades, to shift the transmission to second speed in order to have the engine hold the truck speed low enough for safety. Continuous or long time application of the brakes is not good practice, because it causes excessive wear of the linings.

When driving upgrade, some drivers have an inclination to try to reach the top without shifting gears. This is not good practice because the engine and drive mechanism is put under great strain unnecessarily and the speed of the truck is reduced.

The governor limits the speed of the engine to its maximum power. Therefore, to negotiate a hill at the highest speed with least load on the engine, shift the transmission gears to the next lower gear when the engine or truck speed begins to decrease by the "double clutch" method. This will permit driving the truck at the maximum possible governed speed up a hill or through soft surface road.

To shift to lower gears with the vehicle in motion, by the "double clutch" method, proceed as follows:

(a) Disengage the clutch and move the gearshift lever to neutral position.

(b) Engage the clutch and accelerate the engine sufficiently to increase the engine speed so that the transmission gears can be meshed in the next lower gear without clashing.

(c) Then disengage the clutch and shift into the next lower gear. Practice will soon reveal how much the engine should be accelerated in step (b) in order to accomplish a smooth, silent shift to lower gears.

25—Sand and Gravel

Drive slowly in loose dry sand or fresh thick gravel, even though the engine will propel the truck at a higher speed, because difficulty may be encountered in steering the truck due to the wheels sliding.

Loose sand or gravel under the tires is dangerous when rolled by the force of the truck. When approaching a sand or loose gravel road, slow down, because after driving on a smooth, hard-surfaced road, the truck will be moving too fast for good steering control on the soft road.

Some types of road have a strip of fresh loose gravel on one side and hard smooth surface on the other side. *Never drive into such a road surface at high speed.* The soft surface material has a tendency to pull the truck farther toward the side on which the soft material is laid.

When starting the trunk in sand or loose gravel, release pressure on the clutch pedal slowly so as not to spin the wheels. Spinning the wheels causes them to work their way down into soft road surfaces and wears the tires unnecessarily.

26—Soft Terrain and Deep Mud

When a truck becomes mired in soft terrain or deep mud good judgment should be used if any attempt is made to drive the vehicle out under

its own power. Any piece of mechanical equipment has its limitations. The axles, propeller shafts, transmission, clutch and engine will withstand a great amount of abuse, yet there is a limit to the amount of abuse to which these units should be subjected.

If the vehicle is pulling through soft mud and the driving wheels start spinning, the engine should not be raced and no attempt should be made to "jump" the vehicle out of the mud. Racing the engine usually results in digging the driving wheels deeper in the mud, and trying to "jump" the vehicle may lead to destruction of some part of the drive line such as the clutch, transmission, propeller shafts, or axles. When the vehicle is hopelessly mired in deep mud, it should be towed out by winch equipment (if so equipped) or by another truck.

27—To Stop the Vehicle

Remove pressure on foot accelerator and apply the brakes by pressing down on the brake pedal (5, Fig. 2). When the truck has been slowed down to engine idling speed, disengage the clutch and move the transmission gearshift lever to neutral position. When the truck has come to a complete stop, release the clutch pedal and apply the hand brake lever (10, Fig. 2).

LUBRICATION

There are numerous moving parts in a truck which should be lubricated with the correct grade of lubricant at specified mileage intervals to avoid rapid wear.

The Lubrication Chart shows the type of lubricant which should be used in the various units of the truck. It is important that the chart be studied carefully by all concerned with the lubrication of motor trucks and that the proper lubricants be provided and used according to the chart.

28—When to Change Engine Oil

During the first 1,000 miles, it is recommended that the engine oil which is in the crankcase, when the truck is delivered, be used. If necessary to add oil during the first 1,000 miles, No. 10-W should be used regardless of the season of the year or regardless of climatic conditions.

After the initial oil change at 1,000 miles, oil changes should then be made, *under normal conditions*, every 1,500 to 2,000 miles during winter and every 2,500 to 3,000 miles during summer. The refill capacity is 5 quarts.

Winter Driving

During winter, if the truck is driven for short distances of only a few miles at a time, water will condense in the crankcase and form a sludge which may freeze and clog the oil inlet screen. This is especially true if winter temperatures are extremely low for an extended period of time. Under conditions of this kind, the engine does not become sufficiently warm to expel the water through the crankcase ventilation system, and the oil should, therefore, be changed about every 500 miles, and under extreme conditions, less than 500 miles, to eliminate sludge. The engine should be thoroughly warm before it is drained.

As an alternative to this frequent change period during winter, an occasional drive of 30 miles or more at speeds of 30 miles per hour or higher, will do much to eliminate the water through the crankcase ventilation system and the change period may then be extended to 1,000 miles, or the normally recommended 1,500 mile winter change if these longer drives are indulged in frequently.

Dusty Roads and Dust Storms

Driving over dusty roads or through dust storms introduces abrasive material into the engine. Air cleaners which are kept in good condition decrease the amount of dust that may enter the crankcase. However, if the oil becomes contaminated with dust or dirt, it should be drained promptly to prevent harmful engine wear. The frequency of draining depends upon the sever-

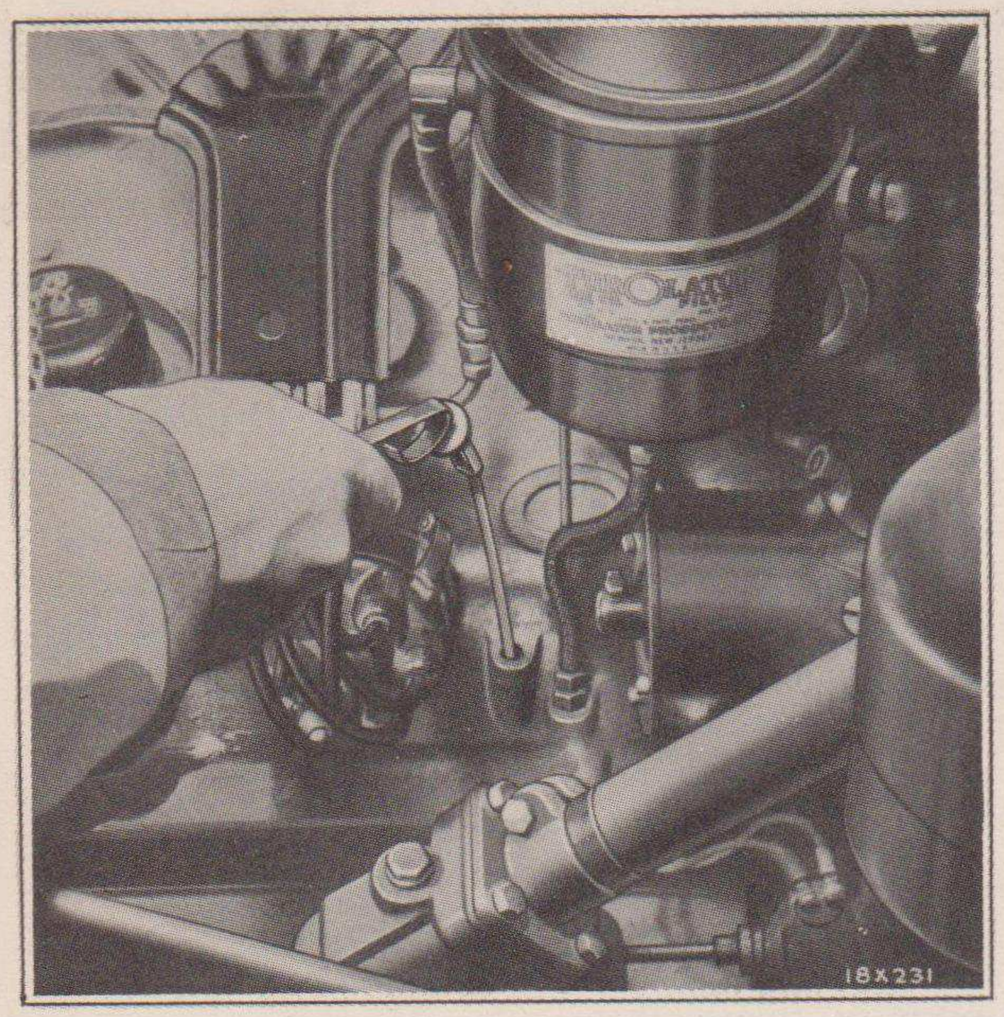


Fig. 8—Engine Oil Level Indicator Location

ity of the dust conditions and no definite draining periods can be recommended.

IMPORTANT: It is always advisable to drain the crankcase while the engine is at normal operating temperature. Oil will drain more completely when hot, and will, therefore, carry more of the foreign material and dirt with it if drained while the engine is warm.

29—Checking Oil Level

Each time a truck is refueled, the oil level should be checked. See Figs. 8 and 9. The oil level indicator is marked at "full" and "half-full". A third marking, between "full" and "half-full," indicates the "running" level. The "full" mark shows the proper level of oil after the engine has *not* been run for a few hours. As soon as the engine is started running, the level will drop somewhat, due to filling of oil passages and the filter.

Oil should not be added until the level is below "running level" as shown in Fig. 9, when one quart may be added. *The level should never be allowed to drop below the "half-full" mark.* The truck should be on a level surface when checking the oil level.

Note: When draining the engine oil, jack up the front end of the truck so that the oil pan will slant downward toward the rear. This will insure complete drainage of the used oil.

30—Engine Oil Recommendations

The grade of oil to be used in the engine depends on the anticipated minimum atmospheric temperature for the period during which the oil is to be used, as indicated in the following table:

Anticipated Atmospheric Temperature	*Grade to Use*
Not lower than 90°F.	S.A.E. 40
As low as 32°F.	S.A.E. 30
As low as +10°F.	No. 20W
As low as —10°F.	No. 10W
Below —10°F.	No. 10-W plus 10% Colorless Refined Kerosene

The interpretation of this table means that S.A.E. 30 is recommended as a general summer oil for trucks having a mileage above 1,000. It may also be used in tropical climates during the winter months where it is known that the lowest temperature will not be lower than 32°F., and where the average temperature will be close to normal summer conditions. For extreme temperatures, exceeding 90°F., S.A.E. 40 engine oil is recommended.

The use of No. 20-W oil should be confined principally to territories during the winter months where mild weather conditions are known to prevail, and where the temperature will not fall below + 10°F. It must not be interpreted that No. 20-W cannot be used above 32°F., should temperatures rise and remain above that temperature. No. 20-W oil is satisfactory for use above 32°F. and a change of oil is, therefore, not necessary until the regular mileage interval.

No. 10-W is recommended as a general winter oil in climates where normal winter conditions prevail, and where temperatures may fall as low as —10°F., but not lower. No. 10-W may also be used above + 10°F. or above 32°F. with

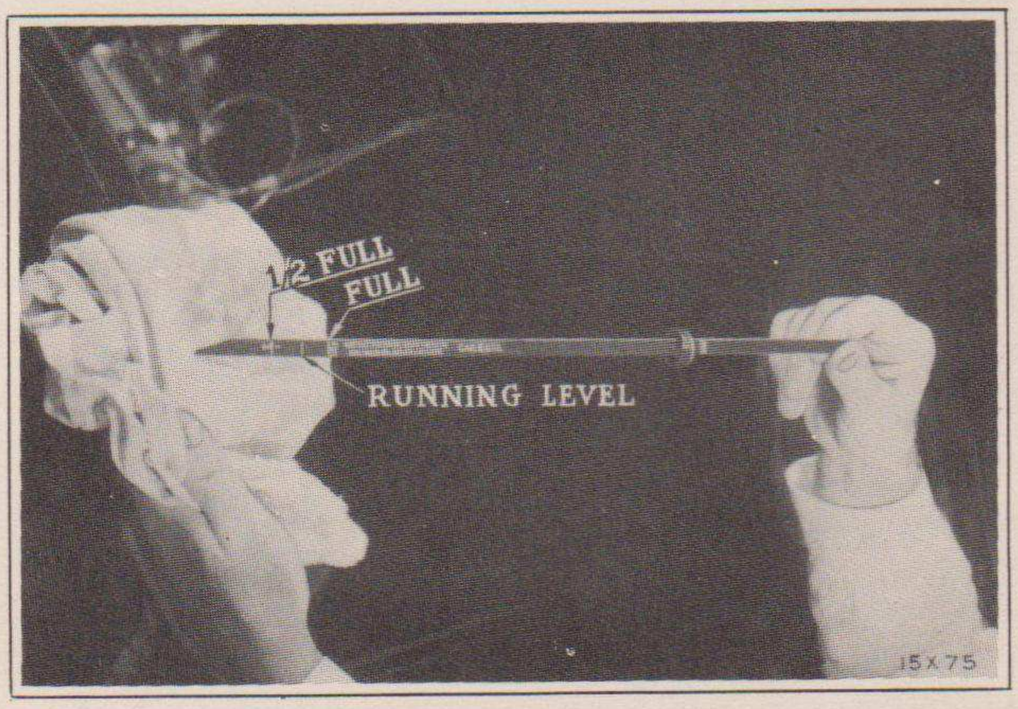


Fig. 9—Engine Oil Level Indicator

safety should temperatures rise above these points during the winter months. A change is, therefore, not necessary until the next mileage period.

For sub-normal winter conditions such as temperatures below — 10° F., it is recommended that No. 10-W be diluted with about 10% of colorless refined kerosene. The kerosene should be mixed thoroughly with the No. 10-W engine oil before being added to the engine.

In addition to the periodical lubrication specified on the Lubrication Chart on the next page, the following units should be inspected, lubricated or serviced according to instructions.

Engine

See Subject 30.

Oil Filter

Replace cartridge every 10,000 miles under average conditions or whenever engine oil becomes excessively dirty. **See Subject 187.**

Battery

Add distilled water to ⅜" above plates (see directions on top of battery filler plugs) at least once a month or every 1,000 miles. See Subject 116.

Brake Master Cylinder

The level of the brake fluid in the brake master cylinder should not be allowed to go lower than ½ inch below the bottom of the reservoir cover. Check the fluid level each time truck is lubricated.

Door Hinges

The door hinges should be lubricated occasionally with light engine oil.

Clutch Release Bearing

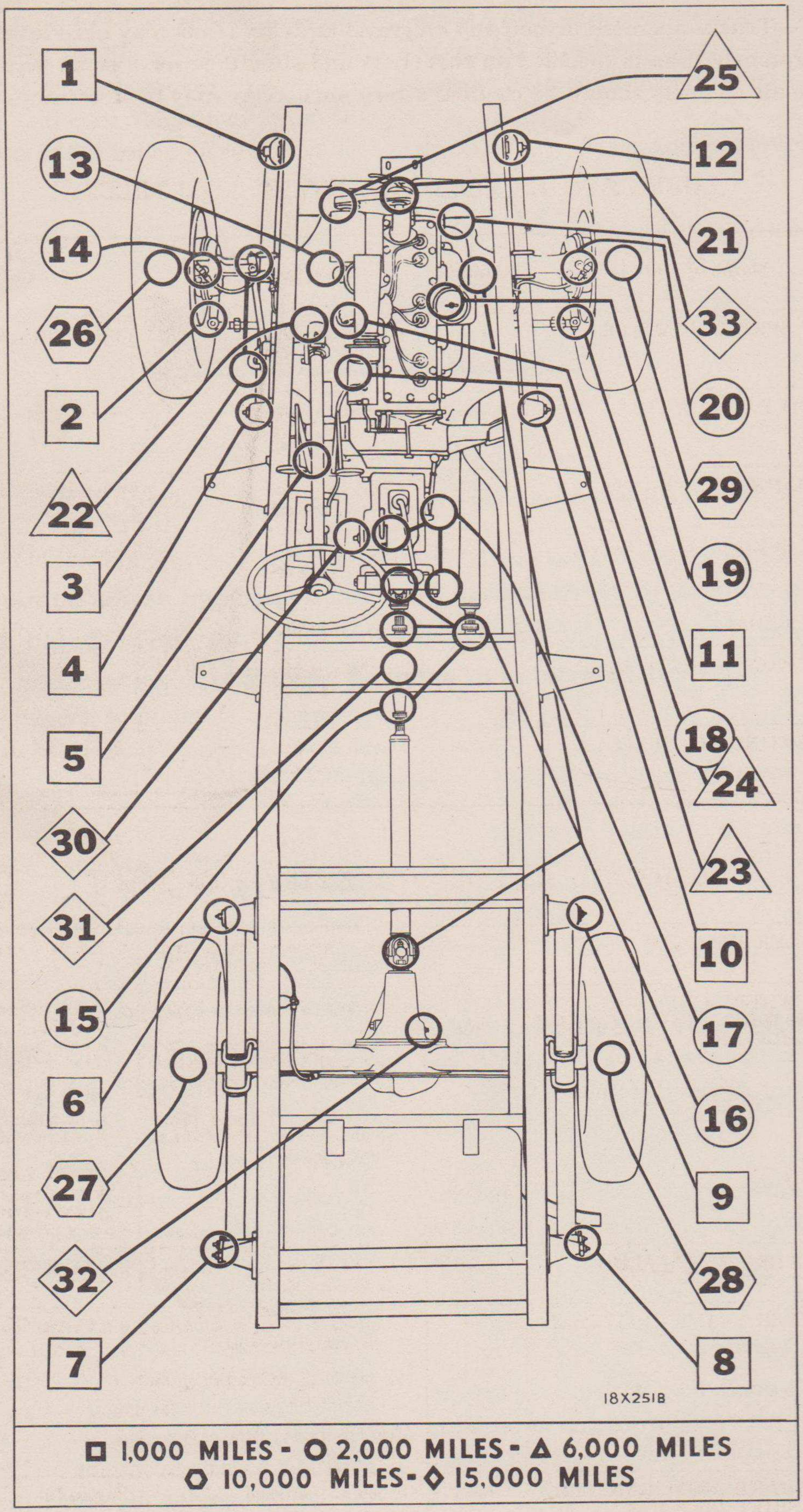
The clutch release bearing is lubricated at the time of assembly and requires no further lubrication.

Shock Absorbers

Maintain fluid at level of filler plug hole located on top side of shock absorber. Check fluid level every 10,000 miles. **See Subject 223.**

Fuel Filter

A heavy duty fuel filter, mounted on the engine side of the dash removes dirt and abrasive particles before the fuel reaches the carburetor. If the fuel filter becomes clogged with dirt, the fuel flow to the carburetor will be interrupted causing the engine to lose power or stop. To clean the filter see Subject 229.



□ 1,000 MILES - ○ 2,000 MILES - △ 6,000 MILES
⬡ 10,000 MILES - ◇ 15,000 MILES

Fig. 10—Lubrication Chart

IMPORTANT—Trucks operated principally on gravel or dusty roads may need lubrication attention more frequently than is specified on this chart and should be serviced as required. In dusty territories the air cleaners should be cleaned often: once a day may be necessary under extreme conditions.

LUBRICATE AS FOLLOWS EVERY 1,000 MILES

Chart Key No.	Name of Unit	Capacity	How Lubricated	Type of Lubricant
1 and 12	FRONT SPRING SHACKLES	——	4 Lubricant fittings (2 on each side)	Semi-Fluid Chassis Lubricant
2 and 11	TIE ROD BALL JOINTS	——	2 Lubric nt fittings (1 on eacn side)	Semi-Fluid Chassis Lubricant
3	DRAG LINK BALL JOINTS	——	2 Lubricant fittings (1 on each end)	Semi-Fluid Chassis Lubricant
4 and 10	FRONT SPRING REAR BOLTS	——	2 Lubricant fittings (1 on each side)	Semi-Fluid Chassis Lubricant
5	BRAKE PEDAL	——	1 Lubricant fitting	Semi-Fluid Chassis Lubricant
6 and 9	REAR SPRING FRONT BOLTS	——	2 Lubricant fittings (1 on each side)	Semi-Fluid Chassis Lubricant
7 and 8	REAR SPRING SHACKLES	——	4 Lubricant fittings (2 on each side)	Semi-Fluid Chassis Lubricant

LUBRICATE AS FOLLOWS EVERY 2,000 MILES

13	OIL FILLER PIPE CAP	——	Clean in kerosene and oil with engine oil. See Subject 188.	S.A.E. 50 engine oil
14 and 20	FRONT WHEEL UNIVERSAL DRIVE JOINTS AND STEERING KNUCKLE PIVOT BEARINGS	1 lb. each joint	4 Lubricant plugs (2 each side) Remove lower plug and lubricate until lubricant runs out. Reinstall plug. Remove top plug and inject small amount of lubricant then reinstall plug.	0° F. OR BELOW—Use a semi-fluid No. 0 sodium soap grease made from a low pour point steam cylinder oil stock. 0° TO+32°—Use a soft No. 1 sodium soap grease made from steam cylinder oil stock. +32° OR ABOVE—Use a medium No. 2 sodium soap grease made from steam cylinder oil stock.
15	PROPELLER SHAFT SPLINES	——	3 Lubricant fittings (1 on each shaft)	Semi-Fluid Chassis Lubricant
16	PROPELLER SHAFT UNIVERSAL JOINTS	——	6 Lubricant plugs (1 on each universal joint cross) Remove plugs and install lubricant fittings. After lubricating, be sure to reinstall plugs.	S.A.E. 140 Gear Lubricant
17	HAND BRAKE AND TRANSFER CASE SHIFT LINKAGE	——	Oil joints of linkage	Engine Oil
18	DISTRIBUTOR	——	1 oil cup	Light Engine Oil

LUBRICATE AS FOLLOWS EVERY 2,000 MILES—Cont'd

Chart Key No.	Name of Unit	Capacity	How Lubricated	Type of Lubricant
19	CARBURETOR AIR CLEANER	1 Qt.	Remove air cleaner from carburetor, remove filter element, wash in kerosene and dry thoroughly. Empty dirty oil from reservoir, clean and refill to indicated level. Note: If extreme dusty conditions are encountered, clean air cleaner more frequently, or when oil becomes mudded up.	Winter—No. 20-W Engine Oil Summer—S.A.E. 50 Engine Oil
21	WATER PUMP	——	1 Lubricant fitting	Water Pump Grease

LUBRICATE AS FOLLOWS EVERY 6,000 MILES

22	STEERING GEAR	½ Pt.	Remove filler plug, replenish when necessary—do not overfill	S.A.E. 90 Fluid Gear Lubricant
23	STARTING MOTOR	——	1 Oil Cup	Engine Oil
24	DISTRIBUTOR	2 or 3 drops	Remove cap and rotor, apply 2 or 3 drops of engine oil to wick beneath rotor. Caution: See that no oil or grease is on or near breaker points.	Engine Oil
25	GENERATOR	10 drops each cup	Oil Cup at front. Oil hole with sliding cover at rear.	Light Engine Oil

LUBRICATE AS FOLLOWS EVERY 10,000 MILES

26 and 29	FRONT WHEEL HUB BEARINGS	8 oz. each wheel	Remove hub and bearings, clean and repack. See Subject 44 for adjustment of front wheel bearings.	Short Fibre Wheel Bearing Grease, Medium
27 and 28	REAR WHEEL HUB BEARINGS	8 oz. each wheel	Remove hub and bearings, clean and repack. See Subject 59 for adjustment of rear wheel bearings	Short Fibre Wheel Bearing Grease, Medium

LUBRICATE AS FOLLOWS EVERY 15,000 MILES

30	TRANSMISSION	6 pts. (7 pts. with power take-off)	Drain, flush with flushing oil and refill. Filler plug—right side of case. Drain plug—bottom of case at rear.	S.A.E. 90 Hypoid Gear Lubricant (Inactive Type)
31	TRANSFER CASE	4 pts.	Drain, flush with flushing oil and refill. Filler plug—rear of case. Drain plug—bottom of case.	S.A.E. 90 Hypoid Gear Lubricant (Inactive Type)
32	REAR AXLE DIFFERENTIAL	4½ pts.	Drain, flush with flushing oil and refill. Filler plug: Right side of carrier Drain plug: Lower rear of housing cover	S.A.E. 90 Extreme Pressure Hypoid Gear Lubricant (Inactive Type)
33	FRONT AXLE DIFFERENTIAL	4½ pts.	Drain, flush with flushing oil and refill. Filler plug: Left side of carrier Drain plug: Lower front of housing cover	S.A.E. 90 Extreme Pressure Hypoid Gear Lubricant (Inactive Type)

FRONT AXLE

The front axle as well as the rear axle is a driving unit for the truck. However, power to the front wheels is controlled by the transfer case shifting lever in the driver's compartment. In other words the front axle drive can be engaged by pulling the shifting lever toward the rear of the truck, or disengaged by pushing the shifting lever forward according to existing driving requirements. The drive to the rear axle cannot be disengaged by the transfer case shifting lever. See operating instructions in Subjects 8 and 23. The power drive from the engine to the front and rear road wheels is through the clutch at the engine, then through the transmission, the transfer case, the propeller shafts and the axle units.

The front axle is built with universal joints at the steering knuckles through which power is delivered to the road wheels from the main drive gear, the pinion and the differential. It is of the full-floating type so that only the torque or driving power load is carried by the axle drive shafts. See Figs. 11 and 12.

The differential and carrier assembly in the front axle is identical with that used in the rear axle. For service procedure on the front assembly, refer to the "Rear Axle and Differential Carrier Assembly" section of this manual.

The following information in this section applies to trucks equipped with either the Bendix-Weiss or the Rzeppa type universal drive assembly in the front wheels except where otherwise noted. Service operations for the Bendix-Weiss universal drive are outlined in Subject 34 while the Rzeppa drive unit is covered in detail in Subject 35. The make of universal drive assembly used can be identified by a metal tag on the front axle housing at the inspection cover.

31—Front Axle Assembly

Removal

(a) Jack up front end of truck and place supports under the frame or the front bumper.

(b) Remove both front wheels. If necessary to remove the wheel hub assemblies, follow the instructions given in Subject 43. In the present procedure, it is not necessary to remove the bearing cups, the inner bearing cone and rollers and the inner oil seal from the wheel hubs.

(c) Disconnect the following—

(1) Brake hose at the brake supports, being careful not to damage or lose the *two gaskets* at each support.

(2) Shock absorber links at the bottom end.

(3) Front universal joint at the differential.

(4) Drag link at the steering arm.

(d) Place a jack or other support under the front axle assembly and remove the front spring clips. Then lower the axle assembly and remove it from under the truck.

Installation

When installing the front axle, make sure the head of each spring center bolt enters the center hole in its respective spring saddle on the axle housing. Also securely tighten the nuts on the spring clips after installing them in position.

In connecting the brake hose, be certain that the contacting surfaces are clean and the two gaskets are in place at the wheel cylinder end of each hose with the gasket having the larger hole next to the head of the retaining screw. It is also necessary after completing the assembly of the front axle, to bleed all brake lines (see Subject 75) in order to remove any air that might have entered the brake system when the front hoses were disconnected from the brake supports.

Lubrication of the front axle must not be overlooked. The differential, the universal joints and the wheel bearings should all be checked and properly lubricated with the right lubricant. Refer to the "Lubrication" section of this manual for lubrication of these units.

The alignment of the front wheels, including king pin angle, camber, caster and toe-in should be checked and replacements or adjustments

(Continued on page 18)

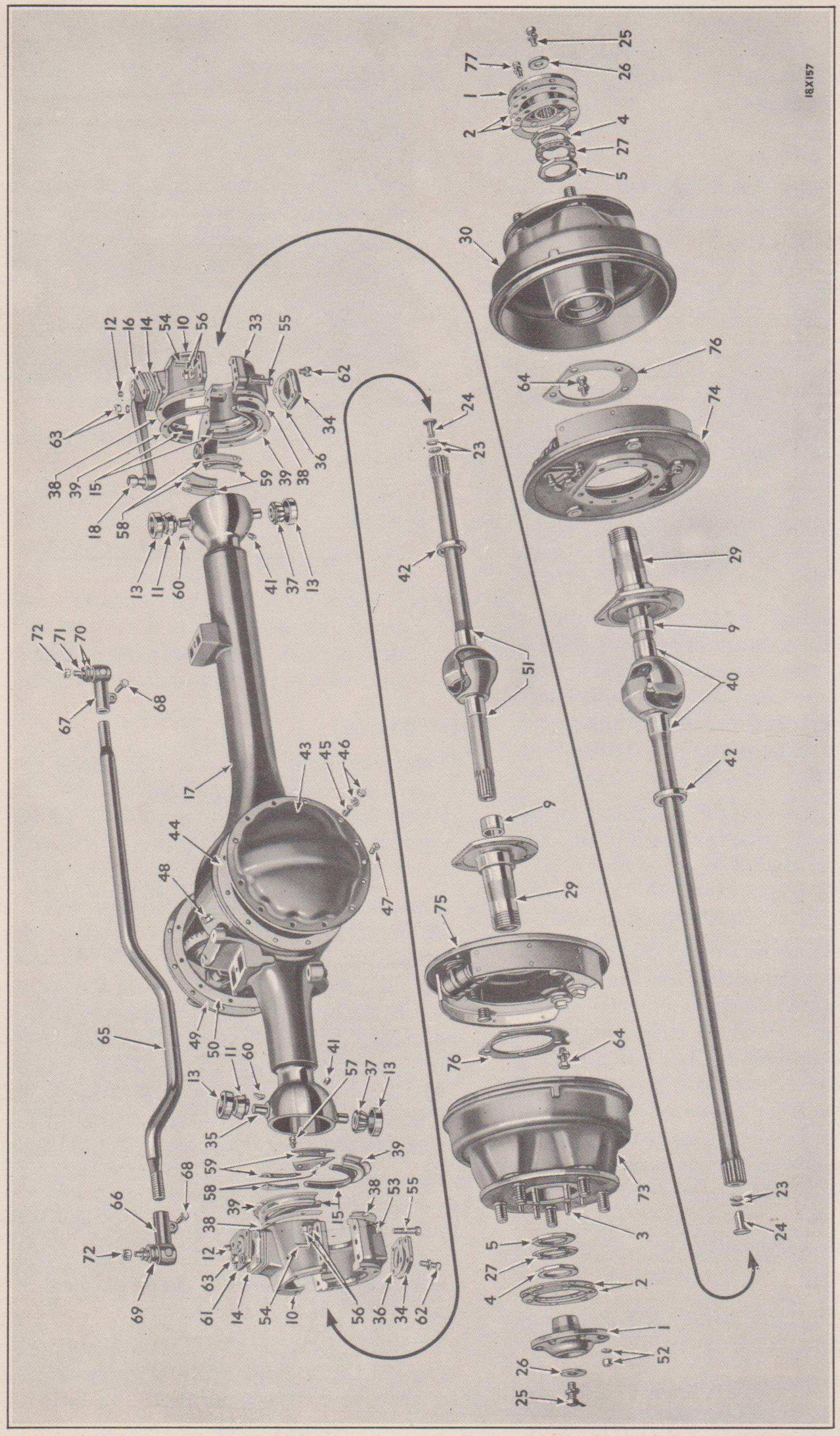


Fig. 11—Front Axle with Bendix-Weiss Universal Drive (disassembled view)

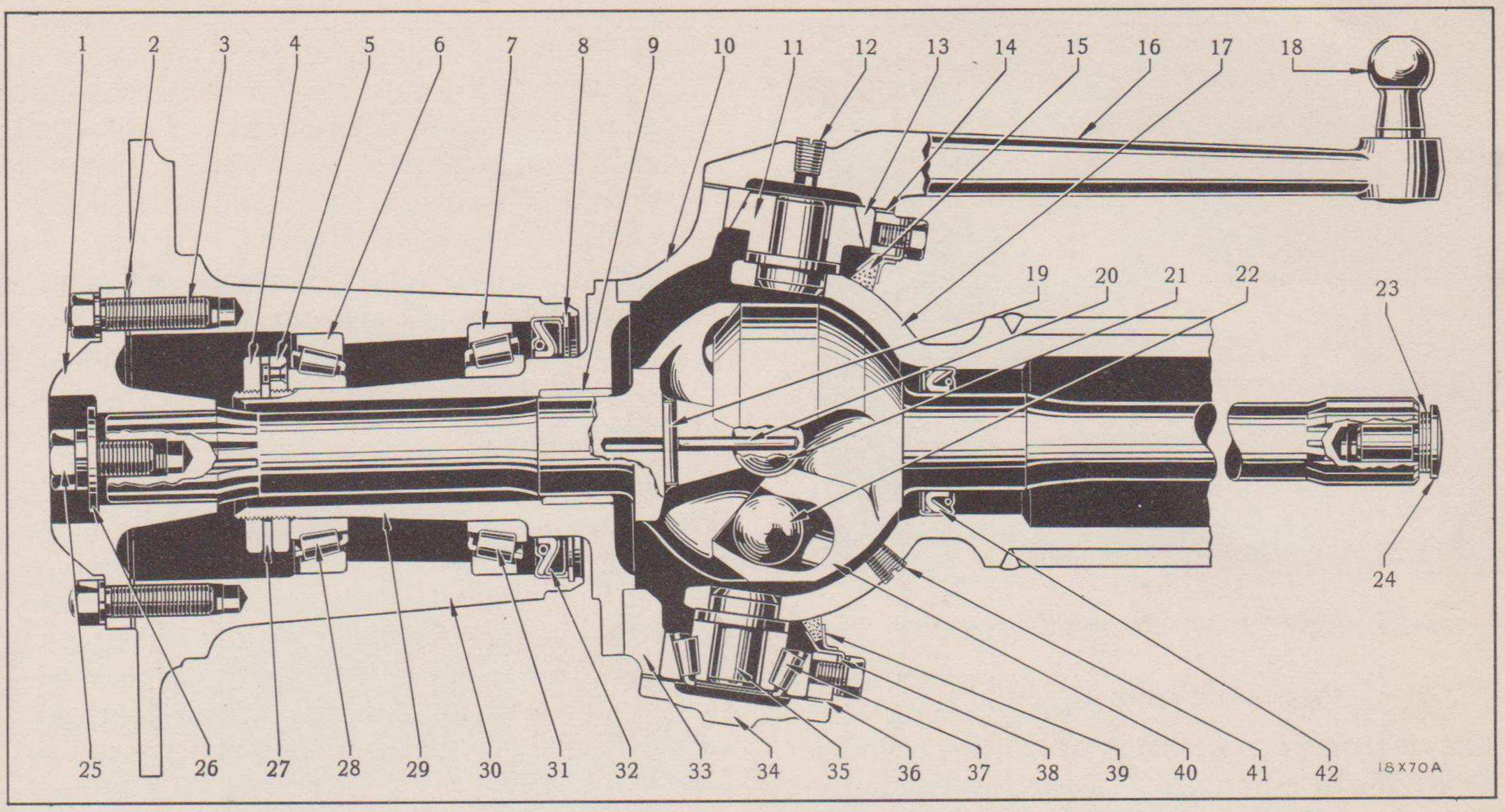


Fig. 12—Front Axle with Bendix-Weiss Universal Drive (assembled view)

Figs. 11 and 12—Front Axle with Bendix-Weiss Universal Drive

1—Front axle drive flange
2—Front axle drive flange shims
3—Front axle drive flange stud
4—Front wheel bearing adjusting nut—outer
5—Front wheel bearing adjusting nut—inner
6—Front wheel bearing cup—outer
7—Front wheel bearing cup—inner
8—Front wheel bearing oil seal retainer snap ring
9—Front axle steering knuckle bushing
10—Front axle steering knuckle flange—upper
11—Front axle steering knuckle flange bearing cone—upper
12—Front axle steering knuckle flange bearing cap grease plug
13—Front axle steering knuckle flange bearing cup
14—Front axle steering knuckle bushing bearing cap shims
15—Front axle steering knuckle flange oil seal
16—Front axle steering arm
17—Front axle housing
18—Front axle steering arm ball
19—Universal drive center ball pin retainer pin
20—Universal drive center ball pin
21—Universal drive center ball
22—Universal drive outer ball
23—Universal drive shaft thrust button shims
24—Universal drive shaft thrust button
25—Front axle drive shaft screw and lockwasher
26—Front axle drive shaft screw plain washer
27—Front wheel bearing adjusting nut lock
28—Front wheel bearing cone and rollers—outer
29—Front axle steering knuckle
30—Front wheel hub and brake drum assembly—left
31—Front wheel bearing cone and rollers—inner
32—Front wheel bearing oil seal
33—Front axle steering knuckle flange—lower left
34—Front axle steering knuckle flange bearing cap—lower
35—Front axle trunnion socket bearing pin
36—Front axle steering knuckle flange bearing cap gasket
37—Front axle steering knuckle flange bearing cone and rollers—lower
38—Front axle steering knuckle flange oil seal gasket
39—Front axle steering knuckle flange oil seal retainer
40—Universal drive assembly—left
41—Front axle trunnion socket grease plug
42—Universal drive shaft oil seal
43—Front axle housing cover
44—Front axle housing cover gasket
45—Front axle housing cover stud
46—Front axle housing cover stud nut and lockwasher
47—Front axle housing drain plug
48—Front axle housing vent
49—Front axle differential and carrier assembly
50—Front axle drive pinion carrier gasket
51—Universal drive assembly—right
52—Front axle drive flange stud nut and lockwasher
53—Front axle steering knuckle flange—lower right
54—Front axle steering knuckle flange dowel
55—Front axle steering knuckle flange bolt
56—Front axle steering knuckle flange bolt nut and lockwasher
57—Front axle steering knuckle flange oil seal screw and lockwasher
58—Front axle steering knuckle flange joint oil seal felt
59—Front axle steering knuckle flange joint oil seal felt retainer
60—Front axle steering knuckle flange bearing cone key
61—Front axle steering knuckle flange bearing cap—upper
62—Front axle steering knuckle flange bearing cap screw and lockwasher
63—Front axle steering knuckle flange bearing cap stud nut and lockwasher
64—Front axle steering knuckle to flange screw and lockwasher
65—Front axle steering knuckle tie rod
66—Front axle steering knuckle tie rod end—right
67—Front axle steering knuckle tie rod end—left
68—Front axle steering knuckle tie rod end clamp bolt
69—Front axle steering knuckle tie rod end dust cover
70—Front axle steering knuckle tie rod end dust cover washers
71—Front axle steering knuckle tie rod end dust cover spring
72—Front axle steering knuckle tie rod end ball nut
73—Front wheel hub and brake drum assembly—right
74—Front wheel brake support assembly—left
75—Front wheel brake support assembly—right
76—Front wheel brake oil slinger
77—Drive flange puller screw and lock nut

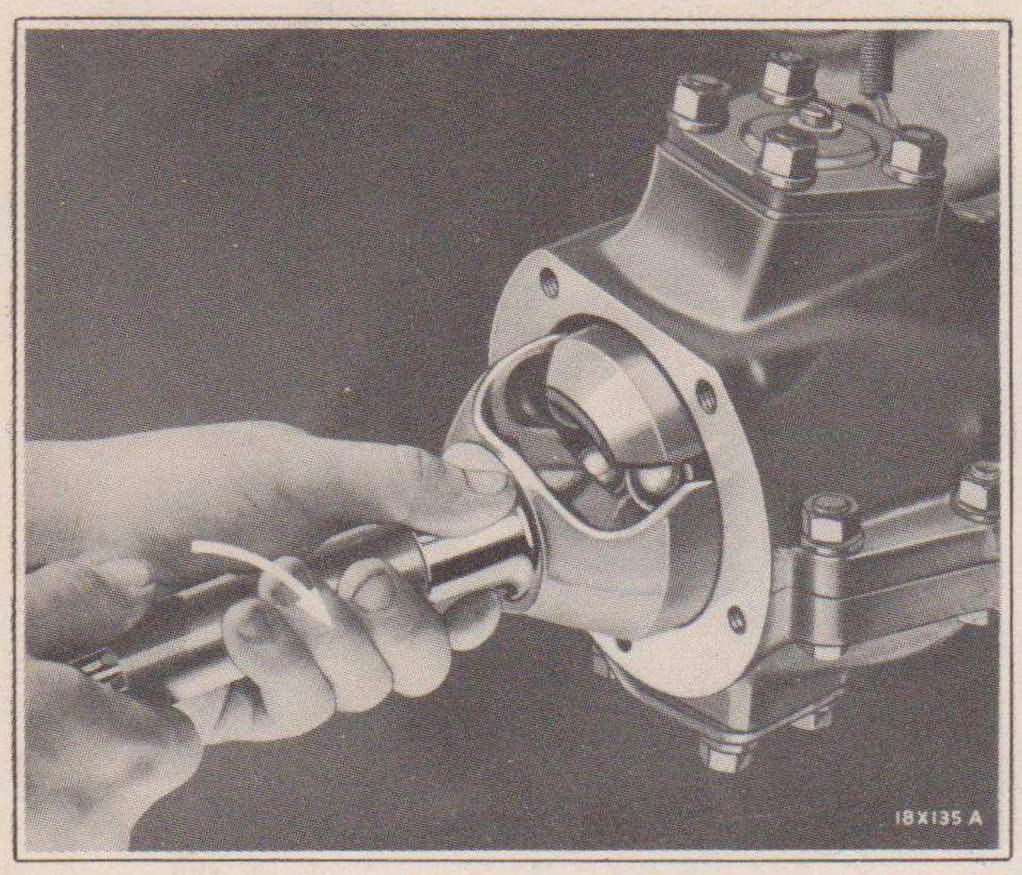


Fig. 13—Removing Universal Drive Assembly

(Continued from page 15)

made whenever necessary as outlined under "Front Wheel Alignment," page 31. The turning angle should also be checked as outlined in Subject 37.

32—Front Axle Housing

Removal

(a) Remove the front axle assembly from the truck as outlined in Subject 31.

(b) Remove both wheel hub assemblies as explained in Subject 43. It is unnecessary in this procedure to remove the bearing cups, the inner bearing cone and rollers and the inner oil seals from the wheel hubs.

(c) Pull out the universal drive assembly at each end of the housing after first making sure each steering knuckle flange is straight with the axle housing or in the normal position with the road wheels straight ahead. To prevent possibility of universal joint coming apart when being removed from axle housing, twist the shaft as it is being withdrawn as shown in Fig. 13.

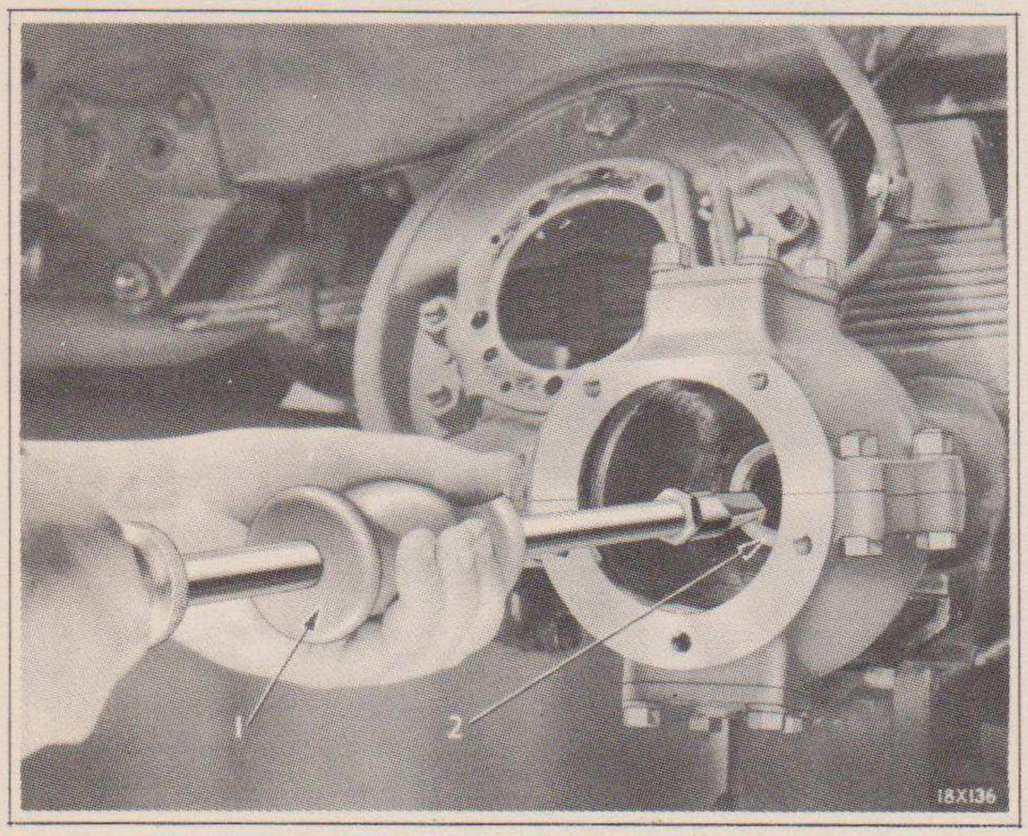


Fig. 14—Removing Universal Drive Shaft Oil Seal
1—Universal drive shaft oil seal 2—Tool C-637

(d) Remove both steering knuckle assemblies as outlined in Subject 40.

(e) Remove the differential carrier assembly and cover by taking off the retaining nuts and washers.

Installation

When assembling and installing the axle housing, be sure to observe all *cautions* and follow carefully all of the instructions given for these operations in the Subjects 31, 40 and 43 referred to above. This includes bleeding the brakes, adjusting the steering knuckle flange bearings, adjusting end play in the universal drive assemblies and aligning the front wheels. Also replace all gaskets with new ones to avoid lubricant leaks.

33—Front Axle Universal Drive Assembly

Removal and Installation

(a) Remove front wheel hub assembly as explained in Subject 43. It is not necessary in this particular operation to remove the bearing cups, the inner bearing cone and rollers and the oil seal from the wheel hub.

(b) Disconnect the brake hose hold down spring from the hose clip.

(c) Remove the brake support retaining screws, the lock washers and the oil slinger.

(d) Pull off the brake support assembly and fasten it to the frame or axle housing with a wire or rope to prevent kinking the brake hose. The brake hose should not be disconnected as otherwise it would be necessary to bleed the brake system.

(e) Pull off the steering knuckle.

(f) With the steering knuckle flange straight with the axle housing or in the normal position with the front wheels straight ahead, pull out the universal drive assembly with a twisting motion as shown in Fig. 13.

When removing the Bendix-Weiss drive, check to make sure that the thrust button and shims are in position at the inner end of the shaft. If not, it will be necessary to remove the differential carrier assembly to recover these parts.

With the above parts removed, it is good practice to check the condition of the universal drive shaft oil seal in the outer end of the axle housing. If worn or damaged it should be replaced with a new one. This seal assembly is a drive fit in the housing and special tools must be used for its removal and installation. See Figs. 14 and 15.

It is also important that the adjustment of the steering knuckle flange bearings be checked as outlined in Subject 41, with the universal drive assembly and flange oil seals removed.

IMPORTANT: If the drive assembly is to be replaced by another, be sure to use the same (or same thickness) drive shaft shims and thrust button (when used) as in the shaft removed to establish an approximate adjustment. If the truck is equipped with a Bendix-Weiss universal drive, refer to Subject 36 for adjustment procedure. However, if equipped with a Rzeppa universal drive, no adjustments are required, but the assembly should be installed in the correct operating position as explained in Subject 35.

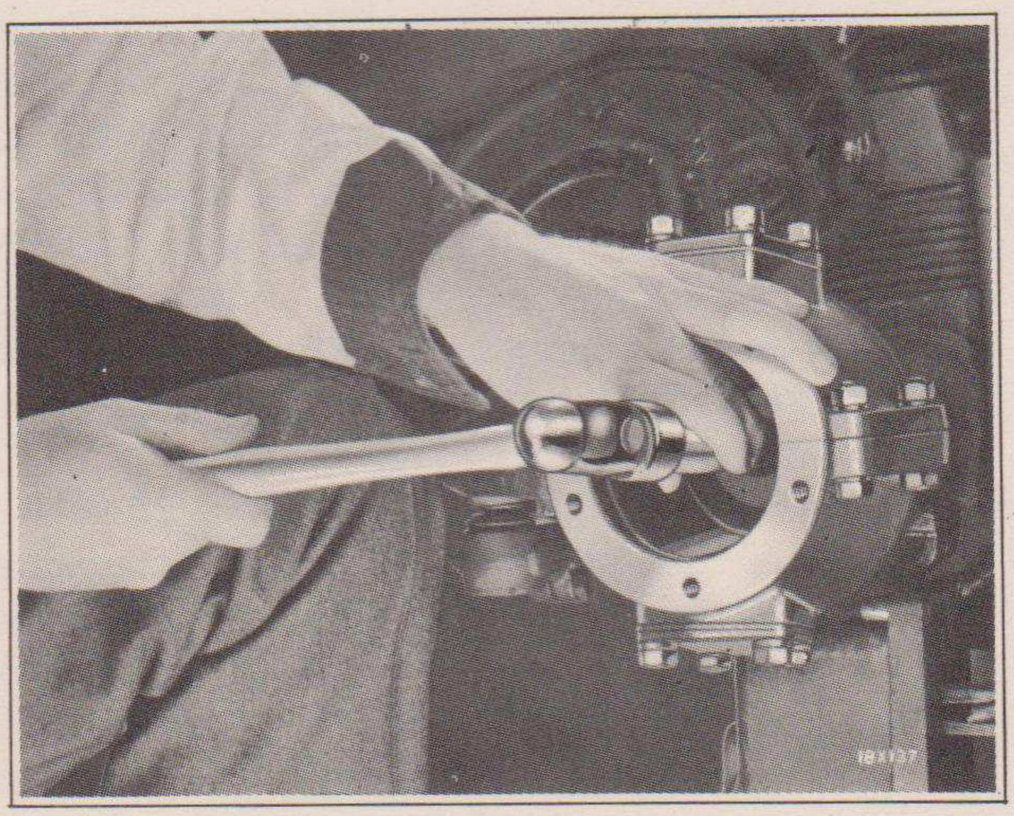


Fig. 15—Installing Universal Drive Shaft Oil Seal (Tool DD-827)

Before installing the front axle universal drive shaft assembly, thoroughly clean and lubricate all parts as the assembly work progresses. Be sure the shims between the hub and the drive flange are in good condition so as to avoid oil leakage.

34—Bendix-Weiss Universal Drive Assembly

Disassembly

(a) After removing the front axle universal drive assembly as outlined in Subject 33, clean the parts thoroughly to facilitate disassembly.

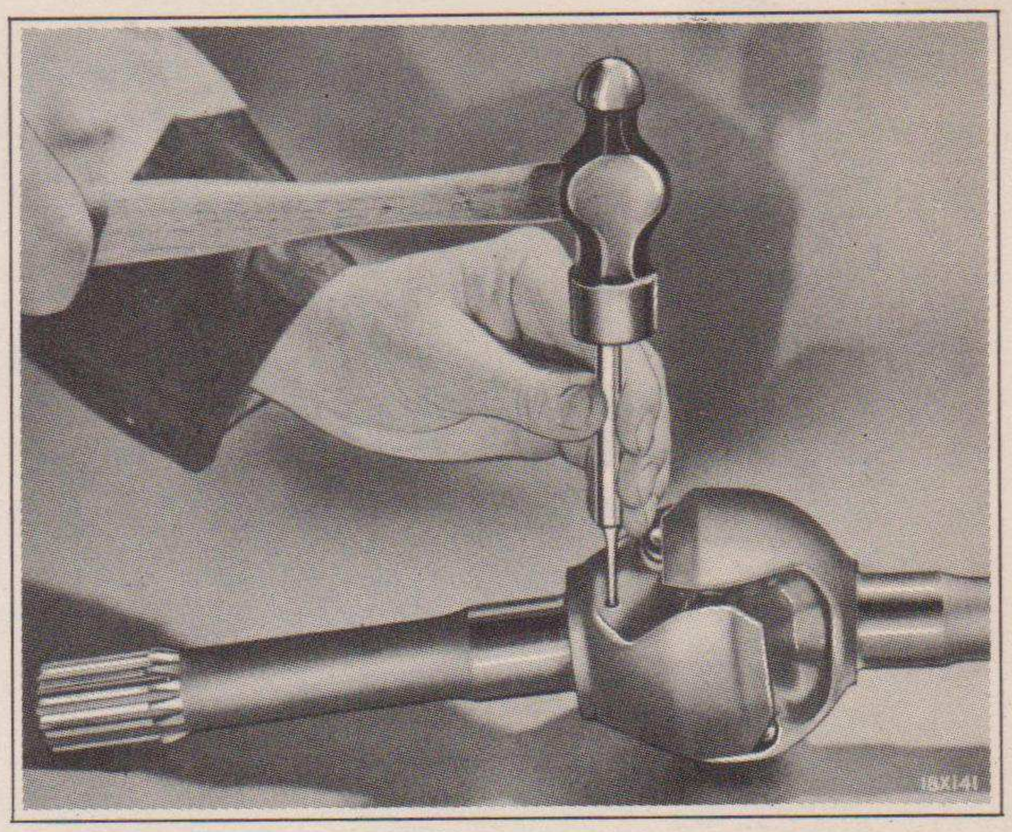


Fig. 16—Removing Universal Drive Center Ball Pin Retainer Pin (Bendix-Weiss)

(b) Drive out the center ball pin retainer pin as shown in Fig. 16.

(c) Bounce the end of the short shaft on a wooden block as shown in Fig. 17 to dislodge the center ball pin, allowing the pin to move farther in the drilled passage in the short shaft. If the lubricant holds the center ball pin in position in the ball, it may be dislodged by means of a pointed instrument inserted in the retainer pin hole.

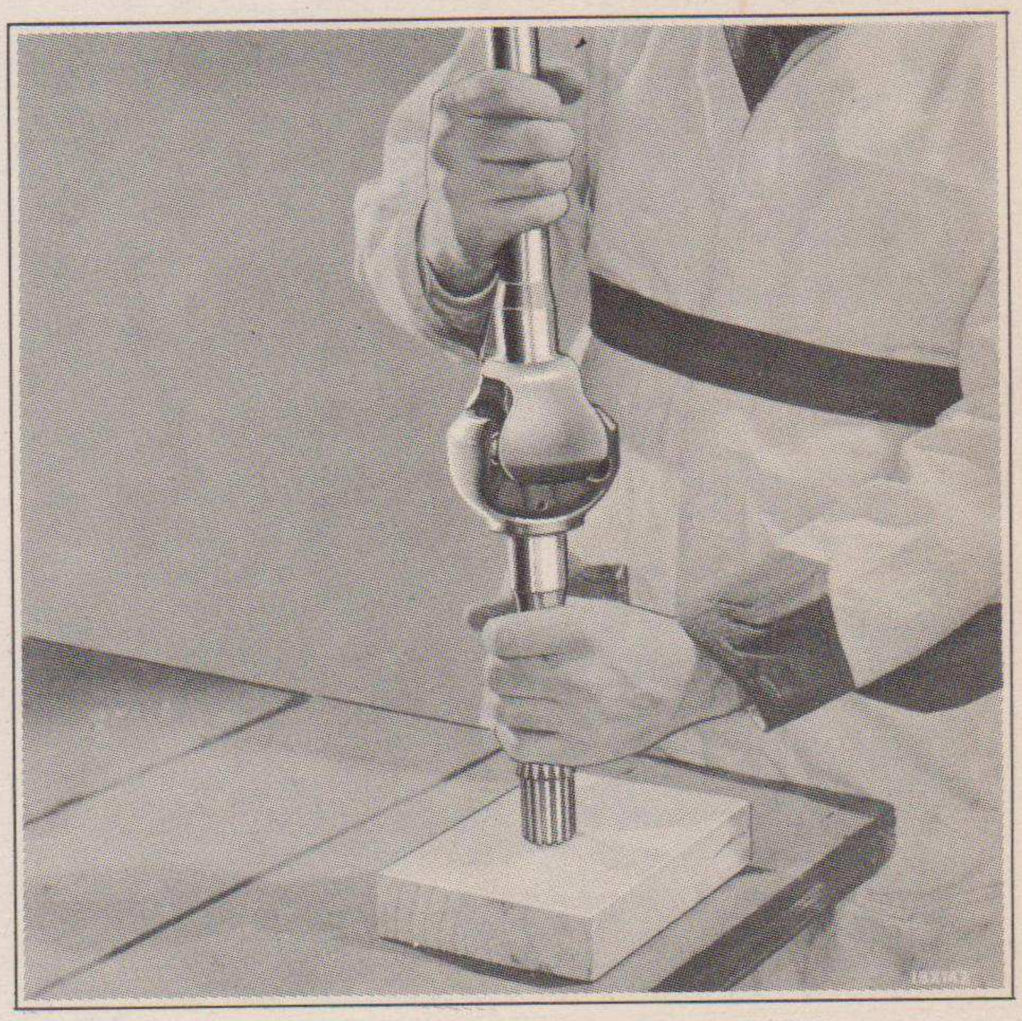


Fig. 17—Dislodging Universal Drive Center Ball Pin (Bendix-Weiss)

(d) With the assembly in a vertical position (long shaft at top), clamp the short shaft in the vise using wooden or soft metal protectors on the jaws of the vise to protect the shaft.

(e) Swing the long shaft to one side as shown in Fig. 18 and at the same time raise it slightly to pull the two sections of the assembly apart and loosen the center ball. Then turn the center ball with the fingers so that the groove in it lines up with the race, to permit the adjacent driving ball to be moved past the center ball.

(f) With the thumb and forefinger, take the driving ball out of the assembly. The remaining three balls and center ball will then drop out, allowing the two sections of the drive assembly to be separated.

(g) As the drive balls are a selective fit, it is necessary that they be replaced in the joint from which they were removed or replaced with balls of the same size, providing the various parts do not indicate excessive wear.

(h) To remove the center ball pin, turn the shaft end for end, allowing the pin to fall out.

Assembly

(a) Make sure all parts are clean and in good condition. If inspection reveals either universal joint yoke to be damaged, the complete drive assembly should be replaced. All of the remaining parts, however, may be replaced when necessary. The center ball pin, the center ball and the four driving balls should be examined and replaced if they are cracked, excessively worn or contain flat spots. Driving balls are available in seven sizes, varying from .003″ under standard size to .003″ over the standard size in steps of .001″. See "Note" page 21. The standard size is 1.000″ in diameter.

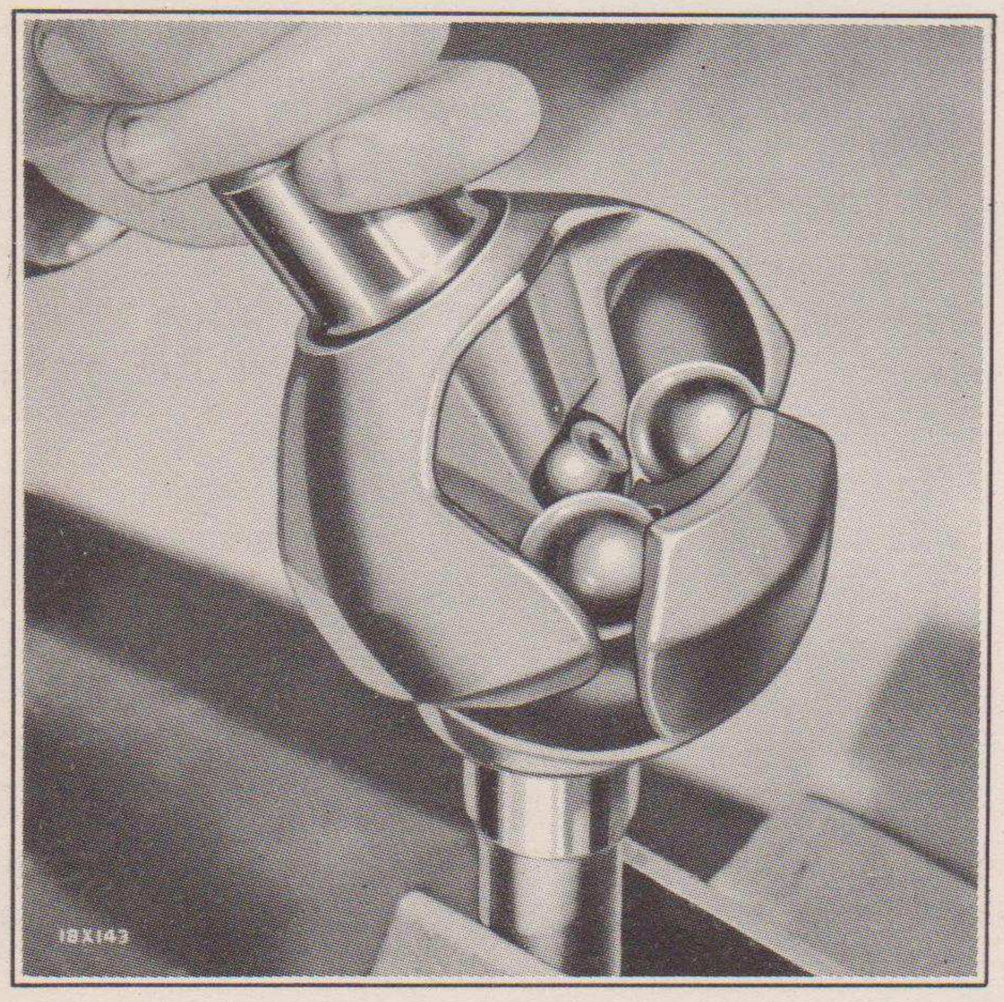


Fig. 18—Removing or Installing Universal Drive Balls (Bendix-Weiss)

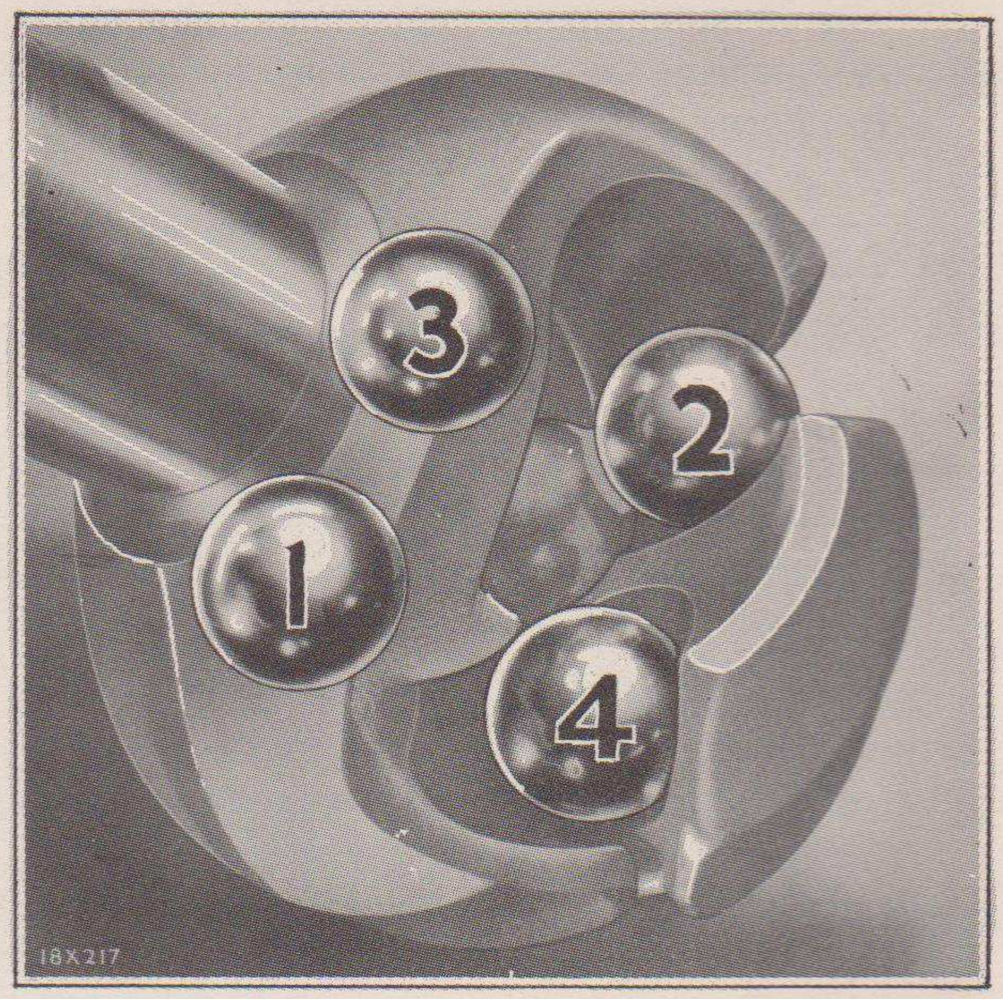


Fig. 19—Universal Drive Ball Installation Diagram (Bendix-Weiss)

Whenever the universal drive is disassembled, the drive balls must be measured with a micrometer in order to determine their correct location. This procedure should also be followed if the two sections of the universal drive assembly should come apart when it is withdrawn from the axle housing.

Selective assembly is not required when replacing the center ball or center ball pin, as these parts are supplied in one size only.

(b) If the drive balls are of different sizes, the two largest balls should be placed diagonally across from each other, as shown at 1 and 2 or 3 and 4, Fig. 19.

(c) Clamp the short shaft in a vise (use protectors on the vise jaws) with the universal joint section at the top and thoroughly clean the center ball pin hole in the inner end of the short shaft to allow the pin to move freely in the hole. Then install the pin 5, Fig. 20.

(d) Install the center ball in the socket on the end of the short shaft with the groove in the ball facing you and then place the long shaft in position on the ball.

(e) Install three of the drive balls. To install the fourth drive ball, turn the center ball to bring the groove toward the adjacent driving ball about to be installed, to permit the driving ball to be pushed into position.

(f) Straighten up the long shaft and remove the universal drive assembly from the vise and turn it end for end, clamping the long shaft in the vise with the short shaft at the top.

(g) Swing the short shaft sideways and lift it slightly to loosen the center ball and then turn the center ball to align the hole in it with the center ball pin in the end of the short shaft, allowing the pin to drop into position in the ball. It may be necessary to turn the center ball slightly to align the hole with the pin.

(h) Install a *new* retainer pin in the joint end of the short shaft. See Fig. 20. Then remove the assembly from the vise and center punch both ends of the retainer pin to hold it in position.

Note: If play develops from wear, in a universal drive assembly where the ball races are in good condition, the difficulty may be remedied through the installation of larger drive balls, as follows:

(a) With the universal drive disassembled, measure the drive balls with a micrometer to determine the size of each ball.

(b) Select one or two new balls .001″ larger than the smallest ball originally used in the assembly. Reassemble the universal drive with the new ball or balls and the two or three largest original balls.

(c) Clamp the long shaft of the assembly in a vise.

(d) Install the drive shaft screw 25, Fig. 12 in the end of the short shaft. Then firmly push the two sections of the drive assembly together. This will apply a tension on the drive balls if the balls are not too small.

(e) To determine the desired preload, attach a pull scale to the drive shaft screw and note how many pounds pull is required to move the short shaft sidewise. If the pounds pull required to move the short shaft is less than 10 to 15 pounds, larger balls must be used, repeating operations (a) and (b).

The desired preload should be measured with the spring scale over a range of 20° to 25° on one side of the straight position of the joint assembly to 20° to 25° on the other side. Normally, the preload will be less at the point where the joint is in a straight position.

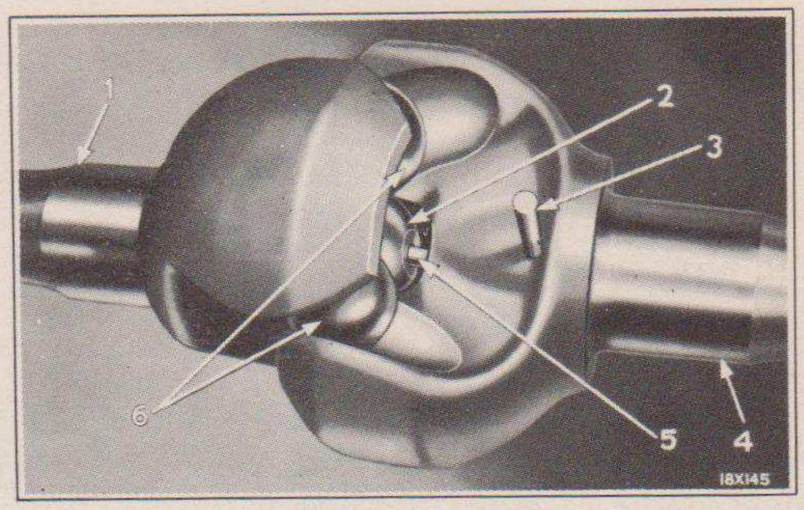


Fig. 20—Installing Universal Drive Center Ball Pin Retainer Pin (Bendix-Weiss)

1—Universal drive shaft (inner splined shaft or driving yoke)
2—Universal drive center ball
3—Universal drive center ball pin retainer pin
4—Universal drive shaft (outer splined shaft or driven yoke)
5—Universal drive center ball pin
6—Universal drive outer balls

Lubricate the drive unit as specified in the "Lubrication" section of this manual. Flex the drive while lubricating it so as to insure lubricant reaching all working surfaces of the balls and ball races.

The front axle universal drive assembly is now ready to be installed in the front axle housing and the wheel hub and various other parts assembled in their normal position.

35—Rzeppa Universal Drive Assembly

The Rzeppa universal drive (see Fig. 21) is of the constant velocity type and is interchangeable with the Bendix-Weiss universal drive previously covered.

There is no thrust button on the inner end of the drive shaft used with the Rzeppa universal drive. However, a total of .052″ in shim stock (2, Fig. 11) is placed between the outer shaft drive flange and the wheel hub, to provide correct operating position of the universal drive assembly. There are two .020″, one .007″ and one .005″ shims used on each side of the truck. If necessary to replace the shims make sure the correct thickness shims are used.

Unlike the Bendix-Weiss universal drive, the alignment of the Rzeppa unit is not

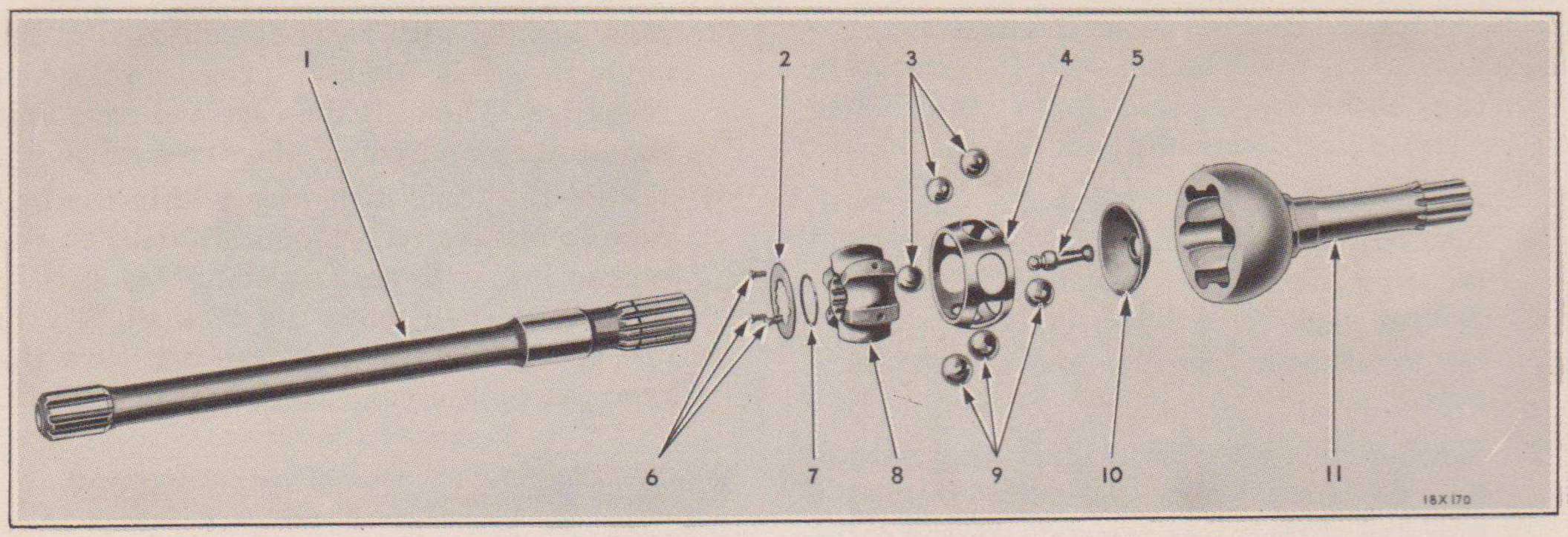


Fig. 21—Rzeppa Universal Drive

1—Shaft (inner splined shaft)
2—Retainer
3—Balls
4—Ball cage
5—Pilot pin
6—Retainer screws
7—Snap ring
8—Ball inner race
9—Balls
10—Pilot
11—Outer race bell (or outer splined shaft)

affected by the replacement of axle parts or by differential adjustments.

Disassembly

(a) After removing the universal drive assembly as outlined in Subject 33, clean the parts thoroughly to facilitate disassembly.

(b) Clamp the short shaft in a vise with the splined end down. Use wooden or soft metal protectors on the jaws of the vise to protect the shaft.

(c) Remove the drive shaft retainer screws.

(d) Pull the drive shaft out of the inner ball race and take off the snap ring and retainer if desired.

(e) Remove the pilot pin (Fig. 22), which is located at the inner end of the outer shaft.

(f) With the first two fingers of either hand, tilt the inner ball race and ball cage assembly as far as possible to bring one of the balls at the top of the raceway, as shown in Fig. 23, and at the same time cock the race and cage assembly slightly to one side to release the ball and allow easy removal of it. Remove the remaining balls in the same manner.

CAUTION: The universal drive should be

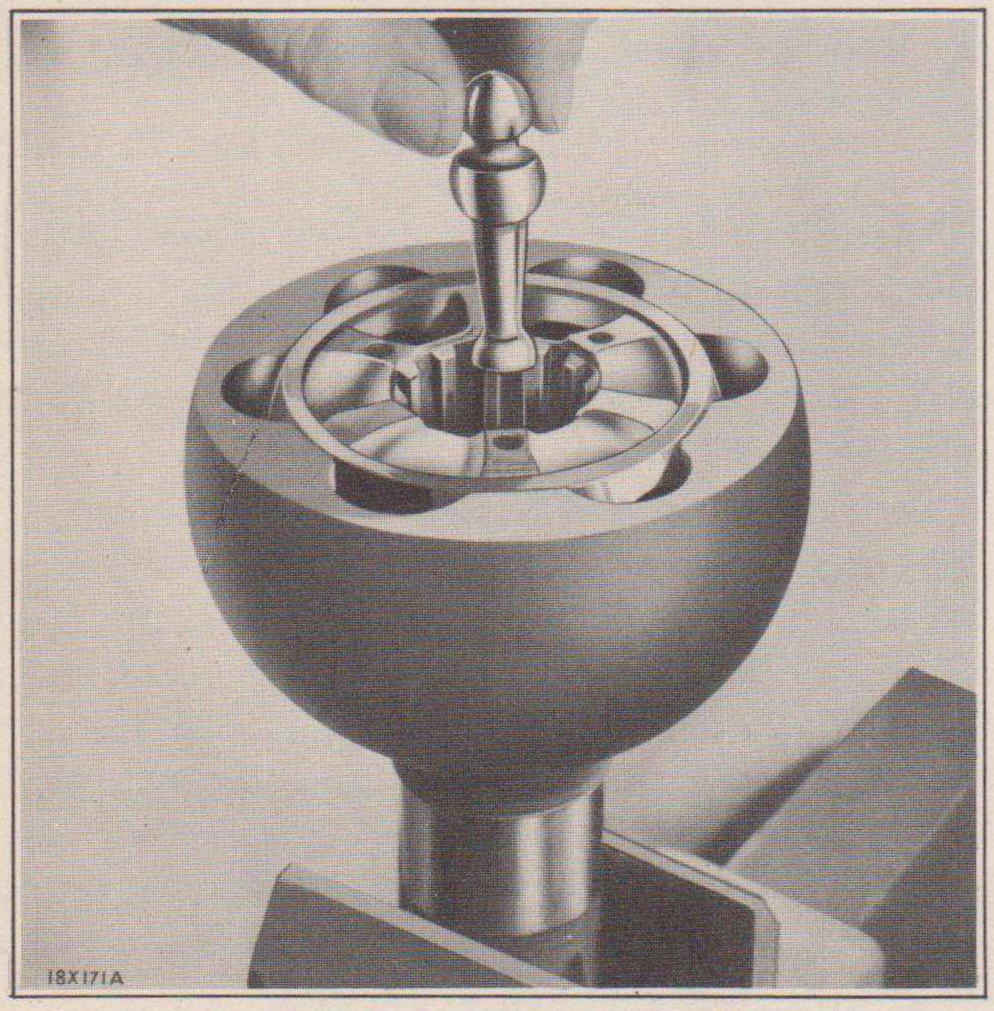


Fig. 22—Removing or Installing Universal Drive Pilot Pin (Rzeppa)

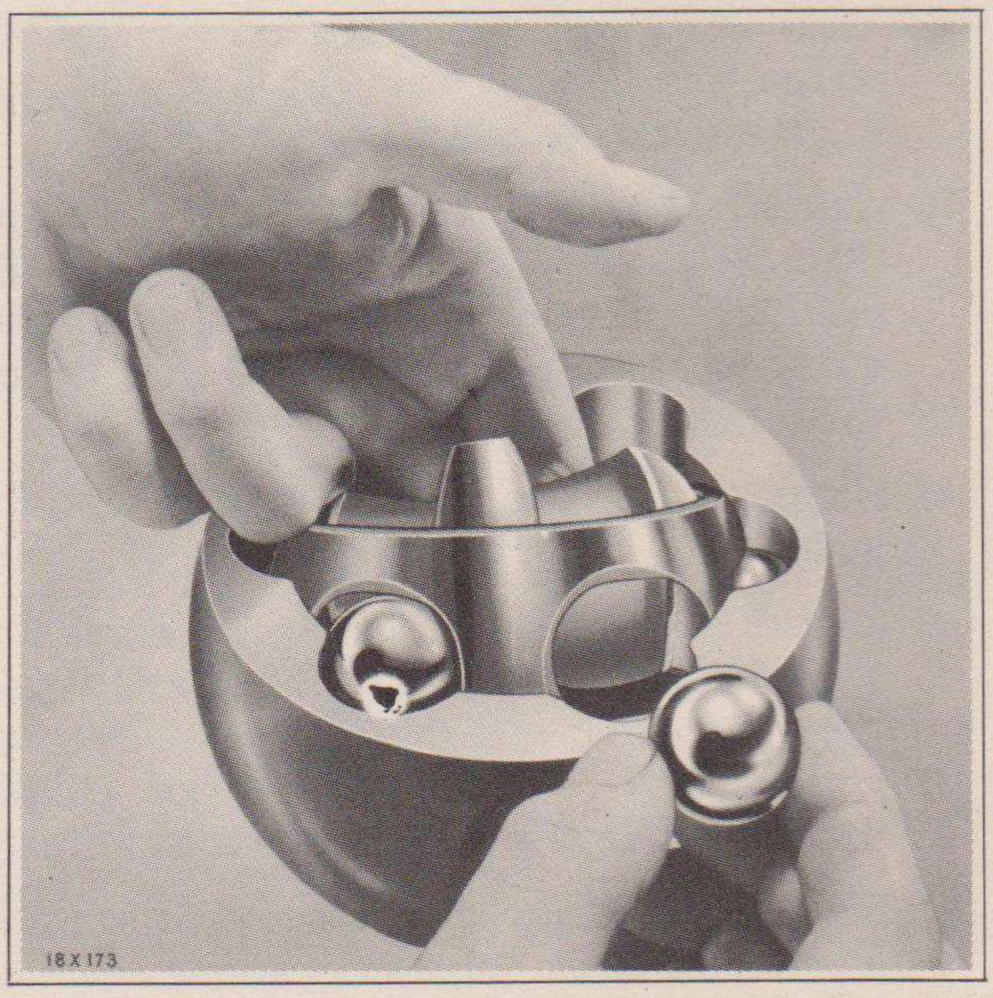


Fig. 23—Removing Universal Drive Ball (Rzeppa)

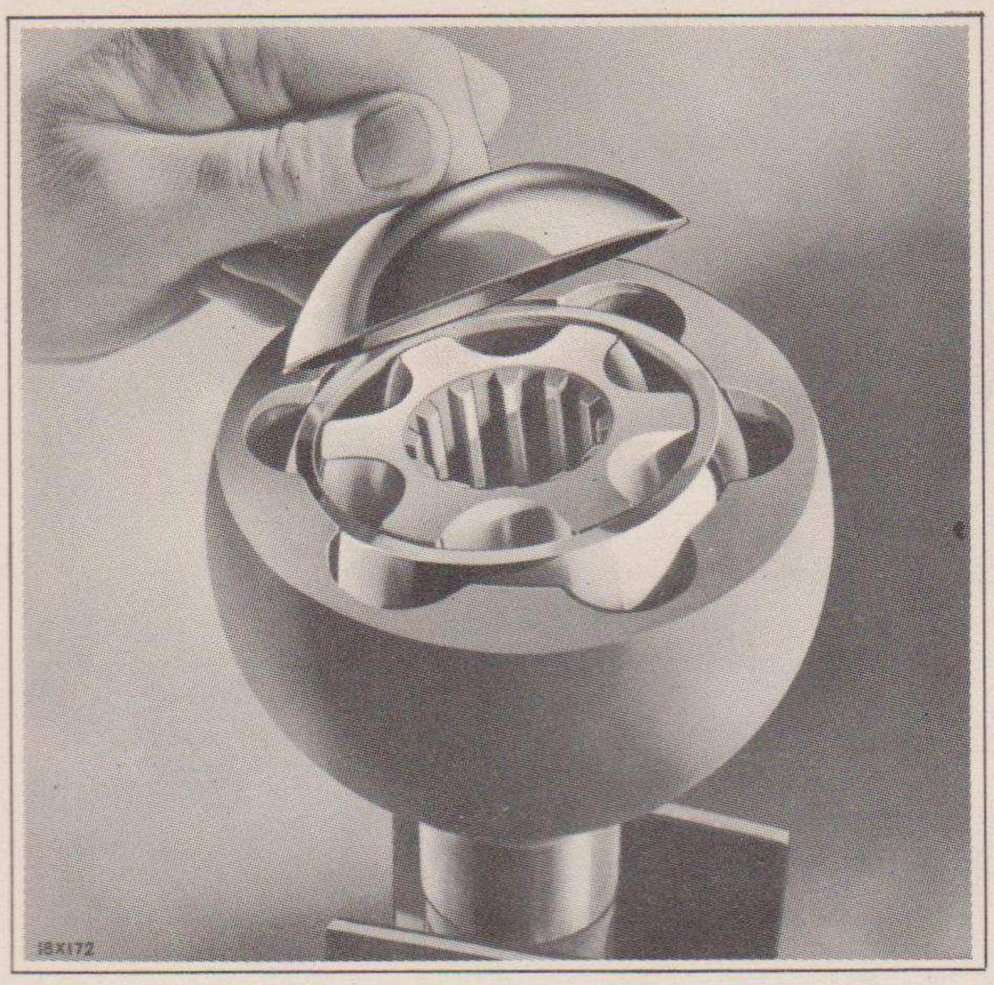


Fig. 24—Removing Universal Drive Pilot (Rzeppa)

disassembled without any binding. Do not force or jam the parts. If binding does occur, move the parts back to their normal position and proceed as before with one of the other balls.

(g) **Rotate the race and cage unit to bring the** pilot at the top and remove the pilot as **shown in Fig. 24.**

(h) **Rotate the race and cage unit back part** way, as shown in Fig. 25, to bring the two elongated slots on opposite sides of the ball cage parallel with two opposite ribs in the outer race bell, which are between the ball raceways. Then lift the race and cage unit straight up and out of the drive unit.

(i) Rotate the inner ball race within the ball cage to bring any two opposite ribs on the race in line with the two elongated slots in the cage. Then move the race slightly in one of the slots in the cage and turn the race out of the cage as shown in Fig. 26.

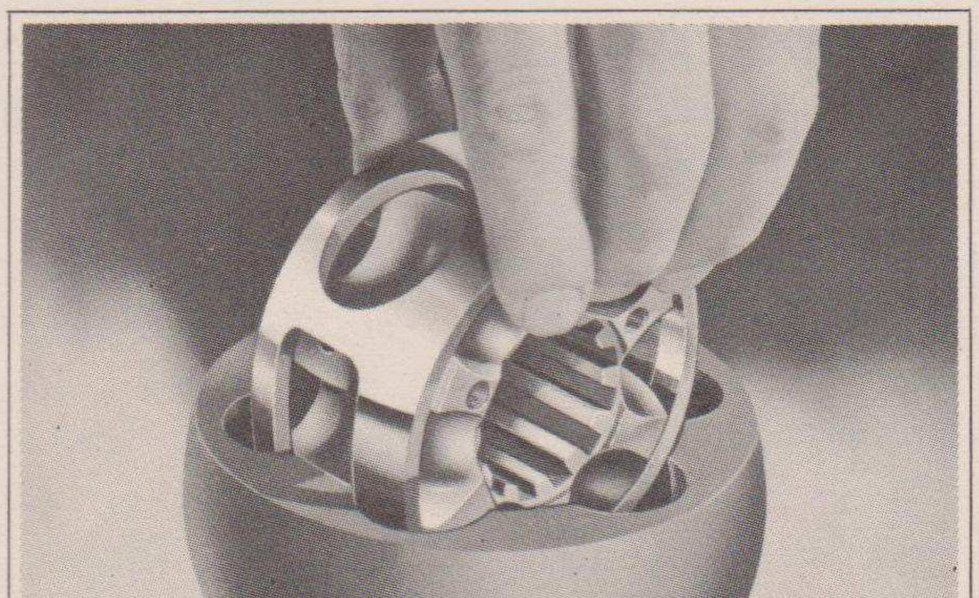


Fig. 25—Removing Universal Drive Inner Race and Ball Cage (Rzeppa)

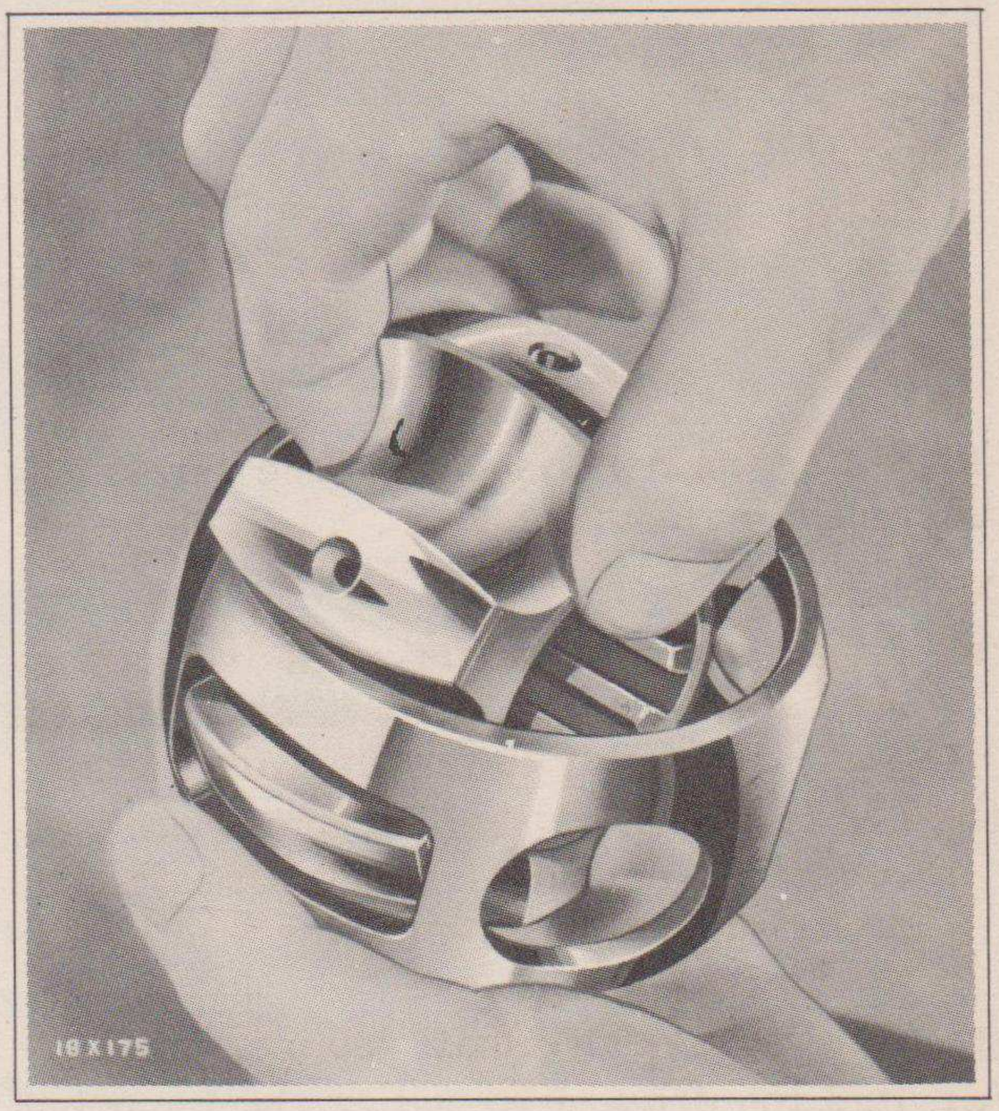


Fig. 26—Removing Universal Drive Inner Race from Ball Cage (Rzeppa)

Assembly

(a) Make sure all parts are clean and in good condition. Inspect the balls for cracks or flattened spots and the raceways for scores. Lightly lubricate all parts as they are being assembled.

(b) Clamp the drive unit (short shaft) in a vise with the splined end down. (Use protectors on the vise jaws.)

(c) Assemble the inner ball race in the ball cage by lining up any two opposite ribs on the race with the two elongated slots in the cage and rotating the race in position in the cage. Then rotate the race to line up the two sides of both units.

(d) Install both the race and cage in the drive unit by rotating this assembly sufficiently to allow the two elongated slots in the cage to slide down over any two opposite ribs between the raceways in the drive unit.

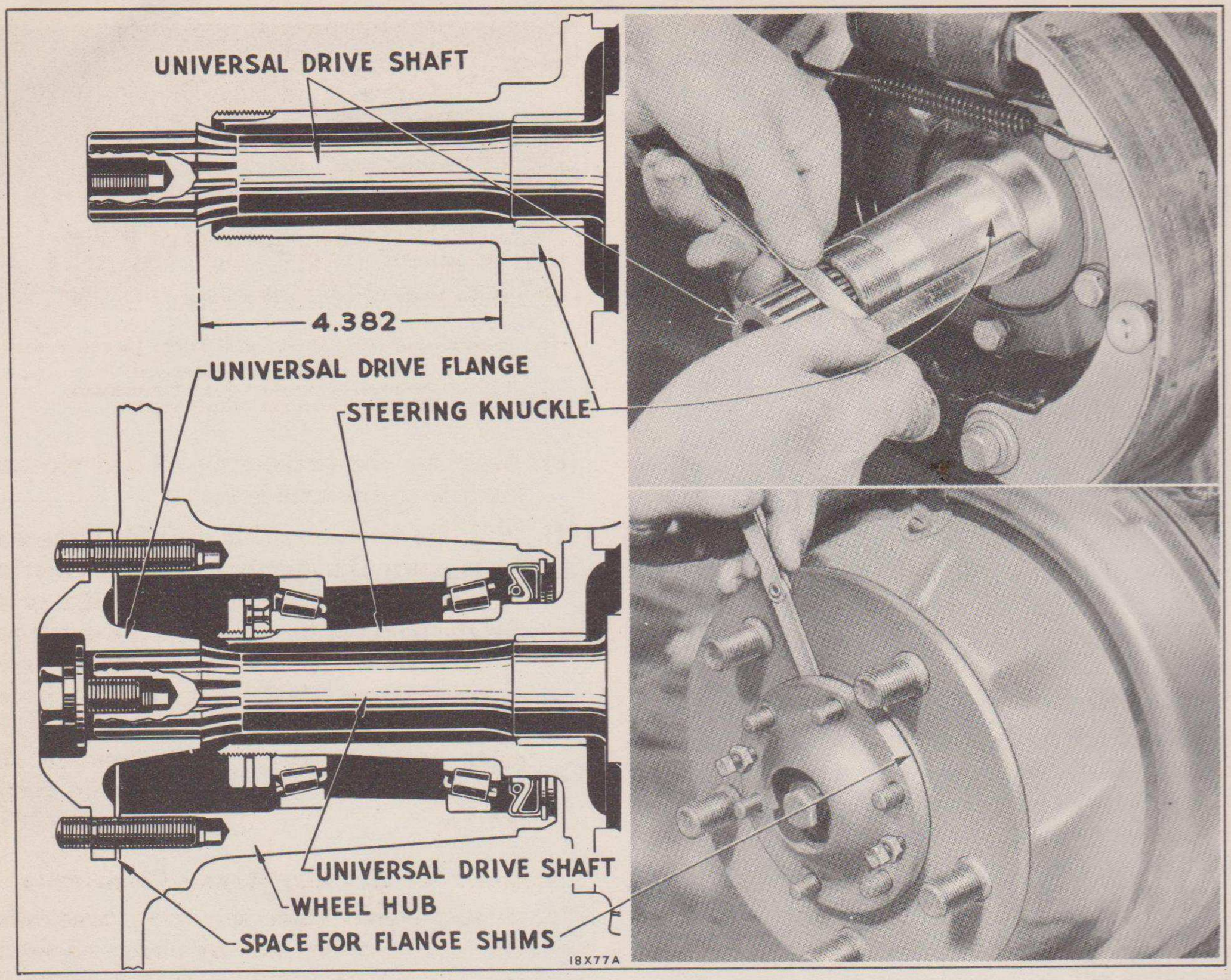


Fig. 27—Front Axle Shaft End-Play Adjustment (Bendix-Weiss only)

(e) Rotate the race and cage unit to bring the bottom of the race at the top and install the pilot, after which rotate the assembly to its normal position with the pilot at the bottom and the screw holes in the race at the top as shown in Fig. 22.

(f) With the first two fingers of either hand, tilt the race and cage assembly to bring one of the ball sockets in the cage in line with one of the raceways in the drive unit and toward the top sufficiently to allow the ball to drop into place. The inner race and cage unit should also be cocked slightly to permit easy installation of the ball.

(g) Tilt the race and cage assembly to the other five positions in turn to install the remaining balls.

(h) Install the pilot pin (Fig. 22), making sure the flatened ball is inserted down.

(i) With the snap ring and retainer in position on the drive shaft, install the drive shaft making sure the snap ring is down into the inner race counterbore. Then install the shaft retainer screws and lock with prick punch on both ends of screwdriver slot.

When installing the Rzeppa universal drive assembly in the truck refer to instructions at the beginning of this subject.

36—Front Axle Universal Drive Assembly Adjustments (Bendix-Weiss only)

The front axle universal drive assemblies are designed so the universal joints will oscillate around the same axis as the steering knuckle trunnion pins (king pins). This operating position is adjustable only with the Bendix-Weiss universal drive installation. Consequently, the

alignment of this type drive is affected by replacement of the universal drive assembly, steering knuckle, axle housing, differential parts or sidewise adjustment of the drive gear.

Whenever any of these parts are replaced, the operating position of the universal drive should be checked and corrected, if necessary, before driving the truck. Whenever the differential drive gear or bearings are adjusted sidewise, both axle shaft assemblies should be pulled out of the housing far enough to permit making the differential adjustment. Then, when the differential adjustment is completed, each universal drive assembly should be adjusted for correct location.

To check the universal drive location, the wheel hub assemblies must be off the steering knuckles. If these assemblies are already in position, they can be removed as explained in Subject 44, but without removing the bearing cups, the inner bearing cone and rollers and the inner oil seal from the wheel hub.

With an accurate steel rule or depth gauge, measure the distance from the steering knuckle flange inner bearing shoulder to the flat shoulders of the splines at the outer end of the axle shaft as shown in Fig. 27. This measurement should be 4.382″ or a full 4⅜″.

Adjustment for Location (Bendix-Weiss only)

Adjustment for correct operating position of the Bendix-Weiss universal drive assembly is made by removing or installing shims between the inner end of the axle shaft and the thrust button. See Fig. 28. To make this adjustment proceed as follows:

(a) Remove the steering knuckle and brake support. It is unnecessary to disconnect the brake hose to remove the brake support.

(b) Pull out the universal drive assembly as shown in Fig. 13, after first making sure that the steering knuckle flange is straight with the axle housing or in the normal position with the front wheel straight ahead.

(c) Place shims between the inner end of the shaft and the thrust button. The total thickness of these shims to start checking should be about $\frac{3}{16}$″. (If replacing a shaft assembly, use shims taken from the shaft being replaced.) Make certain that the thrust button is pushed in as far as it will go and that the shims are not loose.

(d) Install the universal drive assembly, making certain that it is in as far as it will go.

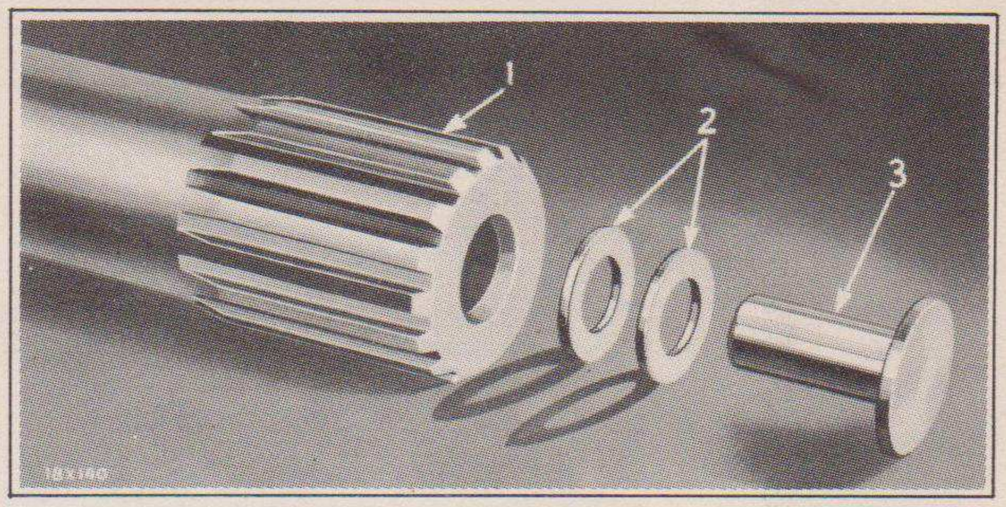


Fig. 28—Universal Drive Shaft Thrust Button (Bendix-Weiss)

1—Universal drive inner splined shaft
2—Universal drive shaft thrust button shims
3—Universal drive shaft thrust button

(e) Assemble the brake support and steering knuckle to the axle housing.

(f) With the drive assembly pushed all the way in, measure the distance from the steering knuckle flange inner bearing shoulder to the flat shoulders of the splines at the outer end of the drive shaft. See Fig. 27. If the measurement is not 4.382″ or a full 4⅜″, it can be corrected by removing or installing the necessary amount of shims between the inner end of the drive shaft and the thrust button.

Adjustment for End Play (Bendix-Weiss only)

The Bendix-Weiss universal drive assemblies are adjustable for end play by means of shims between the wheel hub and the drive shaft flange. This adjustment is made in the following manner:

(a) Install the wheel hub and drive shaft flange, leaving off the flange retaining nuts and washers and the shims between the hub and the flange.

(b) Install the drive shaft screw so as to firmly seat the flange against the shoulders of the drive shaft splines. Also make certain that the hub is properly tightened against the bearings.

(c) Force the drive shaft flange in toward the hub as far as possible to eliminate the end play in the universal drive assembly by butting the inner end of the drive shaft against the differential pinion shaft. This can be accomplished by driving lightly on the flange with a lead mallet.

(d) With the flange and drive assembly forced inward as far as it will go, measure with a feeler gauge, the space between the drive shaft flange and the wheel hub as shown in Fig. 27.

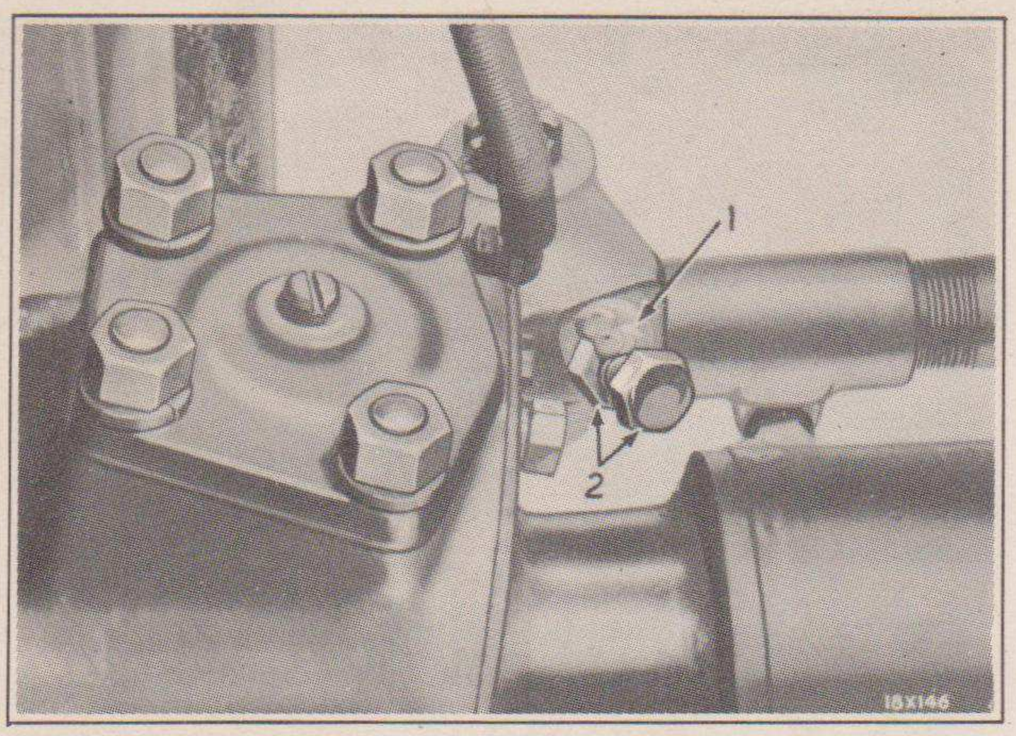


Fig. 29—Steering Knuckle Stop Screw
1—Weld 2—Steering knuckle stop screw and nut

(e) Remove the drive shaft flange.

(f) Add .020″ to the total dimension just determined with the feeler gauge and install that amount of shims between the drive shaft flange and the hub. This will establish the required .020″ end play or float in the assembly, which is necessary to prevent binding in the universal drive assembly.

37—Steering Knuckle Stop Screws

The steering knuckle stop screws are adjusted at the factory to allow each front wheel a turning angle of 28° (—0° to +1°) when on an inside turn. These stop screws are then arc welded in position, as shown in Fig. 29, and the adjustment cannot be altered. The turning angle of the front wheels can be checked with a turn-table or by means of chalk marks on the floor representing the straight ahead and turned positions of the wheels.

To determine the turning angle with chalk marks, first set the front wheels in a straight ahead position. Then draw a straight forward line on the floor just in front of the wheels to represent this position of the wheels. Next turn the wheels to the extreme right and mark the floor to show this position of both wheels, after which turn the wheels to the extreme left and again mark the floor to show this third position of the wheels. All of these wheel positions are clearly illustrated with lines representing the chalk marks in Fig. 30.

When the front wheels are turned to the extreme left, the left wheel is on the inside of the turn and should have turned through an angle "A" of 28° (—0° to +1°). With the wheels turned to the extreme right, the right wheel is on the inside of the turn and it, too, should have turned an angle "B" of 28° (—0° to +1°) from the straight ahead position.

If the turning angle of the front wheels is found to be more or less than the amount specified, it is an indication that some part is bent or otherwise damaged and should be replaced. The above described turning angle must not be confused with the turning angle of either wheel when on the outside of the turn, as this turning angle is less and is not to be considered in checking the adjustment of the stop screws.

If the turning angle is greater than that specified, it will be possible to cramp the front wheels to a more acute angle than that for which the universal drives are designed, thereby bringing about excessive strain and possible destruction of the front axle drive assembly.

38—To Remove Broken End of Front Axle Drive Shaft

(a) Perform all of the operations listed in Subject 33.

(b) If the break is less than about 4″ from the inner end of the shaft, it will be necessary to remove the differential carrier assembly as outlined in Subject 60, to remove the short section of the shaft. If the break is more than 4″ from the inner end, the inner section of the shaft can be snared out through the housing with a wire loop, after removing the inner oil seal.

When removing a Bendix-Weiss drive in this manner, check to make sure that the thrust button and shims are in position at the inner end of the shaft. If not, it will be necessary to re-

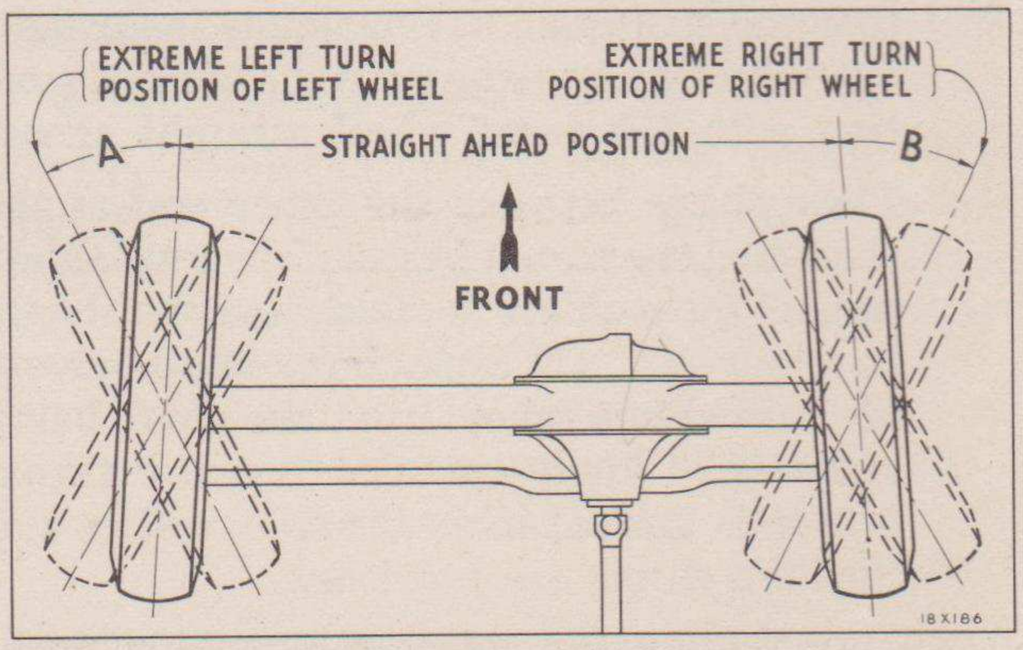


Fig. 30—Turning Angle

move the differential carrier assembly to recover these parts.

When installing the new universal drive assembly, check the various adjustments as covered in Subject 36 and make sure that the necessary lubricant is added.

39—Differential Carrier Assembly

(See "Differential Carrier Assembly" on page 43)

40—Steering Knuckle Flange Bearings

Each steering knuckle is supported by two bearings mounted on pins at the top and bottom of the ball end of the axle housing. While these pins are welded in position, they can be replaced with new ones which are available from the Chrysler Corporation Parts Division. The top bushing is keyed to the trunnion socket bearing pin, while a tapered roller bearing is used at the bottom pin.

Removal

(a) Remove the front wheel and hub assembly as outlined in Subject 43. In the present operation, however, it is not necessary to remove the bearing cups, the inner bearing cone and rollers and the inner oil seal from the wheel hub.

(b) Disconnect the tie-rod end from the steering knuckle lower flange. See Subject 45.

(c) Pull out the universal drive assembly as outlined in Subject 33, after first making sure the steering knuckle flange is straight with the axle housing or in the normal position with the front wheel straight ahead.

(d) Drive out the dowel pin at each side of the steering knuckle flange.

(e) Remove the four bolts (2 each side) holding the upper and lower halves of the flange together, and dismount the flange parts.

(f) Pull the top and bottom bearing cones off the trunnion socket bearing pins on the ball end of the axle housing with a bearing puller. See Fig. 31.

(g) Press the cups out of the flange or drive them out with a brass drift.

Installation

When reinstalling the steering knuckle assembly, first place the upper and lower halves of the knuckle flange in position on the ball end of the axle housing and install the two dowel pins. Then complete the assembly operations and check the adjustment of the knuckle bearings as covered in Subject 41.

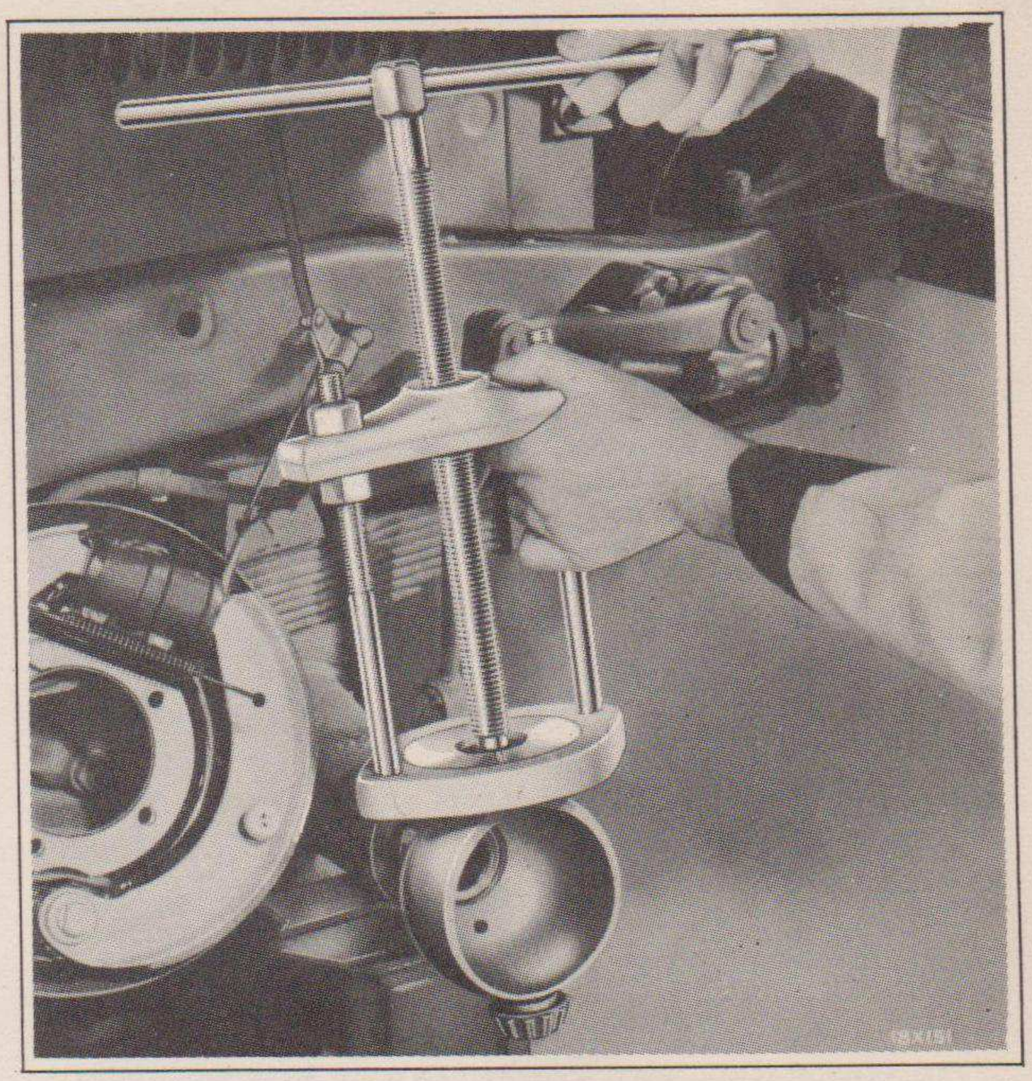


Fig. 31—Removing Steering Knuckle Flange Bearings (Tool C-293-U)

Replacing Front Axle Trunnion Socket Bearing Pins

In the event a trunnion socket bearing pin breaks away from the axle housing, replace it with a new one as follows:

(a) Remove the steering knuckle flange as outlined under the sub-heading "Removal" in this subject and take out the broken pin. Dress up the pin hole in the ball end of the axle housing if necessary.

(b) Install the new pin in position on the end of the housing and then reinstall the steering knuckle flange and flange bearings to keep the pin in position.

(c) Tack-weld the pin at the inner end of the axle housing.

(d) Remove the steering knuckle flange and flange bearings.

(e) Finish welding the pin to the housing and dress the inside of the housing ball with a portable grinder.

(f) Install the steering knuckle flange and wheel assembly as covered under the heading "Installation" in this subject.

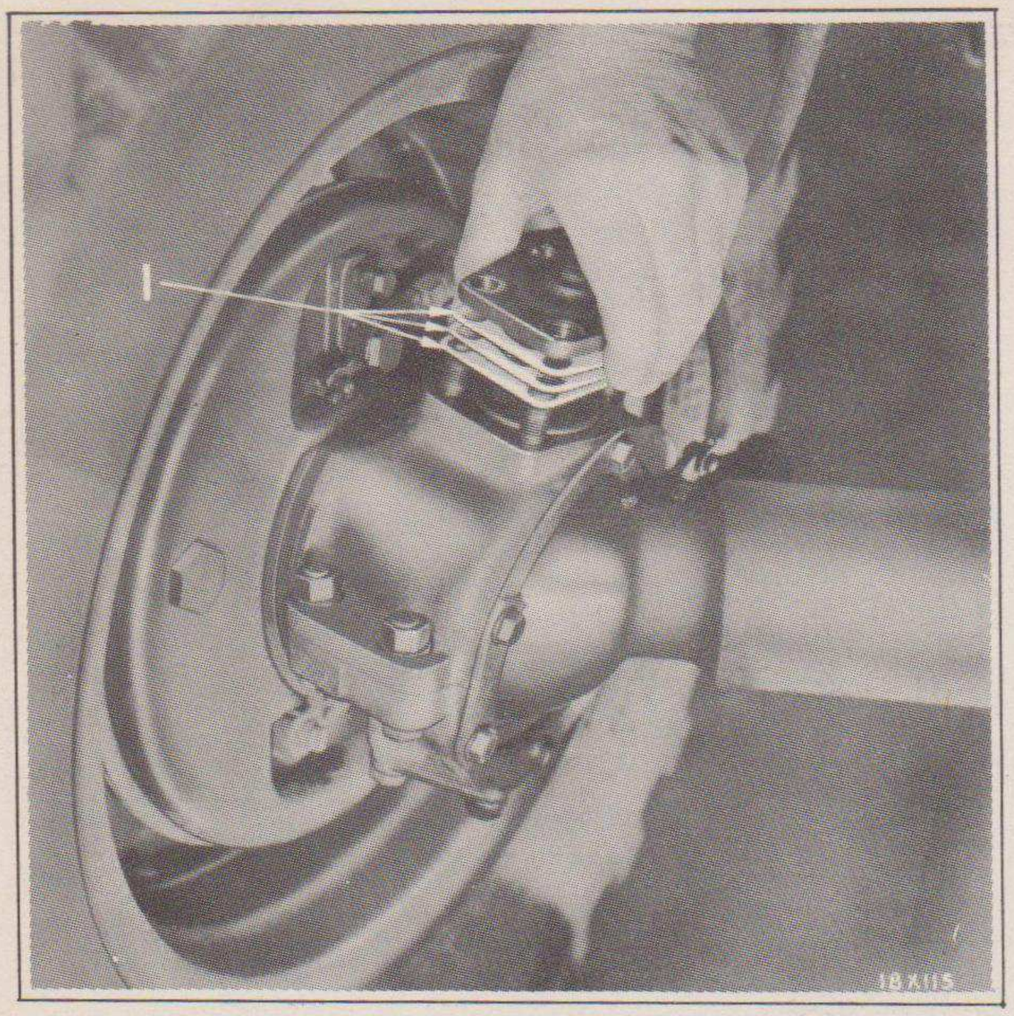


Fig. 32—Steering Knuckle Flange Bearing Adjusting Shims

41—Adjustment of Steering Knuckle Flange Bearings

(a) After jacking up the front wheel, remove the wheel and disconnect the tie-rod as outlined in Subject 45.

(b) Remove the retaining cap screws and lock washers at the top bearing. If working on the left wheel, also disconnect the drag link from the steering knuckle flange.

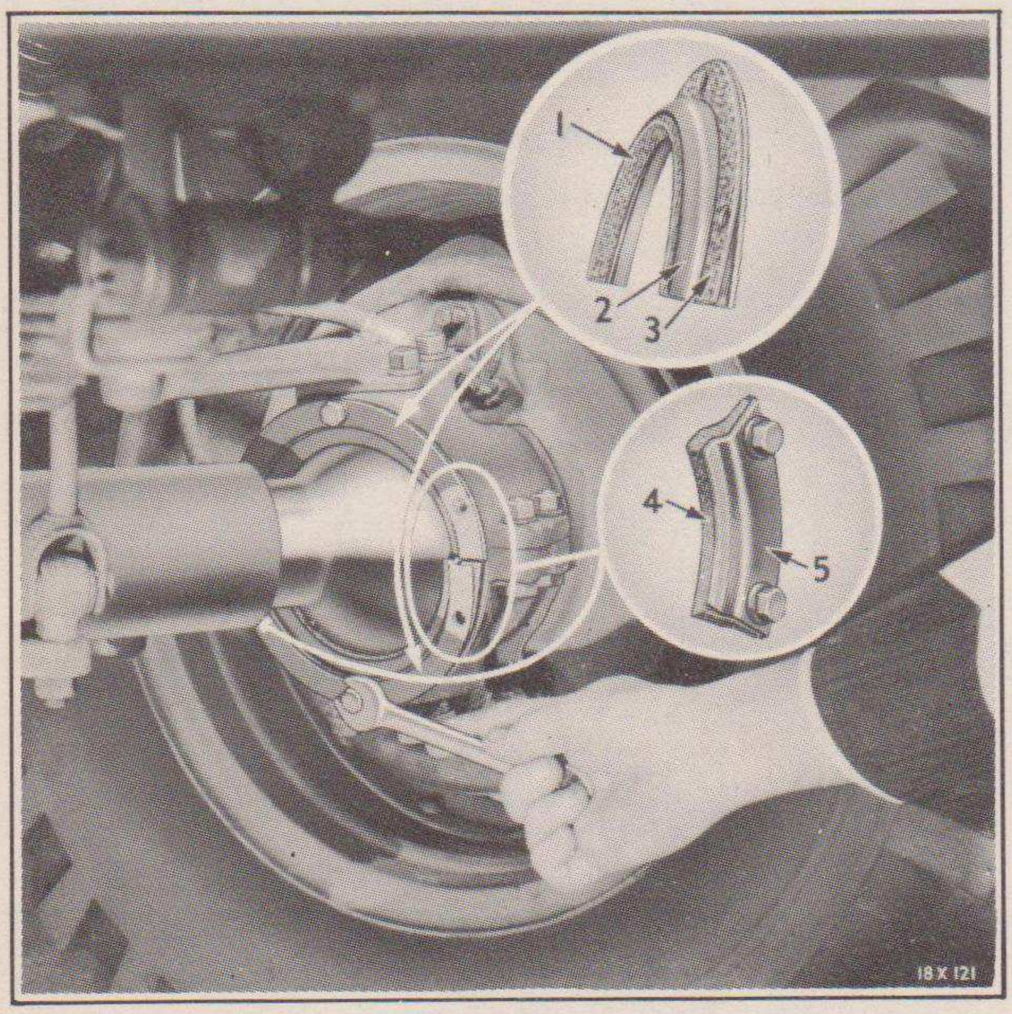


Fig. 33—Removing Steering Knuckle Flange Oil Seals

1—Steering knuckle flange oil seal
2—Steering knuckle flange oil seal retainer
3—Steering knuckle flange oil seal retainer gasket
4—Steering knuckle flange joint oil seal
5—Steering knuckle flange joint oil seal retainer

(c) Adjustment of the steering knuckle flange bearings is made by means of the shims between the top bearing cap and the steering knuckle flange. See Fig. 32. Remove shims to tighten or add shims to loosen the bearings. The bearings should be adjusted first so there is no end (up and down) play in the steering knuckle assembly but with sufficient freedom to oscillate freely by hand. Make sure that bearing caps and bearings are seated by tapping with a soft hammer or mallet. Then remove the bearing cap and reduce the total thickness of the shim pile .005". After this is done, there should be a perceptible drag felt when oscillating the knuckle by hand but it should not bind.

(d) Install the tie-rod and wheel.

42—Replacing Steering Knuckle Flange Oil Seal

(a) Remove the cap screws attaching the oil seal retainer to the steering knuckle flange.

(b) Remove the two retainer joint oil seal retainers together with the upper and lower halves of the oil seal retainer. See Fig. 33.

Before installing the oil seal assembly, carefully examine the ball on the outer end of the front axle housing for roughness and scratches that would damage the seal. If such imperfections are found to exist, smooth them down with fine emery cloth.

When installing the oil seals, make sure the ends of the felts line up with the ends of the retainers. It is also good practice to replace the retainer gaskets to prevent lubricant leakage.

If a truck is to remain standing outdoors for an extended period of time, a coating of grease should be applied to the exposed portion of the ball ends of the axle housing surrounding the universal joints, to prevent rusting. These surfaces are machined and cannot be painted or rustproofed because they move against oil seals when the front wheels are turned for steering the truck. Rusty surfaces would rapidly destroy the oil seals and allow lubricant to be lost from the universal joints. These surfaces are lubricated automatically when the truck is in operation.

43—Front Wheel Hub Bearings

Removal

(a) After jacking up the wheel, remove the nuts

which hold the wheel to the hub, using special wrench No. DD-812.

(b) Lift off the wheel and tire assembly.

(c) Remove the nuts (and lock washers) which hold the axle drive flange to the hub.

(d) Remove the front axle drive shaft screw.

(e) Pull out the hub drive flange by loosening the lock nuts on the two pusher screws in the flange and turning the screws in as shown in Fig. 34.

Care must be used to preserve the number and condition of the shims.

(f) Unscrew the wheel bearing outer adjusting nut, using special tool DD-824, as shown in Fig. 35, and remove the inner adjusting nut lock.

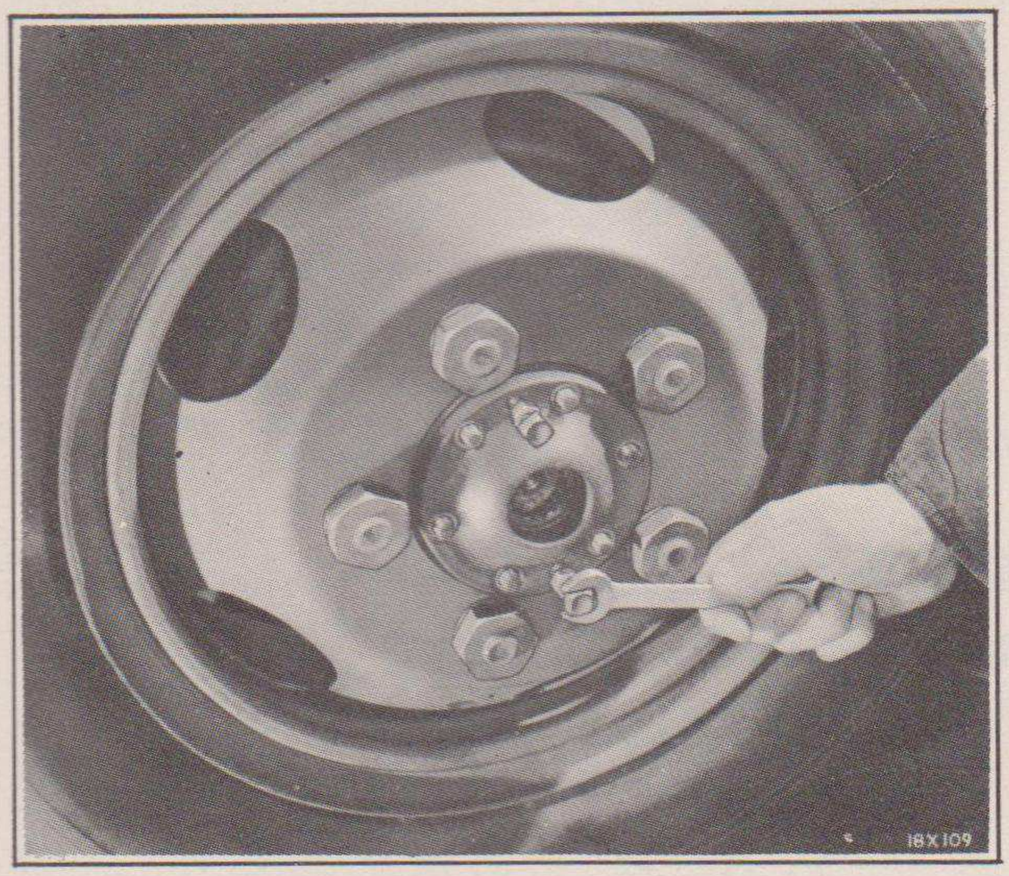


Fig. 34—Removing Drive Flange with Puller Screws

(g) Unscrew and remove the bearing inner adjusting nut.

(h) Pull off the hub and brake drum assembly, using special tool DD-423, as shown in Fig. 36, and then remove the outer bearing cone and rollers.

(i) Remove the oil seal retainer snap ring.

(j) Using a drift, drive out the inner bearing cone and rollers and the oil seal. Inspect the oil seal for wear and possible damage.

(k) Drive out the inner and outer bearing cups, removing the inner cup from the inner end of the hub and the outer cup from the outer end of the hub.

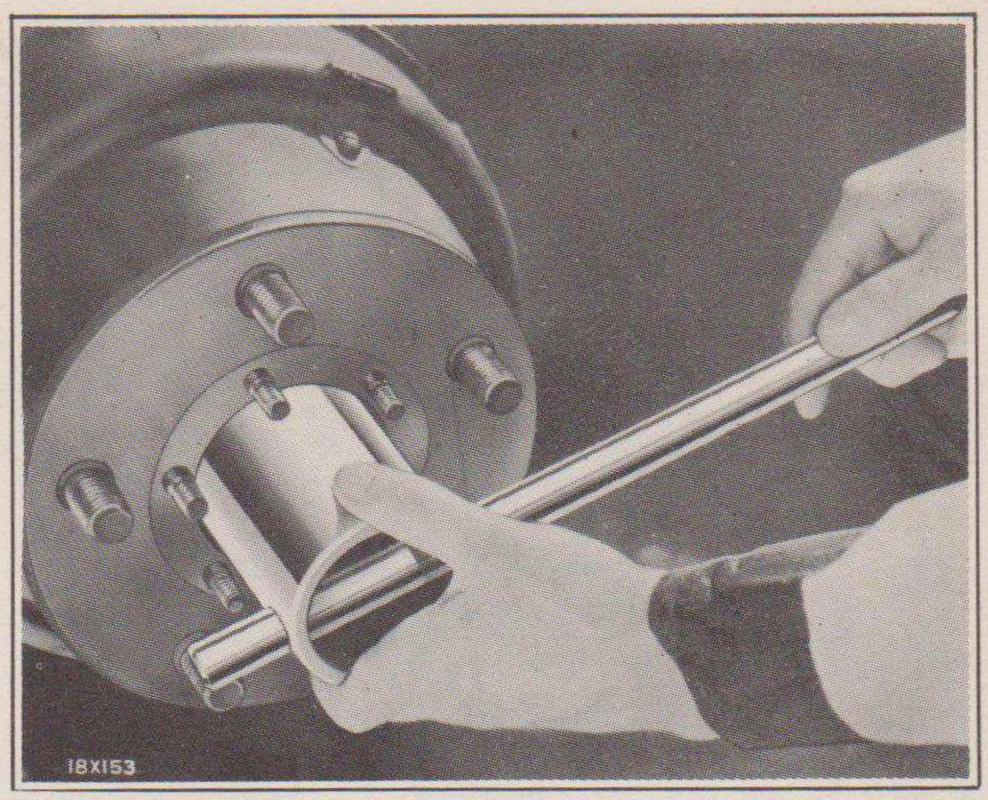


Fig. 35—Removing Front Wheel Bearing Adjusting Nuts or Adjusting Bearings (Tool DD-824)

Installation

Before assembling the bearings in the front wheel hub, make sure all old lubricant is removed and the various parts are clean and in good condition. Then install the inner and outer bearing cups, driving them in place with a drift. Make sure the cups are correctly installed with the thick edge toward the center of the wheel hub. Next coat the inner bearing cone and rollers with short fibre wheel bearing grease (medium) and assemble them in the inner cup, after which install the oil seal with special tool DD-808. See Fig. 37. Then install the oil seal retainer snap ring. Place a quantity of wheel bearing lubricant in the hub between the bear-

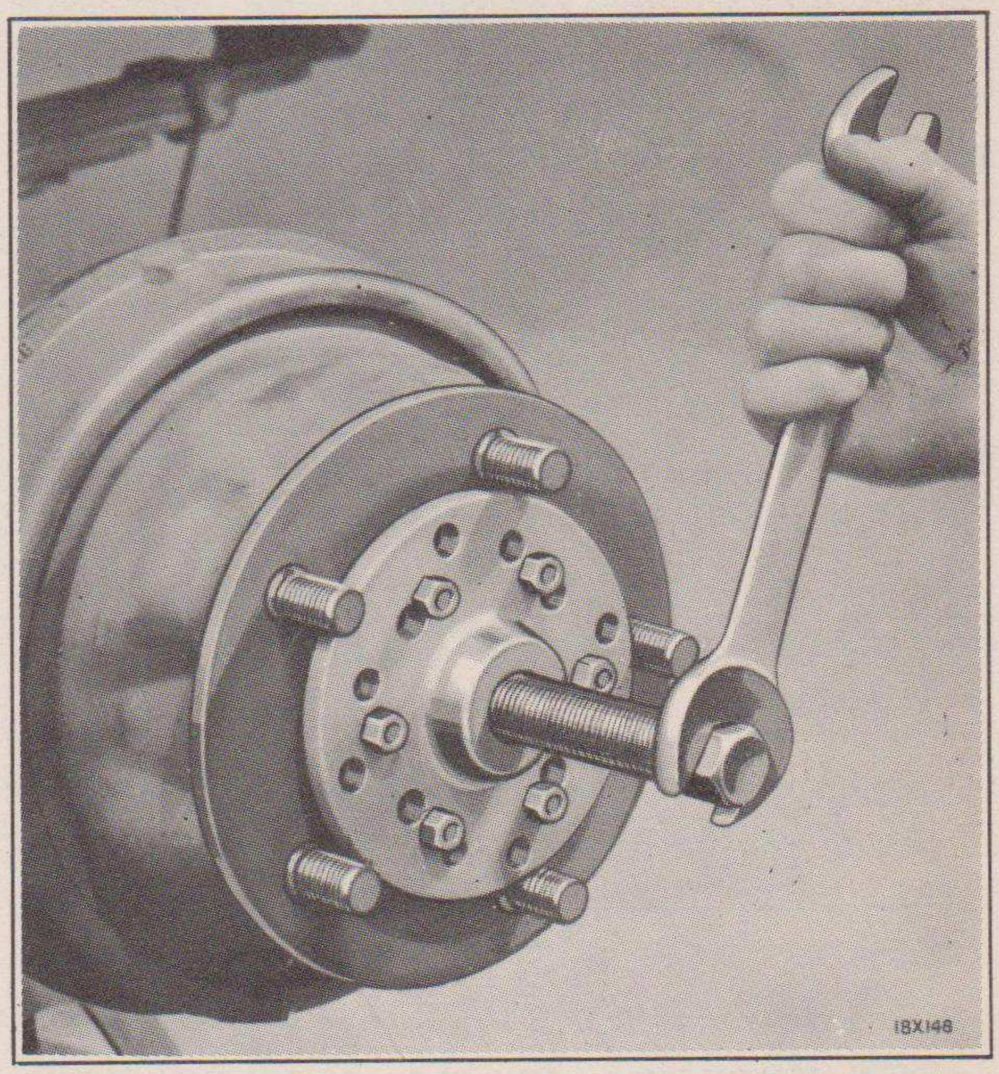


Fig. 36—Removing Wheel Hub with Puller (Tool DD-423)

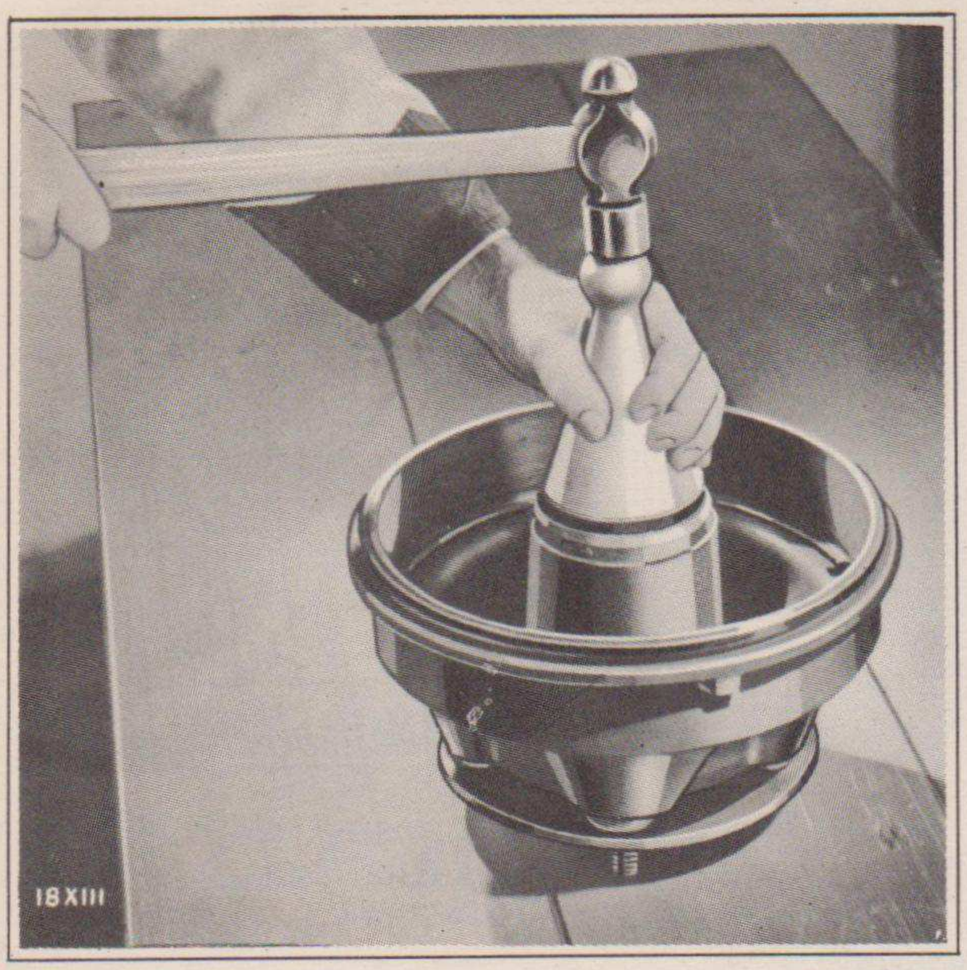


Fig. 37—Installing Wheel Bearing Oil Seal (Tool DD-808)

ing cones (do not fill the space over half full).

Before installing the hub, inspect the surface of the steering knuckle where it contacts the inner oil seal to make certain that it is smooth. Roughness will cause rapid wear of the seal and oil leakage. Use care when sliding the hub onto the steering knuckle to keep it straight with the knuckle so as not to damage the oil seal.

With the hub in position, install the outer bearing cone and rollers and the bearing inner adjusting nut. Before installing the outer bearing cone and rollers, thoroughly coat them with short fibre wheel bearing grease (medium). Then install the wheel and adjust the hub bearings as outlined in Subject 44, after which reinstall the remaining parts.

When installing the hub drive flange, be sure to put in the same number and thickness of shims as originally used and make certain that the puller screws do not bottom against the hub and are securely locked in place.

44—Adjustment of Front Wheel Hub Bearings

(a) Remove the axle drive flange, the bearing outer adjusting nut and the adjusting nut lock. See Subject 43. Then turn the hub bearing inner adjusting nut with special tool DD-824 (see Fig. 35) until the bearings are tight so that the wheel cannot be shaken by hand, but can be rotated without binding. This is sometimes difficult to detect when adjusting front wheel bearings because of the weight of the wheel, especially when dual wheel equipment is used. The recommended method is to turn the adjusting nut tight and back it off about 1/6 of a turn.

(b) Install the adjusting nut lock, making certain that the dowel pin in the inner adjusting nut enters a hole in the lock. It may be necessary to turn the lock over and even to turn the inner adjusting nut slightly in one direction or another in order to permit the dowel pin to enter one of the holes. The bearing adjustment must not be changed to any extent.

(c) Install outer adjusting nut and tighten it securely.

(d) Test the bearing adjustment again after tightening the outer adjusting nut, as the inner adjusting nut may have been tightened when tightening the outer nut. If so, remove the outer adjusting nut and the nut lock and repeat the foregoing operations. *Do not attempt to free up the bearing by loosening the outer adjusting nut only.*

(e) Install the axle driving flange.

45—Steering Tie-Rod

Removal and Disassembly

(a) Loosen the retaining nut at the top end of each tie-rod end stud, which holds the tie-rod end to the steering knuckle flange arm.

(b) Remove the tie-rod end studs from the steering knuckle flanges by forcing them

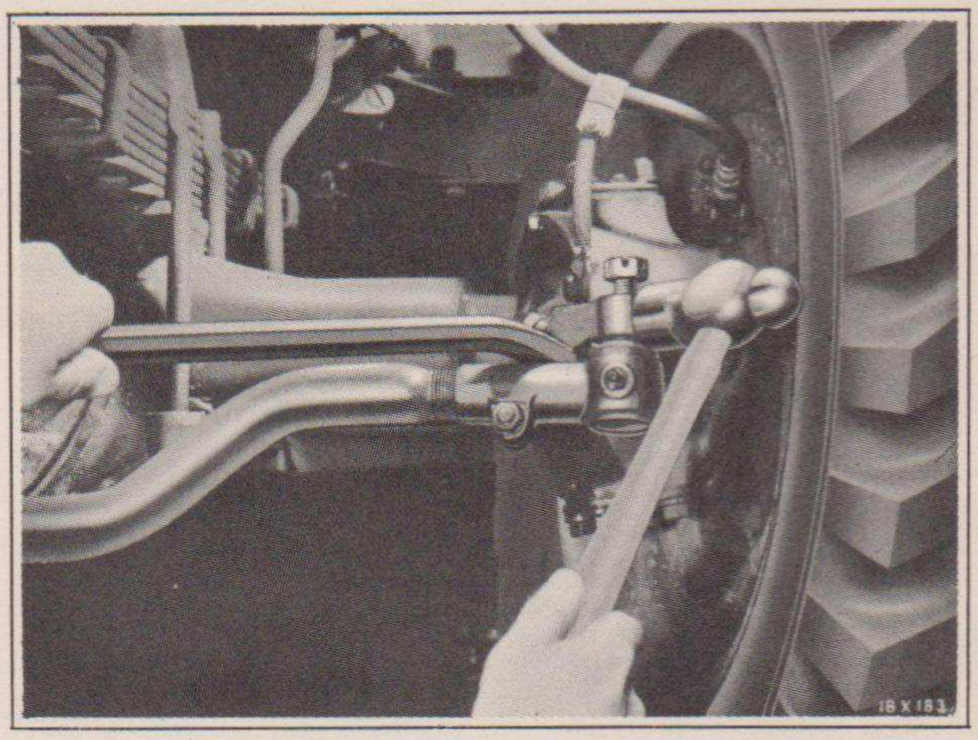


Fig. 38—Removing Steering Tie Rod Ends from the Steering Knuckle Flange

out with a pry-bar inserted above the tie-rod and below the steering knuckle flange arm as shown in Fig. 38. While applying this pressure, give the end of the steering knuckle flange arm a smart rap with a hammer. Then remove the tie rod ball stud nuts. When removing the studs from the flanges, be careful not to lose the spring, the composition washer and the two metal washers on each stud.

(c) Remove the clamp bolt on each tie-rod end assembly and screw the ends off the tie-rod. The tie-rod end assemblies cannot be disassembled. Therefore, in case of damage or worn parts, new ends must be used.

Assembly and Installation

Install the tie-rod ends on the tie-rod, leaving about ¾" of threads exposed at each end of the tie-rod for adjustment purposes. The right end of the tie-rod is threaded with a coarse thread and the left end with a fine thread, making it possible to obtain a close toe-in adjustment.

When installing the tie-rod assembly on the steering knuckle flanges, make sure the tie-rod ends are clean and the springs and washers are correctly arranged on the studs between the tie-rod ends and the flange arms. The composition washer should be placed between the two metal washers with the spring mounted above the washer assembly. The small end of the spring should be at the top next to the flange arm.

For adjustment of the tie-rod, refer to Subject 49.

FRONT WHEEL ALIGNMENT

Correct front wheel alignment produces easy, positive steering with a minimum of scuffing action between the tires and the road.

All the factors of front wheel alignment are inter-related but each angle has a specific purpose. Should any one angle get out of position, the harmonious relationship of all of them 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 when installing new front axle parts, the angles in both front wheels (See Fig. 39) should be checked as follows:

(a) King pin inclination.
(b) Camber.
(c) Caster.
(d) Toe-in and toe-out.

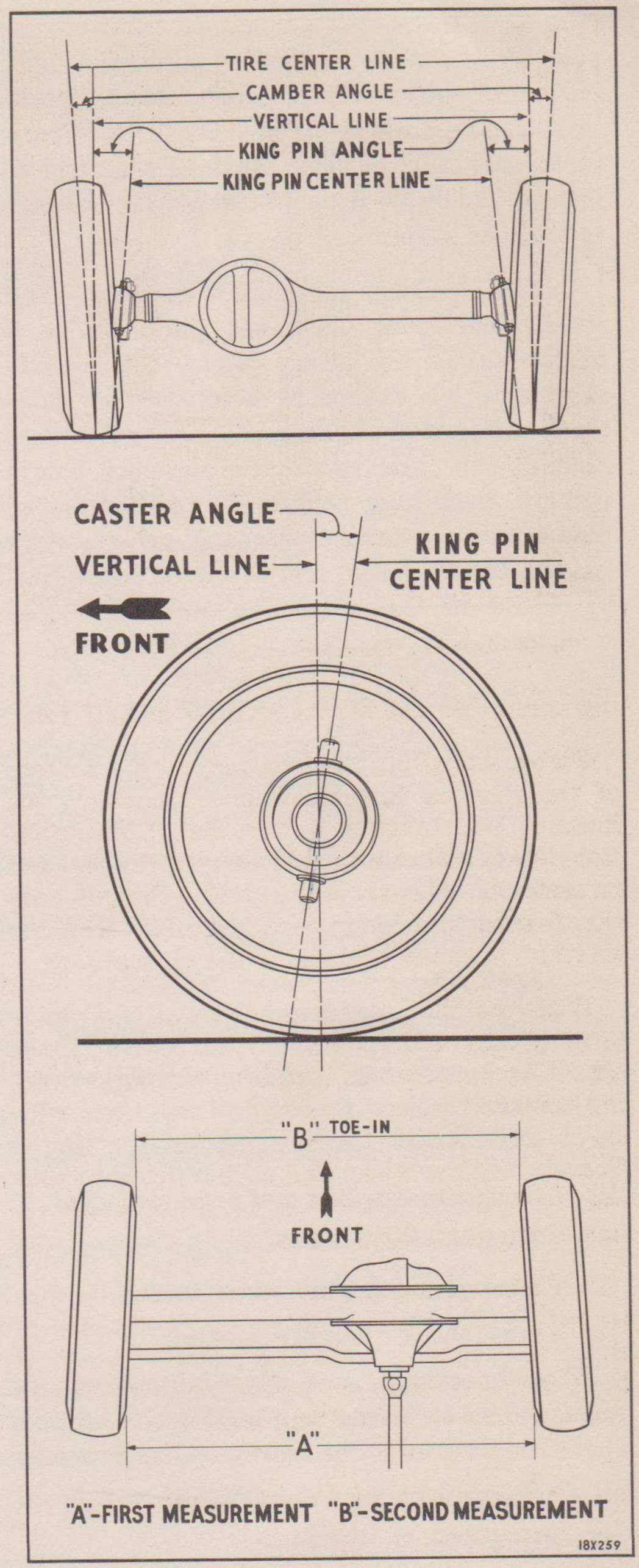


Fig. 39—Front Wheel Alignment Angles

The instructions in this manual for checking front wheel alignment are based on the use of Feragen equipment.

There are many other types of checking

equipment in use that accomplish the same purpose, although the method of using the equipment may differ from the instructions in this manual. Regardless of the make or type of equipment used, however, the checking and adjusting should be done in the proper sequence as outlined herein.

Before checking the alignment of the front wheels, the operations listed below 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, replacing or adjusting any part of the front axle or steering, prior to aligning the front wheels, complete instructions will be found in the respective sections of this manual.

(a) *Inflate all tires to recommended pressure.*

(b) *Check condition of tires* (blow-out patches, thin treads, vulcanizing, etc.). See "Wheels and Tires" section of this manual.

(c) *Check wheel and tire run-out* (wobble) and eccentricity.

(d) *Check brakes for dragging.*

(e) *Check wheels for proper balance.*

(f) *Check front wheel bearing adjustment.*

(g) *Check steering knuckle bearing adjustment.*

(h) *Check front springs and retaining clips.*

(i) *Check rear springs and retaining clips.*

(j) *Check steering connections for lost motion.*

(k) *Check steering gear adjustments.*

(l) *Check shock absorber control.*

When checking front wheel alignment, the truck should be placed on a level floor. All tires should be inflated to the recommended pressure.

46—King Pin Inclination

King pin inclination is the amount the steering knuckle pivot pins incline away from the vertical, toward the center of the truck as viewed from the front of the truck (Fig. 39). Inclined pivot pins are closer together at the top than at the bottom.

The correct king pin angle is 8 degrees. When the king pin inclination is incorrect, it is an indication of a bent front axle housing, and the necessary corrections should be made to bring the king pin angle within limits before making any further wheel alignment checks.

Checking King Pin Inclination

The truck should be placed on a level floor with the front wheels resting on locking turntables. It is important that the front axle be perfectly level. Be certain that the wheels are in the *center* of the turntables. The turntables should be locked until the operation is started.

When checking the king pin angle, use the 40 degree scale on the gauge if the wheels are turned 20 degrees each side of the straight-ahead position, or the 50 degree scale if the wheels are turned 25 degrees. See inset in Fig. 42 showing close-up view of scale on gauge.

IMPORTANT: Keep the foot brakes applied so that the wheels cannot turn while all of the following operations are being performed.

(a) Assemble the gauge to the wheel as shown in Fig. 40, with the quadrant parallel with

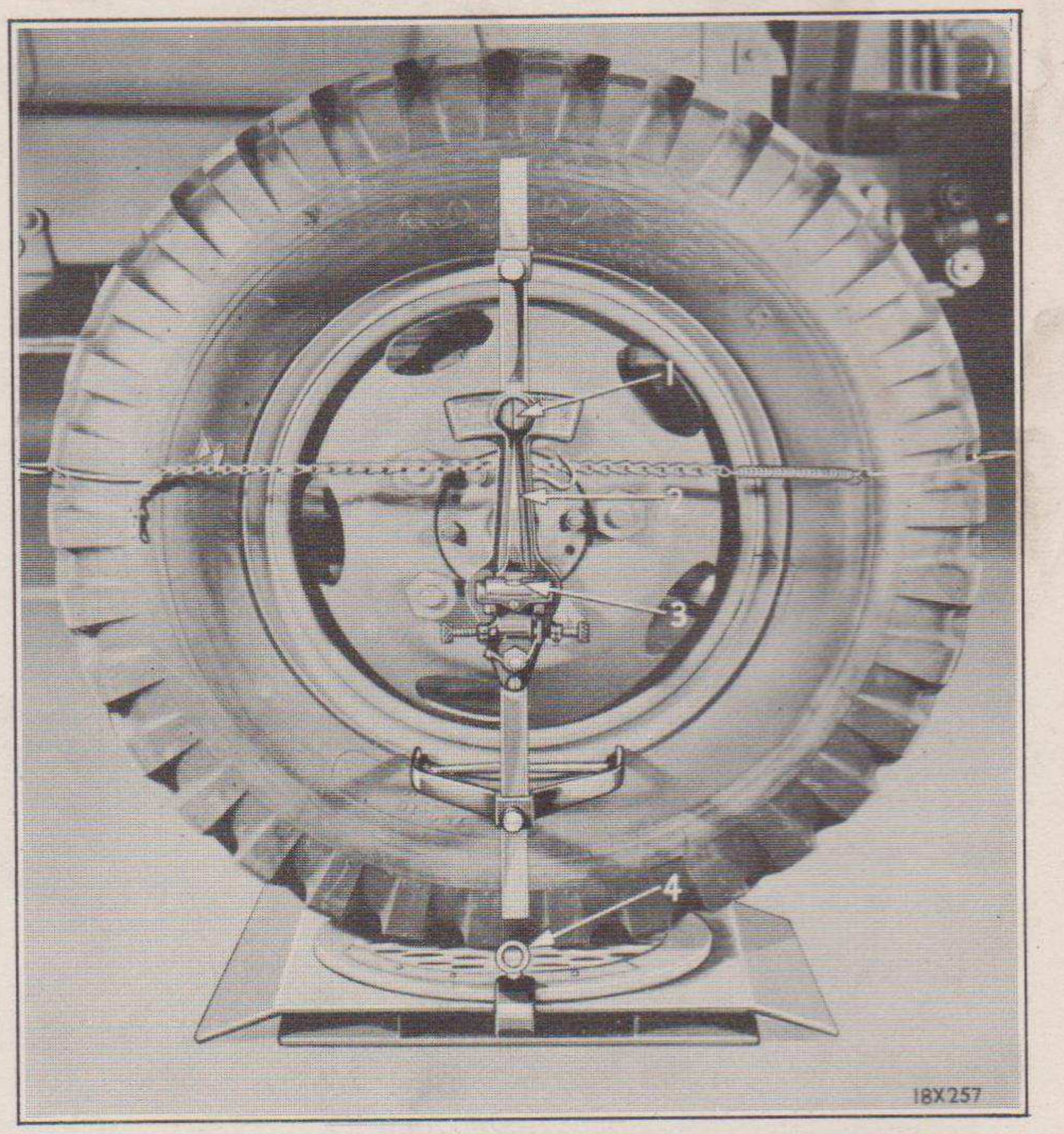


Fig. 40—Checking King Pin Angle—Gauge on Right Wheel (Tool DD-428) (Turntables—Tool DD-435)

NOTE: If tire ring is bent or damaged, place gauge arms against wheel felloe.

1—Hair line on zero
2—Pointer on scratch mark
3—Bubble level
4—Turntable lock pin

the wheel and the front wheels in the straight-ahead position with turntables locked. See that the bubble is level with hair line on zero and pointer on scratch mark. Then pull out turntable lock pins.

(b) *With the gauge on the right wheel,* turn the front wheels to the left until the right wheel has turned 20 degrees, as indicated on the turntable scale.

IMPORTANT: To relieve bind or friction in steering mechanism, it is advisable to turn the wheels slightly beyond 20 degrees, then back to exactly 20 degrees. The brakes must be applied constantly during this operation.

(c) Adjust the secondary screw which controls the short pointer (Fig. 41), until the bubble is centered between the two lines on the spirit level. *Do not disturb this gauge setting or release the brakes.*

(d) With the foot brakes still applied, turn the front wheels to the right until the right wheel has been turned back to an angle of 20 degrees past the straight-ahead position. *Turn the wheels slightly past the 20 degree mark on turntable, then return to exactly 20 degrees, to relieve any possible bind in steering mechanism.*

(e) Adjust the primary screw (Fig. 41), which controls the hair line, until the bubble centers in the spirit level. The reading on the 40 degree scale on the gauge will be the king pin angle for the right wheel.

(f) *To check the king pin angle of the left wheel* attach the gauge to the left wheel, as explained in item (a), and turn the wheels to the right until the left wheel has turned slightly past 20 degrees, then return to exactly 20 degrees to relieve any possible bind in steering mechanism, *keeping foot brakes constantly applied.*

(g) Adjust secondary screw, shown in Fig. 41, which controls short pointer as previously explained in item (c).

(h) Keeping foot brakes applied, turn the front wheels to the left until the left wheel has been turned back to the 20 degree mark on the turntable scale. *Turn the wheels slightly past 20 degrees, then back to exactly 20 degrees to relieve any possible bind in steering mechanism.*

(i) Adjust primary screw (Fig. 41), which controls hair line and take king pin angle reading as explained in item (e).

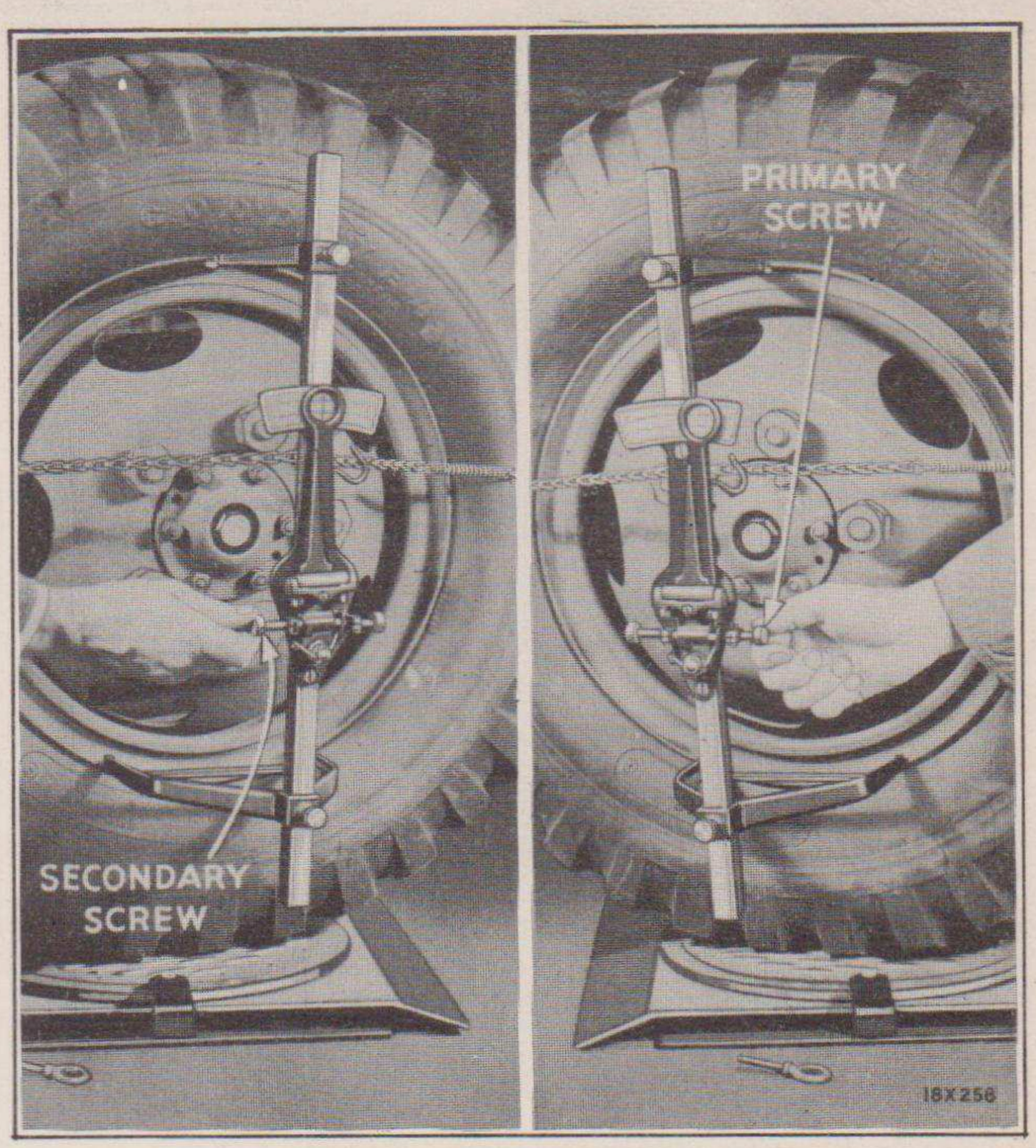


Fig. 41—Checking King Pin Angle—Gauge on Right Wheel (Tool DD-428) (Turntables—Tool DD-435)

NOTE: If tire ring is bent or damaged, place gauge arms against wheel felloe.

47—Wheel Camber

Camber is the amount the wheel inclines away from the vertical at the top as viewed from the front of the truck. See Fig. 39.

With positive camber, the wheels are farther apart at the top than at the bottom. Negative or reverse camber is the opposite—the wheels are closer together at the top than at the bottom. An incorrect camber angle causes a scuffing action between the tire and the road, resulting in abnormal tire wear. Unequal camber in the front wheels may cause the truck to lead to the right or left.

The correct wheel camber of 1½° per wheel is originally set in the axle and cannot be altered by any adjustment. If upon inspection of the camber angle, with an accurate checking gauge, it is found to be greater than 1½° or less than 1°, it is an indication that some part has been bent or excessively worn in service and should be replaced.

Checking Camber

Camber should be checked after the king pin inclination has been checked. If the king pin inclination is incorrect, it should be corrected before checking camber.

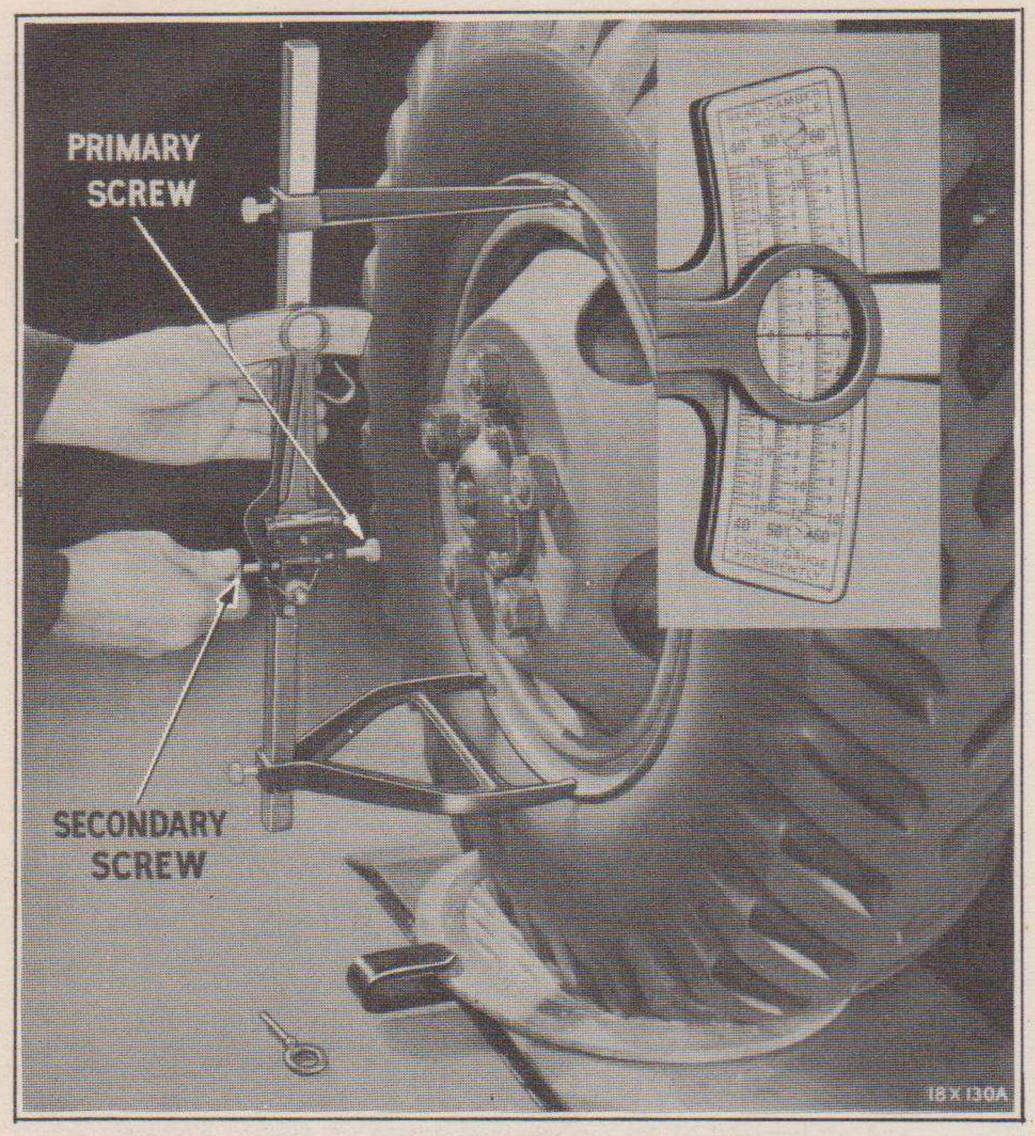


Fig. 42—Checking Camber (Tool DD-428)
NOTE: If tire ring is bent or damaged, place gauge arms against wheel felloe.

(a) Place the front wheels in the straight-ahead position with the weight of the truck on the wheels and with the front axle perfectly level. It is not necessary to have the front wheels on locking turntables when checking camber, although it is good practice to do so as the turntables are required when checking other wheel alignment angles.

(b) Assemble the gauge in position against the wheel as shown in Fig. 42.

(c) Adjust the secondary screw on the quadrant assembly, so that the pointer which is just above the spirit level is on the scratch mark.

(d) Adjust the primary screw which controls the hair line over the scale, so the spirit level bubble is centered.

(e) Take the camber reading in degrees on the scale. Use the 60 degree section of the scale on the quadrant assembly of the gauge for checking camber. See inset Fig. 42. If the wheel is not true (wobbles), turn it one-half revolution (180 degrees) and take another reading. Then average the two readings for the camber angle. Check the camber of both front wheels. Readings from zero toward the wheel indicates camber. Readings from zero away from the wheel indicates reverse camber.

48—Caster Angle

Caster is the amount the steering knuckle pivot pins are inclined toward the front or rear of the truck as viewed from the side of the truck.

Positive caster (Fig. 39) is the tilting of the pivot pins toward the rear of the truck, while negative or reverse caster is the tilting of the pins toward the front of the truck.

Positive caster imparts a trailing action to the front wheels, while negative or reverse caster causes a leading action. The correct amount of positive caster helps to keep the front wheels in the straight-ahead position. When turning a curve, caster acts as a lever, assisting the driver in returning the front wheels to the straight-ahead position.

The caster angle should be 1½°. If it is checked with a suitable gauge and found to be incorrect, the following conditions should be particularly investigated and corrections made by replacing the faulty parts.

(a) Sagged or broken spring leaves.

(b) Excessively worn spring bushings, bolts or shackles.

Checking Caster Angle

The caster angle of both front wheels should be checked after the king pin and camber angles have been checked. If these angles are incorrect, the condition should be corrected before attempting to check the caster angle. Also make sure the truck is perfectly level with the front wheels on locking turntables.

In checking the caster angle, use the 40 degree scale on the gauge if the wheels are turned 20 degrees each side of the straight-ahead position, or the 50 degree scale if the wheels are turned 25 degrees.

IMPORTANT: Keep the foot brakes applied while all of the following operations are being performed to check the caster angle. The front axle differential in 4 x 4 trucks will cause the front wheels to turn in various directions which may affect caster readings, but by keeping the brakes constantly applied, the wheels cannot turn.

(a) Assemble the gauge on the wheel as shown in Fig. 43.

(b) Place the front wheels in the straight-ahead position, making sure they are centrally located on turntables, pull out the turntable lock pins, and adjust the secondary and primary screws to place the hair line over the zero marks on the scale and pointer on scratch mark.

(c) *With the gauge on the right wheel,* turn the front wheels to the left until the right wheel has turned 20 degrees, as indicated on the turntable scale, keeping the foot brakes constantly applied.

IMPORTANT: Turn wheels slightly past 20 degrees, then back to exactly 20 degrees in order to relieve any possible friction in steering connections.

(d) Adjust the secondary screw which controls the short pointer (Fig. 43) until the bubble is centered between the two lines on the spirit level. *Do not disturb this gauge setting.*

(e) Keeping foot brakes constantly applied, turn the front wheels to the right, until the right wheel has turned to an angle of 20 degrees past the straight-ahead position. *Turn wheels slightly past 20 degrees, then back to exactly 20 degrees in order to relieve any possible friction in steering connections.*

(f) Adjust the primary screw (Fig. 43), which controls the hair line, until the bubble centers in the spirit level. The reading on the 40 degree scale on the gauge will be the caster angle.

Reading from zero toward the wheel indicates positive caster.

Reading from zero away from the wheel indicates reverse caster.

(g) *To check the amount of caster in left wheel,* attach the gauge to the left wheel and turn the wheels to the right until the left wheel has turned 20 degrees as indicated on turntable scale, keeping foot brakes constantly applied. *Turn wheels slightly past 20 degrees, then back to exactly 20 degrees to relieve any possible friction or bind in steering mechanism.*

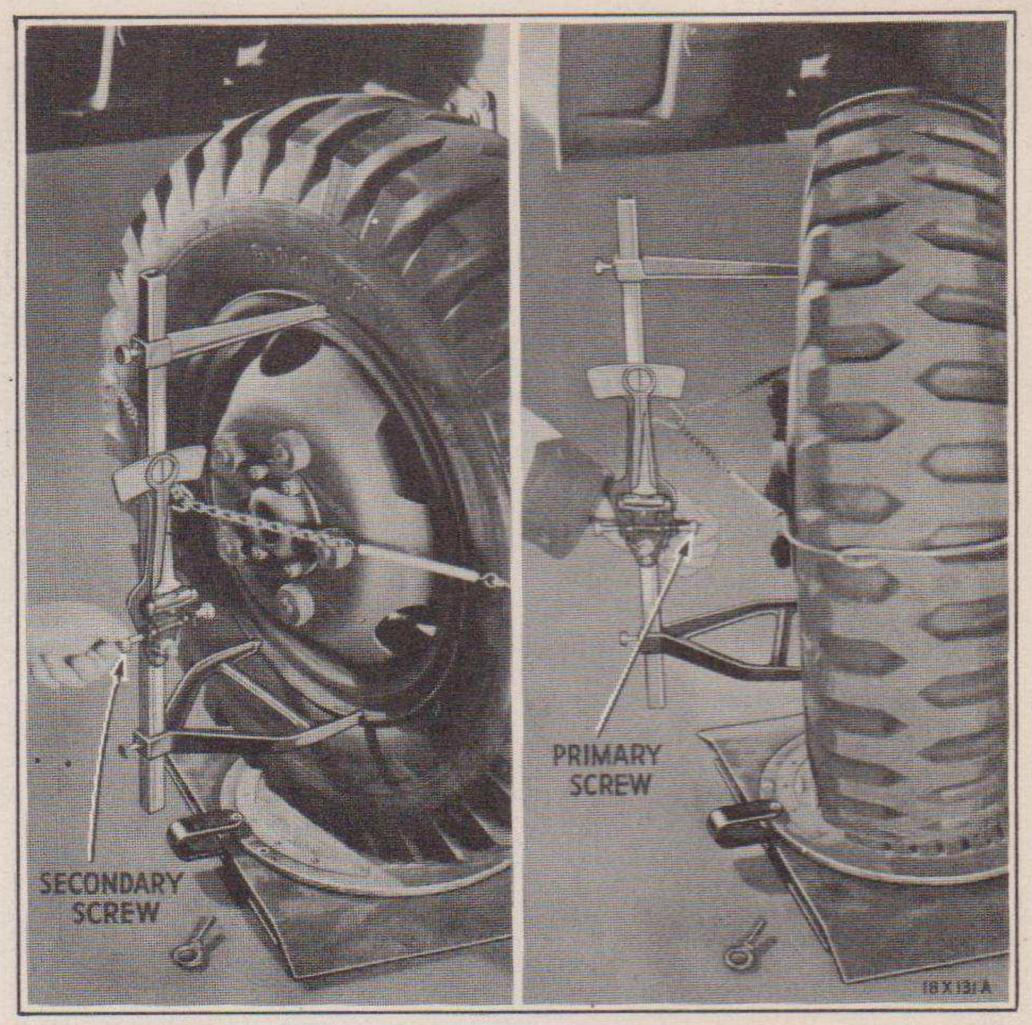


Fig. 43—Checking Caster—Gauge on Right Wheel (Gauge Tool DD-428)

NOTE: If tire ring is bent or damaged, place gauge arms against wheel felloe.

(h) Adjust secondary screw as explained in item (d).

(i) Then turn the front wheels to the left until the left wheel has turned to an angle of 20 degrees past the straight-ahead position, keeping foot brakes constantly applied. *To relieve any possible friction or bind in steering mechanism, turn the wheels slightly past 20 degrees, then back to exactly 20 degrees.*

(j) Adjust the primary screw which controls hair line and take caster reading as explained in item (f).

The turntables used under the front wheels will raise the front end of the truck slightly and therefore should be considered when computing the caster angle. Deduct ¾° from the reading on the gauge to allow for height of turntables.

49—Toe-In

Toe-in is the amount the front wheels are closer together at the front than they are at the back as viewed from the top of the truck. See Fig. 39.

Excessive or insufficient toe-in causes lateral slipping or scuffing between the tire and the road, resulting in abnormal tire wear.

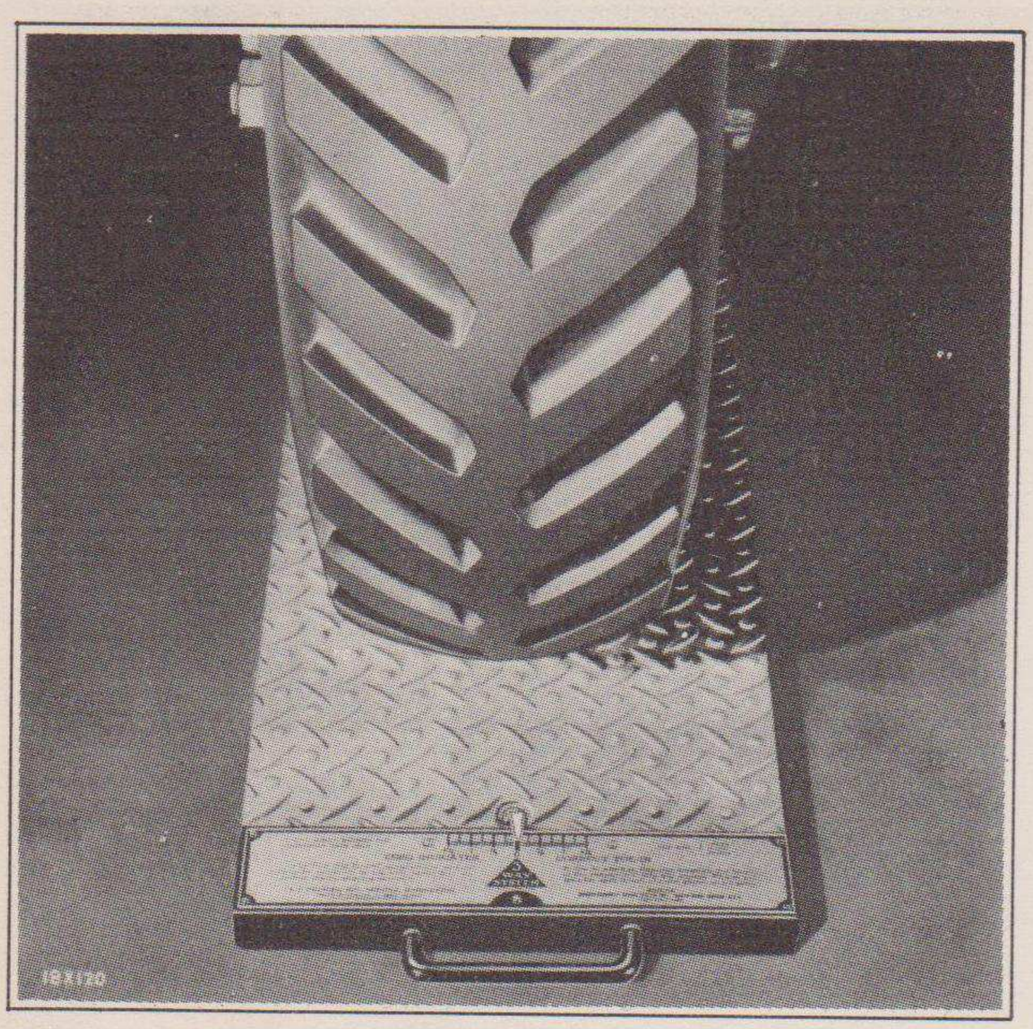


Fig. 44—Front Wheel Toe-in Alignment Board (Tool DD-398)

Checking and Adjusting Toe-In

When checking for causes of excessive tire wear, the king pin, camber and caster angles should first be checked and corrected in the order named. No corrections in toe-in should be made until the other factors of front wheel alignment are known to be within specifications.

(a) Turn the front wheels to exactly the straight-ahead position.

(b) Check the toe-in of the front wheels after rolling the truck ahead one full revolution of the wheels (with only the weight of the truck on the tires).

(c) Actual toe-in measurements should be taken by measuring the distance "A" (Fig. 39) at hub height, between two points on the center of the tread at the *rear* of the tires. Mark this point on the tires, roll the truck ahead so that the markings are in *front* at hub height, and then measure the distance "B" between the same two points on the tire treads. The difference in the two measurements is the actual toe-in or toe-out. If the toe-in is not correct, it should be adjusted as follows:

(d) With the front wheels straight ahead, disconnect the left tie-rod end from the steering knuckle (see Subject 45) and turn the end assembly in the direction necessary to bring the toe-in within the specified limits. Shorten the tie-rod to decrease the toe-in and lengthen it to increase the toe-in. Actual measurement of toe-in, at hub height, should be 0 to ⅛", $\frac{1}{16}$" preferred.

(e) Install the tie rod end.

(f) Check the toe-in again to make certain that it is correct.

To check the toe-in of the front wheels, by the straight-away test, using a wee-gee board or a similar device, proceed as follows:

With all road wheels approximately in line (front wheels straight ahead), drive one of the front wheels slowly over the board close to the front end as shown in Fig. 44, but do not move the steering wheel. (It is not necessary to have the wheel travel absolutely straight on the wee-gee board to get accurate readings.

If the indicator arrow on the board moves in a direction toward the center of the truck, it indicates the lack of proper toe-in of the opposite front wheel. This condition can normally be corrected by removing the left tie rod end and unscrewing it to lengthen the tie rod.

If the indicator arrow on the board moves away from the truck, it indicates excessive toe-in of the opposite front wheel. This condition can normally be corrected by removing the left tie rod end and turning it farther on the tie rod to shorten the tie rod.

The indicator arrow on the board must not move over one-half of a graduation on the scale in either direction in a straight-away test. The ideal condition is to have the arrow remain at zero.

Should a variation of over one-half graduation in arrow movement occur in testing the same wheel two or more times, it is an indication that the wheel bearings or the steering gear are loose or worn or that the floor on which the test is being made is not level.

If the same reading is not obtained from both front wheels in the straight-away test, it indicates that the camber or caster is unsymmetrical.

The next factor of front wheel alignment to be checked is toe-out.

50—Toe-Out

When the wheels are turned to the right or left, they actually toe-out, being farther apart at the front than at the rear. See Fig. 45.

The design of the steering knuckle arms regulates the amount of toe-out, depending on the wheelbase of the truck and the distance between the steering knuckles. To be in correct relative alignment when negotiating a turn, both the front and rear wheels must travel in circles having a common center. The inside front wheel travels in a circle having a smaller radius than the circle traveled by the outside front wheel, therefore, the wheels will be farther apart at the front than at the back when turned off the straight-ahead position. The amount the front wheels toe-out on turns depends on how far the front wheels are turned.

A bent steering knuckle flange arm will cause excessive tire wear even though the amount of toe-in is correct for the straight-ahead position of the front wheels, because when the front wheels are turned to the right or left, the error in toe-out, due to the bent steering knuckle flange arm, would cause excessive scuffing action between the tire and the road. It is, therefore, extremely important to check toe-out as well as toe-in whenever the front wheels are aligned.

Checking Toe-Out on Turns

Before checking toe-out (wheel alignment on turns) all other factors of front wheel alignment should be checked in their proper sequence: King pin angle, camber, caster and toe-in.

Checking devices such as a wheel aligning board and similar devices that measure the amount of slippage between the tire and the road may be used to check alignment of front wheels on turns. Such a check will determine the amount of slippage between the tire and the road when the wheels are turned to the right or left. To check the amount of toe-out on turns, using a wheel aligning board, proceed as follows:

(a) Turn the front wheels to the *left* until the *left* wheel is 20° from the straight-ahead position as determined by a turntable.

(b) Place the aligning board in front of the *right* wheel. Drive the truck onto the aligning board so that the right wheel travels the length of the board.

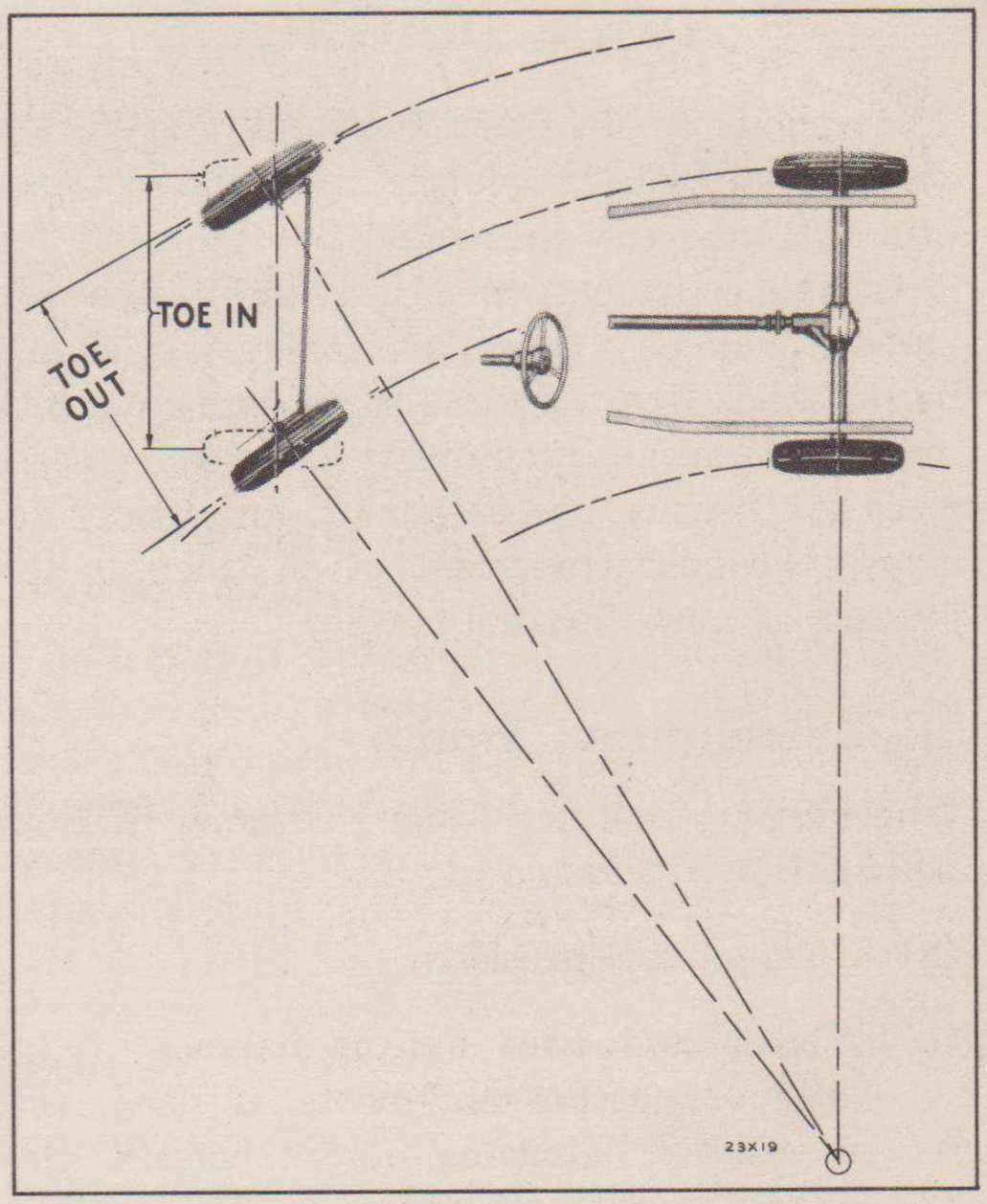


Fig. 45—Steering Geometry on Turns

If the pointer on the board moves more than 2 points (½″) after the wheel has traveled the length of the board, the toe-out is incorrect, indicating misalignment on the left side such as a bent steering knuckle arm.

(c) Repeat the foregoing operations on the right wheel, turning it 20° to the *right* and placing the alignment board under the *left* wheel. Movement of more than 2 points (½″) of the pointer would indicate misalignment such as a bent steering knuckle arm on the right side.

When using an aligning board to check "toe-in" or "toe-out," the direction of movement of the pointer indicates whether the condition is excessive "toe-in" or excessive "toe-out." Movement of the pointer toward the center of the truck indicates "toe-out."

Movement of the pointer in the opposite direction (away from the center of the truck) indicates "toe-in." It must be remembered that due to the floating action of the alignment board, the readings obtained actually indicate the condition of the wheel opposite from the one on the board. Correction of improper toe-out on turns is made by replacing the damaged parts.

SERVICE DIAGNOSIS

The various parts of the front axle, such as the steering knuckle flanges are heat-treated to obtain the inherent characteristics required for front axle construction. Should any of the axle parts become bent through accident, they should be replaced. Heating these parts for straightening or correcting irregularity will render them unfit for further use because it practically destroys the heat treatment given them in the process of manufacture.

51—Shimmy and Tramp

Wheel tramp and high speed shimmy in most cases can be attributed to:

(a) Unequal tire pressure.

(b) Wheels and tires out of balance. (Tire wear or patches and boots, if used, will necessitate balancing of the wheels. See "Wheels and Tires" section of this manual.)

(c) Excessive wear of steering gear parts and steering connections.

(d) Incorrect adjustment of steering knuckle flange bearings. See Subject 41.

When shimmy and tramp exist, a complete front axle alignment and steering check-up should be performed.

52—Wandering

When it is difficult to keep a truck traveling in a straight ahead course, due to a tendency of the front end to pull to the right or left, it is said to wander. This condition can be attributed to:

(a) Unequal or low tire pressure.

(b) Incorrect front wheel caster. See Subject 48.

(c) Loose front wheel bearings. See Subject 44.

(d) Too tight steering gear adjustment. See Subjects 252, 253 and 254.

(e) Front axle shifted on springs. Check for broken spring center bolts and loose clips. Replace damaged parts and tighten clips securely.

(f) Front or rear wheel brakes unequally adjusted.

53—Excessive Tire Wear

Excessive tire wear in most cases is caused by misalignment, improper steering geometry, or under-inflation.

(a) Check front end adjustment as outlined under "Front Wheel Alignment."

(b) For excessive rear tire wear, check wheels and tires for run-out and concentricity. (See "Wheels and Tires" section of this manual.)

(c) Check frame and rear axle housing alignment and correct as necessary.

REAR AXLE AND DIFFERENTIAL CARRIER ASSEMBLY

The rear axle is of the full-floating type (see Figs. 46 and 52) with a hypoid drive gear (ring gear) and drive pinion. With this type axle it is possible to remove or replace the axle drive shafts without removing the road wheels. The differential carrier assembly in the rear axle is identical with that used in the front axle and the same service procedure applies to both units.

REAR AXLE

54—Rear Axle Assembly

Removal

(a) Jack up the rear end of the truck and place a support under the frame or the rear bumper.

(b) Remove both rear wheels. If necessary to remove the wheel hub and brake drum assemblies follow the instructions given in Subject 58. In the present procedure, it is not necessary to remove the bearing cups, the inner bearing cone and rollers and the inner oil seal from the wheel hubs.

(c) Disconnect the following—

(1) The brake hose at the frame connector and at the axle line if desired.

(2) The shock absorber links at the bottom end.

(3) The rear universal joint at the differential.

(d) Place a jack or other support under the rear axle assembly and remove the rear spring hold-down clips; then lower the axle assembly and remove it from under the truck.

Installation

When installing the rear axle make sure the head of each spring center bolt enters the center hole in its respective spring saddle on the axle housing; also tighten the spring clips securely in position.

After installing the rear axle assembly, it is necessary to bleed all brake lines (See Subject 75) in order to remove any air that might have entered the brake system when the rear hose was disconnected.

Lubrication of the rear axle must not be overlooked. The differential and the wheel bearings should be checked and properly lubricated with the right lubricant. Refer to the "Lubrication" section of this Manual for lubrication of these units.

55—Rear Axle Housing

Removal

(a) Remove the rear axle assembly from the truck as outlined in Subject 54.

(b) Remove both wheel hub assemblies as explained in Subject 58. It is unnecessary in this procedure to remove the bearing cups, the inner bearing cone and rollers and the inner oil seal from the wheel hubs.

(c) Disconnect the brake tubes at the brake supports and remove the tube and hose from the axle housing.

(d) Remove the brake support and shoe assemblies.

(e) Remove the differential carrier assembly and the differential cover by taking off the retaining nuts and washers and dismounting these parts:

Installation

When assembling and installing the rear axle housing be sure to observe all cautions and follow carefully all of the instructions given in the operations listed in the subjects referred to under the subheading "Removal." This applies particularly to the bleeding of the brake system and the lubrication of the axle units. Also replace all gaskets with new ones to avoid lubricant leakage.

56—Axle Drive Shaft

Removal and Installation

(a) Remove the axle drive shaft flange retaining nuts and washers. Before removing the

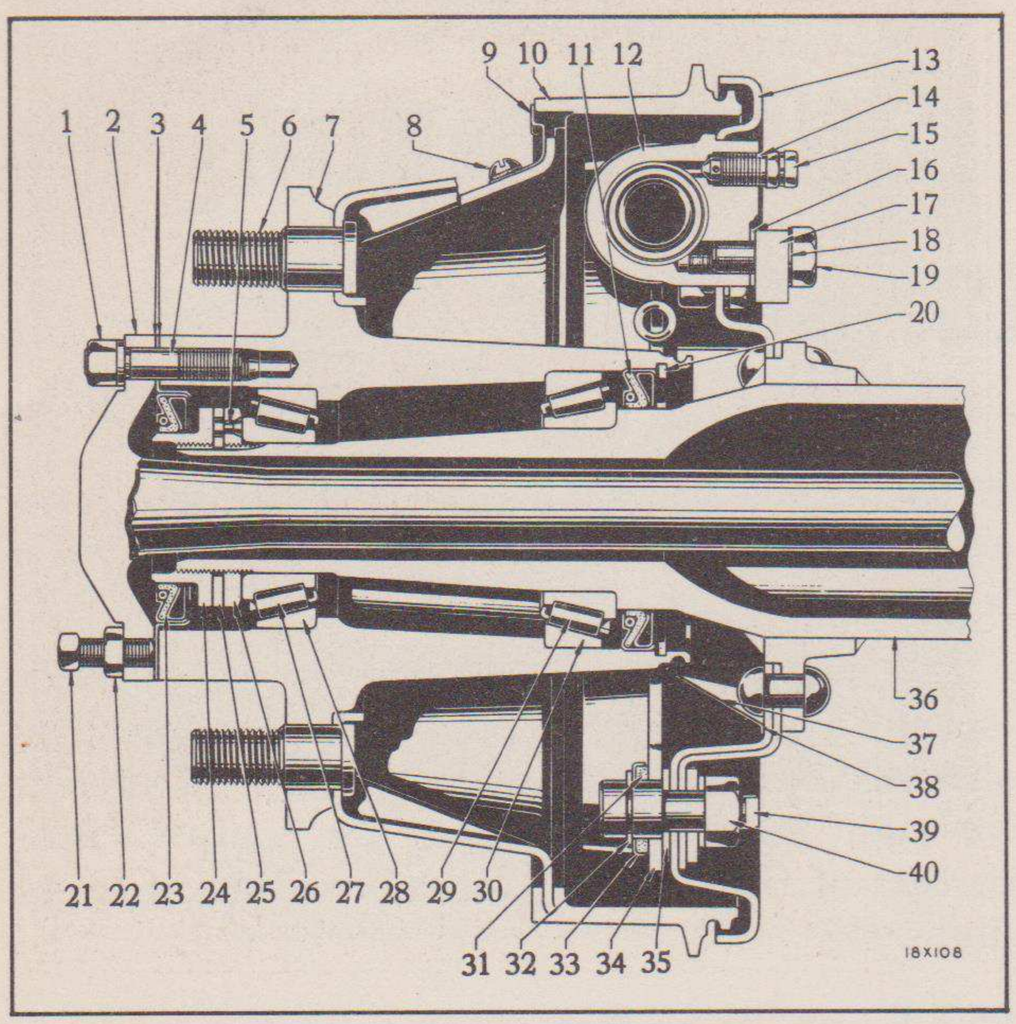


Fig. 46—Rear Wheel Hub, Brake and Bearings

1—Rear axle drive shaft stud nut and lockwasher
2—Rear axle drive shaft
3—Rear axle drive shaft gaskets
4—Rear axle drive shaft studs
5—Rear wheel bearing adjusting nut pin
6—Rear wheel hub stud
7—Rear wheel hub
8—Rear wheel brake drum inspection hole cover screw and lockwasher
9—Rear wheel brake drum inspection hole cover
10—Rear wheel brake drum
11—Rear wheel bearing oil seal—inner
12—Rear wheel brake cylinder assembly
13—Rear wheel brake support
14—Rear wheel brake cylinder bleeder screw
15—Rear wheel brake cylinder bleeder screw cap screw and lockwasher
16—Rear wheel brake cylinder inlet connection gasket
17—Rear wheel brake cylinder inlet connection
18—Rear wheel brake cylinder inlet connection bolt gasket
19—Rear wheel brake cylinder inlet connection bolt
20—Rear wheel bearing oil seal snap ring
21—Rear axle drive shaft puller screw
22—Rear axle drive shaft puller screw lock nut
23—Rear wheel bearing oil seal and retainer—outer
24—Rear wheel bearing adjusting nut—outer
25—Rear wheel bearing adjusting nut lock
26—Rear wheel bearing adjusting nut and pin assembly—inner
27—Rear wheel bearing cone and rollers—outer
28—Rear wheel bearing cup—outer
29—Rear wheel bearing cone and rollers—inner
30—Rear wheel bearing cup—inner
31—Rear wheel brake shoe anchor bolt oil washer
32—Rear wheel brake shoe anchor bolt "C" washer
33—Rear wheel brake shoe anchor bolt oil washer retainer
34—Rear wheel brake shoe
35—Rear wheel brake shoe anchor bolt spacer
36—Rear axle housing
37—Rear wheel brake oil slinger
38—Rear wheel brake oil slinger gasket
39—Rear wheel shoe anchor bolt
40—Rear wheel brake shoe anchor bolt nut and lockwasher

shaft it is good practice to mark the flange and one of the hub studs so that the shaft may be installed in the same position.

(b) Back off the lock nuts on the two puller screws in the shaft flange and turn the puller screws in to remove the shaft. See Fig. 47.

(c) Pull the drive shaft out of the housing.

When installing the axle drive shaft, make sure that all contacting surfaces are clean and free of foreign matter which would prevent the shaft flange, the oil seal retainer and the wheel hub seating properly against the gaskets when tightened down with the retaining nuts. It is also important to have the flange retaining nuts tight as looseness at this point might result in shearing of the studs under load. Use new gaskets to insure against lubricant leakage. Also make sure the puller screws do not bottom against the hub and are securely locked in place.

57—To Remove Broken End of Rear Axle Drive Shaft

(a) Perform all of the operations listed in Subject 56 for removing the axle drive shaft.

(b) If the break is less than about 4" from the inner end of the shaft, it will be necessary to remove the differential carrier assembly as outlined in Subject 61. If the break is more than 4" from the inner end of the shaft, it will be necessary to snare the inner end out through the housing with a wire loop.

When installing the new drive shaft make certain that the wheel bearings are correctly adjusted (See Subject 59) and that the outer oil seal is in good condition. Also make sure the differential is properly lubricated.

58—Rear Wheel Hub Bearings

Removal

(a) After jacking up the rear wheel, remove the wheel and tire assembly.

(b) Remove the retaining nuts and washers, which hold the axle drive shaft in place. Then pull out the drive shaft by loosening the lock nuts on the two puller screws in the shaft flange and turning these screws in as shown in Fig. 47.

(c) Remove the outer oil seal and gaskets.

(d) Remove the outer adjusting nut, the nut lock and the inner adjusting nut as illustrated in Fig. 48, using special wrench DD-824.

(e) Pull off the hub and brake drum assembly and remove the outer bearing cone and rollers. If difficulty is experienced in removing this assembly, use puller No. DD-423. See Fig. 36.

(f) Remove the inner oil seal retainer snap ring.

(g) Using a drift, drive out the inner bearing cone and rollers and the oil seal. Inspect the oil seal for wear and possible damage.

(h) Drive out the inner and outer bearing cups, removing the inner cup from the inner end of the hub and the outer cup from the outer end of the hub.

Installation

Before assembling the bearings in the rear wheel hub, make sure all old lubricant is removed and that the various parts are clean and in good condition, then install the inner and outer bearing cups, driving them in place with a drift. Make sure the cups are correctly installed with the thick edge toward the center of the wheel hub. Next coat the inner bearing cone and rollers with short fibre wheel bearing grease (medium) and assemble in the inner cup. Then install the inner oil seal with a suitable drift, and the oil seal retainer snap ring. Place a quantity of wheel bearing lubricant in the hub between the bearing cones (Do not fill the space over half full).

Before installing the hub, inspect the surface of the axle housing where it contacts the inner oil seal to make certain that the housing surface is smooth. Roughness will cause rapid wear of the seal and oil leakage. Use care when sliding

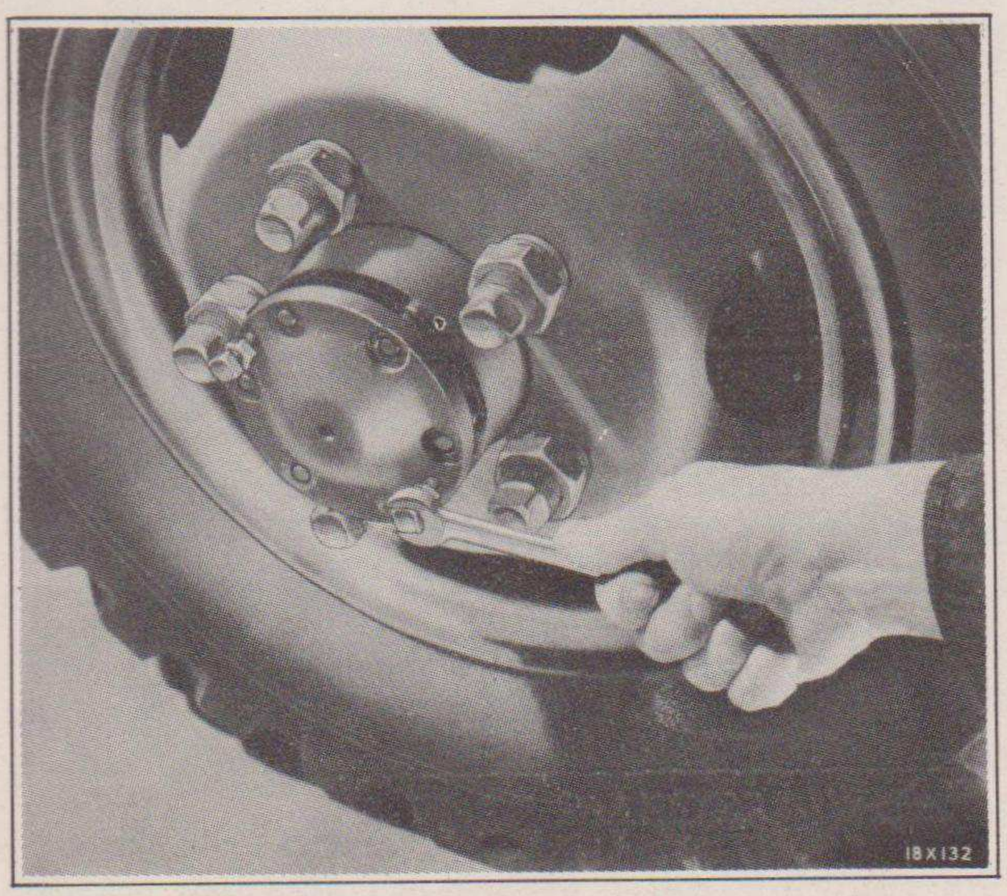


Fig. 47—Removing Rear Axle Drive Shaft with Puller Screws

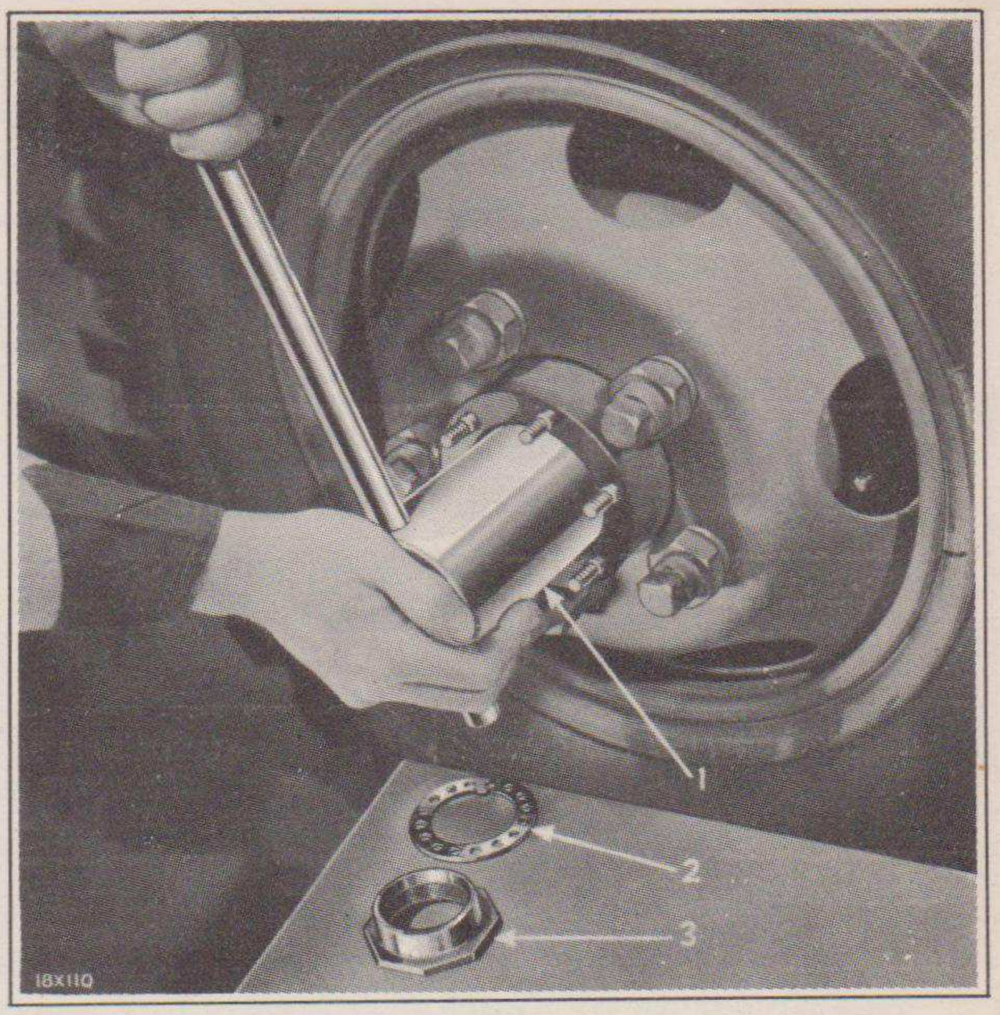


Fig. 48—Removing Rear Wheel Bearing Adjusting Nuts or Adjusting Bearings

1—Tool DD-824
2—Rear wheel bearing adjusting nut lock
3—Rear wheel bearing adjusting nut—outer

the hub onto the housing to keep it straight with the housing so as not to damage the oil seal.

With the hub in position, install the outer bearing cone and rollers and the inner adjusting nut. Before installing the outer bearing and rollers, thoroughly coat these parts with short fibre wheel bearing grease (medium). Then install the wheel and adjust the hub bearings as outlined in Subject 59.

Next install the outer oil seal on the hub studs and outer adjusting nut extension, making sure the nut surface where it contacts the oil seal is smooth and in good condition. The surfaces of the hub and the shaft flange should also be inspected for dirt and roughness that might cause lubricant leakage. Use new gaskets with one on each side of the oil seal retainer. When installing the drive shaft flange, be sure the puller screws do not bottom against the hub and are securely locked in place.

59—Adjustment of Rear Wheel Hub Bearings

(a) After jacking up the wheel, remove the axle drive shaft, the outer oil seal, the bearing outer adjusting nut and the adjusting nut lock. See Subject 58.

(b) Turn the inner adjusting nut clockwise with special tool DD-824 (See Fig. 48) until the bearings are tight, so that the wheel can not be shaken by hand but can be rotated without binding. This is sometimes difficult to detect, when adjusting rear wheel bearings because of the weight of the wheel, especially when dual wheel equipment is used. The recommended method is to turn the inner adjusting nut tight and back it off about ⅙ of a turn.

(c) Install the adjusting nut lock, making certain that the dowel pin in the inner adjusting nut enters a hole in the lock. It may be necessary to turn the lock over and even to turn the inner adjusting nut slightly in one direction or another in order to permit the dowel pin to enter one of the holes. The bearing adjustment must not be changed to any extent.

(d) Install the outer adjusting nut and tighten it securely.

(e) Test the bearing adjustment again after tightening the outer adjusting nut as the inner adjusting nut may have been tightened when tightening the outer nut. If so, remove the outer adjusting nut and the nut lock and repeat the foregoing operations. *Do not attempt to free up the bearings by loosening the outer adjusting nut only.*

(f) Install the outer oil seal and gaskets and the drive shaft. See Subjects 58 and 60 for specific instructions on installing the outer oil seal.

SERVICE DIAGNOSIS

60—Lubricant Leakage from Rear Wheels and Hubs

Lubricant leaking from the rear wheels and hubs usually results from a poor contact of the axle drive shaft flange gaskets or seepage of lubricant past the inner oil seal assembly onto the brakes. See Fig. 46 for arrangement of these parts. More often the leakage is external and will be noticed at the drive shaft flanges. In such instances, it is possible that dirt, or other foreign matter has lodged between the flange or hub and the gaskets and prevents a tight seal. As a service correction, the following procedure is recommended:

(a) Remove the axle drive shaft (see Subject 56) first marking the shaft and one of the hub studs so that the shaft can be installed in the same position.

(b) Clean the contacting surfaces thoroughly and dress the studs if metal peeling has occurred, with a fine file or abrasive cloth.

(c) Try the shaft in position to make sure it is free from interference and the flange fits tightly in place.

(d) Make certain that both oil seal gaskets are in good condition, replacing them if necessary and install the oil seal and shaft assembly.

The outer oil seal is assembled to a retainer that fits over the hub studs, thus being secured in position when the drive shaft flange is bolted to the hub. One gasket is used at each side of the oil seal retainer. The hub bearing outer adjusting nut has a ⅝″ extension that acts as a hub for the outer oil seal. This extension is accurately ground to provide a smooth, long wearing surface for the leather seal.

With the proper fit between the drive shaft flange, the gaskets, and the hub and the inner seal in good condition, lubricant leakage past the outer seal will do no harm.

However, if the outer seal appears to be ineffective, the extension of the outer adjusting nut should be inspected for roughness and if the surface is not smooth, the nut and the seal assembly should be replaced.

To assure an effective and long wearing inner oil seal, the rear wheel bearings should be properly adjusted, as loose wheel bearings will cause distortion of the seal resulting in leakage. Care should also be exercised when installing a rear hub assembly as careless handling may result in the inner wheel bearing shoulder of the axle housing shearing a portion of the seal leather thus rendering the seal ineffective.

DIFFERENTIAL CARRIER ASSEMBLY

(Front and Rear Axles)

61—Differential Carrier Assembly

Removal and Installation

(a) Drain the lubricant from the differential.

(b) Disconnect the propeller shaft universal joint and drop the propeller shaft. If the drive pinion is to be removed from the carrier, loosen the propeller shaft companion flange retaining nut before removing the axle drive shafts.

(c) Remove the universal drive assemblies or drive shafts as outlined in Subjects 33 or 56.

(d) Remove the retaining nuts and lock washers, holding the differential carrier to the axle housing. See Figs. 51 and 52.

(e) Pull the carrier assembly off the housing studs.

When reinstalling the differential carrier assembly, make sure that the contacting surfaces on both the carrier and the axle housing are clean. It is also important to make sure that the housing studs are tight to prevent lubricant leakage. Use a new gasket between the carrier and the housing and tighten the retaining nuts securely.

After completing the assembly operations, lubricate the differential as directed in the "Lubrication" section of this Manual.

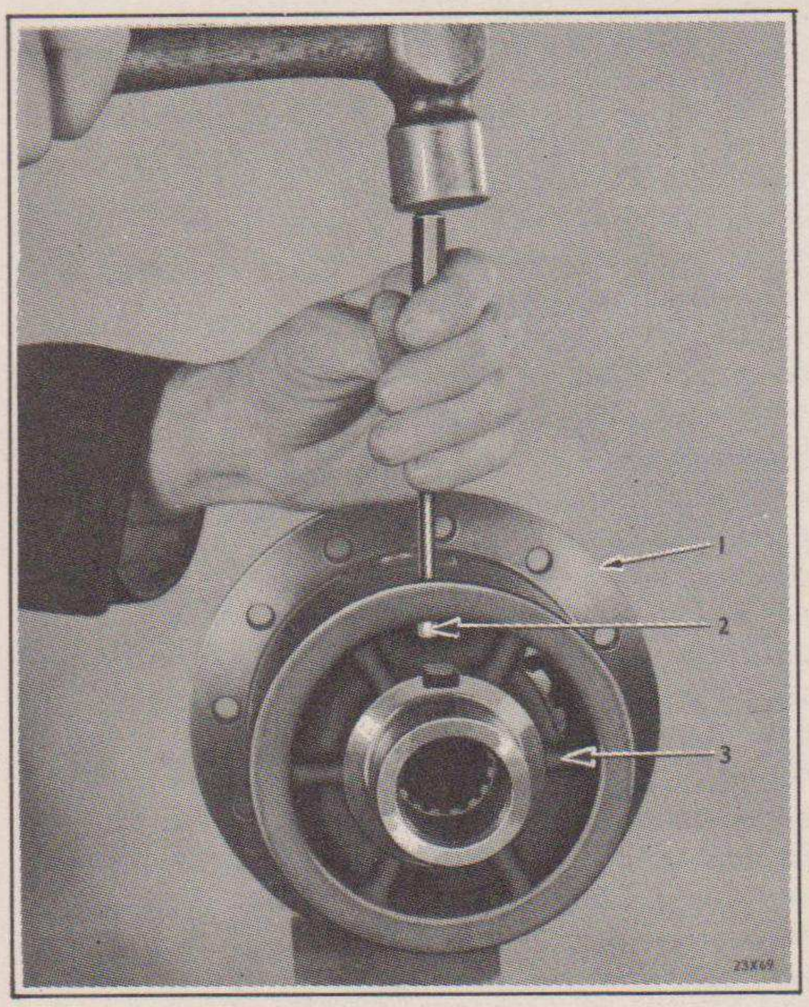


Fig. 49—Removing Differential Case Cap Lock Pin
1—Differential case
2—Differential case cap lock pin
3—Differential case cap

Disassembly of Differential

It is more convenient to mount the differential carrier assembly on a bench stand, such as special fixture No. C-399. Time will be saved when adjusting the drive gear if the bearing adjusters are marked, so that they may be assembled with approximately the same drive gear adjustment. See Fig. 56.

(a) Remove the differential bearing adjuster locks.

(b) Loosen the differential bearing cap retaining screws and unscrew the adjusters to relieve the load on the bearings. Then remove the cap retaining screws and caps, and lift out the differential and ring gear assembly, together with the differential bearing cups.

(c) Remove the differential bearings. Special puller blocks used with tool No. C-293-U are required for this operation.

(d) Remove the differential case cap lock pin by driving it through the case. See Fig. 49.

(e) Place the differential case in a pan and fill the pan with water up to a level ½" below the case cap. See Fig. 50. Remove the case and boil the water, then submerge the case in the boiling water in order to heat the

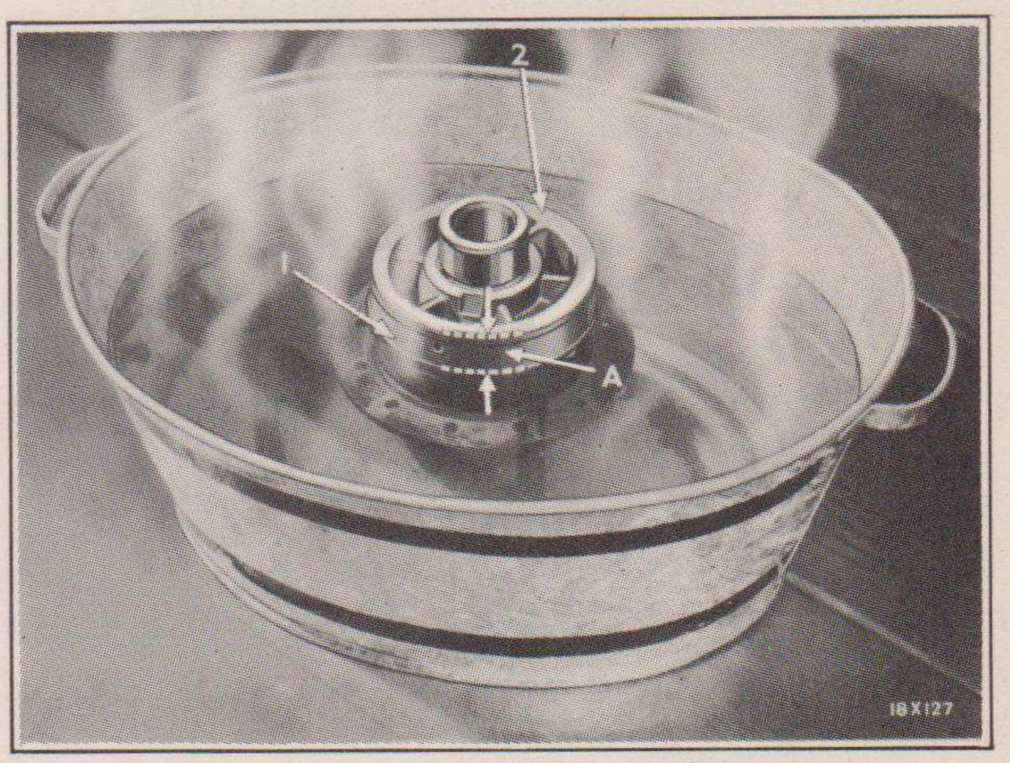


Fig. 50—Removing Differential Case Cap—Expanding the Case
1—Differential case 2—Differential case cap
A—Water level below the cap

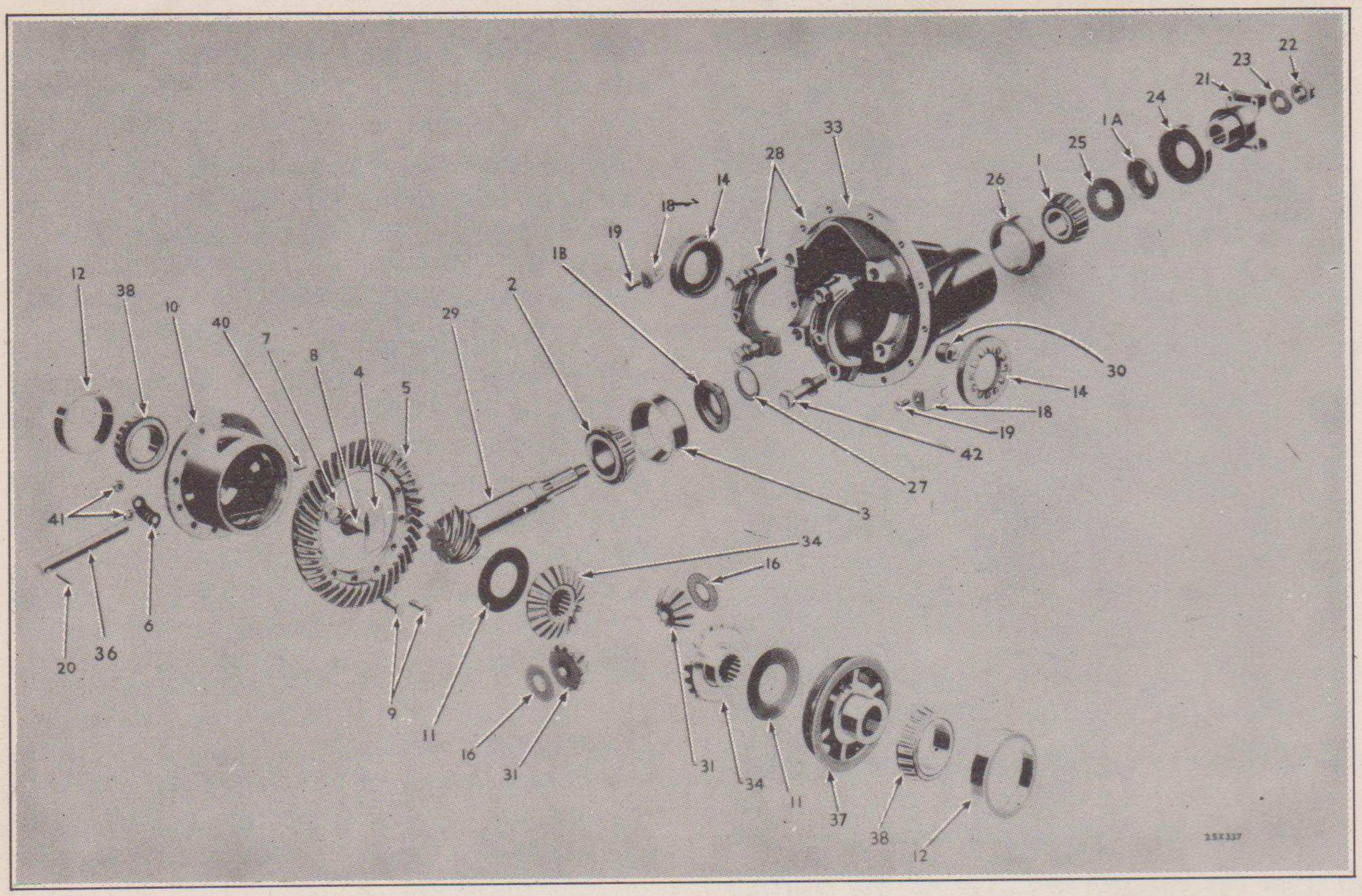


Fig. 51—Front and Rear Axle Differential (disassembled view)

Figs. 51 and 52—Front and Rear Axle Differential

1—Drive pinion front bearing cone and rollers
1A—Drive pinion front bearing oil slinger
1B—Drive pinion rear bearing oil baffle
2—Drive pinion rear bearing cone and rollers
3—Drive pinion rear bearing cup
4—Drive gear thrust pad
5—Drive gear
6—Drive gear bolt nut lock
7—Drive gear thrust screw lock nut
8—Drive gear thrust screw and lockwasher
9—Drive gear bolts
10—Differential case
11—Differential gear thrust washer
12—Differential bearing cup
13—Housing
14—Differential bearing adjuster
15—Drive shaft (rear axle drive shaft illustrated)
16—Differential pinion thrust washer
17—Housing cover gasket
18—Differential bearing adjuster lock
19—Differential bearing adjuster lock screw
20—Differential pinion shaft lock pin
21—Propeller shaft companion flange
22—Propeller shaft companion flange nut
23—Propeller flange companion nut washer
24—Drive pinion bearing oil seal
25—Drive pinion front bearing washer
26—Drive pinion front bearing cup
27—Drive pinion bearing spacer
28—Drive pinion carrier and cap
29—Drive pinion
30—Lubricant filler and level plug
31—Differential pinion
32—Differential carrier stud nut
33—Differential carrier gasket
34—Differential gear
35—Drive shaft (rear axle drive shaft—illustrated)
36—Differential pinion shaft
37—Differential case cap
38—Differential bearing cone and rollers
39—Housing cover
40—Differential case cotter pin
41—Drive gear bolt nuts
42—Drive pinion carrier cap screw and lockwasher

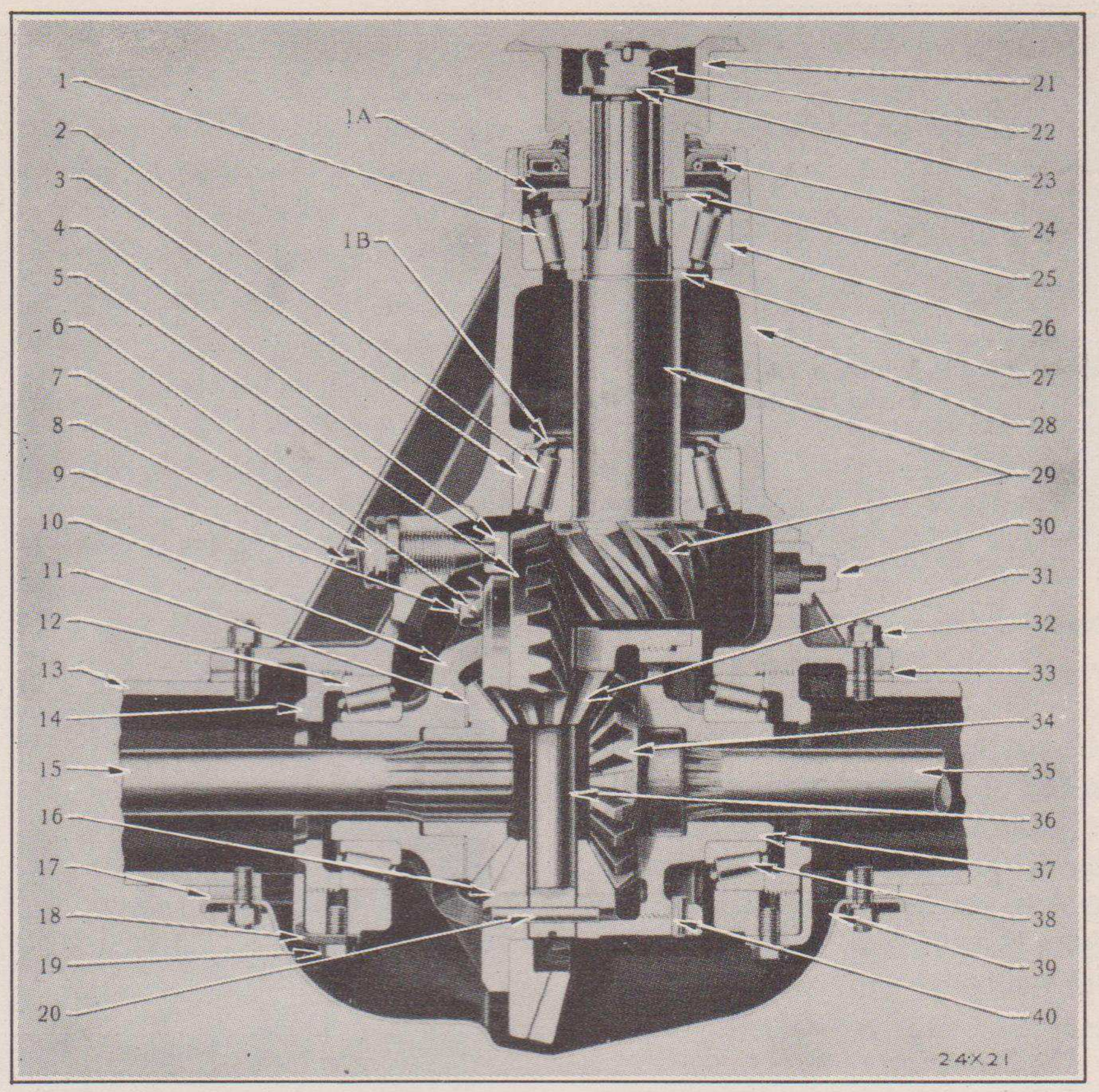


Fig. 52—Front and Rear Axle Differential (assembled view)

case without heating the cap. *Do not heat the case with a flame,* due to the use of composition washers behind the side gears. Remove the case from the water and attach it immediately to a fixture and remove the cap, using a special spanner wrench, C-525 as shown in Fig. 53. While a helper applies pressure on the spanner wrench, jar the cover loose with a hammer and soft drift with a smart rap on the web of the cap.

(f) Remove the differential pinion shaft lock pin by driving it out of the case with a hammer and punch. See Fig. 54.

(g) Remove the differential pinion shaft. The gears and thrust washers will then all be loose and fall out of the case.

(h) Remove the nuts and bolts that hold the drive gear to the differential case.

(i) Push the drive gear off the differential case.

Assembly of Differential

When installing the differential gears and thrust washers, coat these parts with differential lubricant to facilitate holding them in place while installing the pinion shaft. After the differential pinion shaft is in position, install the lock pin and peen over the outside edge of the hole to retain the pin in place.

It will be necessary to heat the case (Fig. 55) as outlined in the foregoing disassembling instructions and install the case cap, tightening it rigidly with a spanner wrench, C-525, as far as it will go. Drill a new hole through the cap and case of a size corresponding to the small end of the case cap lock pin, and install a new (unused) lock pin, driving it in flush with the outside of the case.

Upon completing the assembly operations, install the differential unit in the carrier, making sure the drive gear thrust pad is in position. Then adjust the differential bearings and the gear clearance as outlined in Subject 62.

62—Differential Bearing Adjustment

The differential bearings may be adjusted without removing the carrier assembly from the

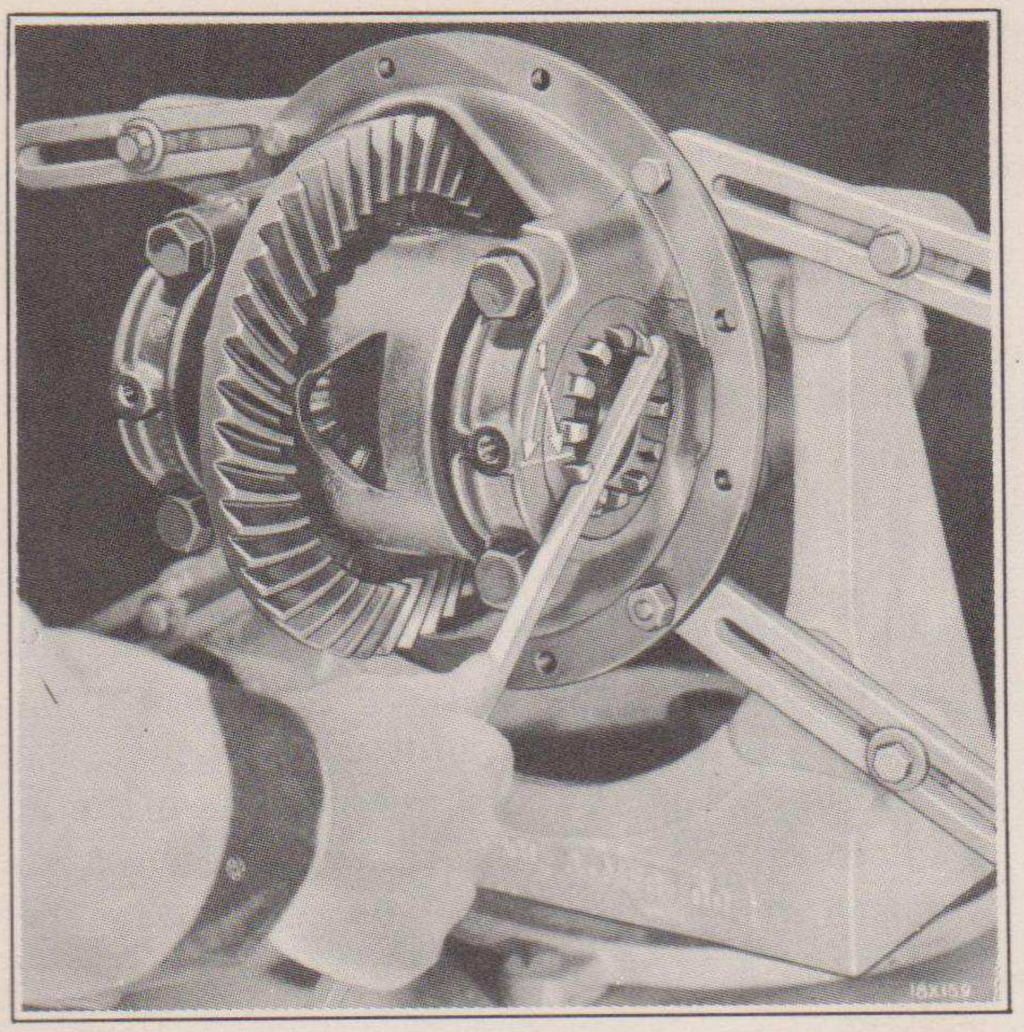


Fig. 56—Adjusting Differential Bearings
1—Locating marks for differential bearing adjusters

or left by turning the right and left hand adjusters an *equal* amount in the same direction to give the required clearance between the drive gear and the pinion and tighten the bearing cap retaining screws. To do this loosen the right hand adjuster, counting the number of lugs the adjuster is moved; then tighten the left hand adjuster an *equal* amount in the same direction to maintain the proper bearing tension.

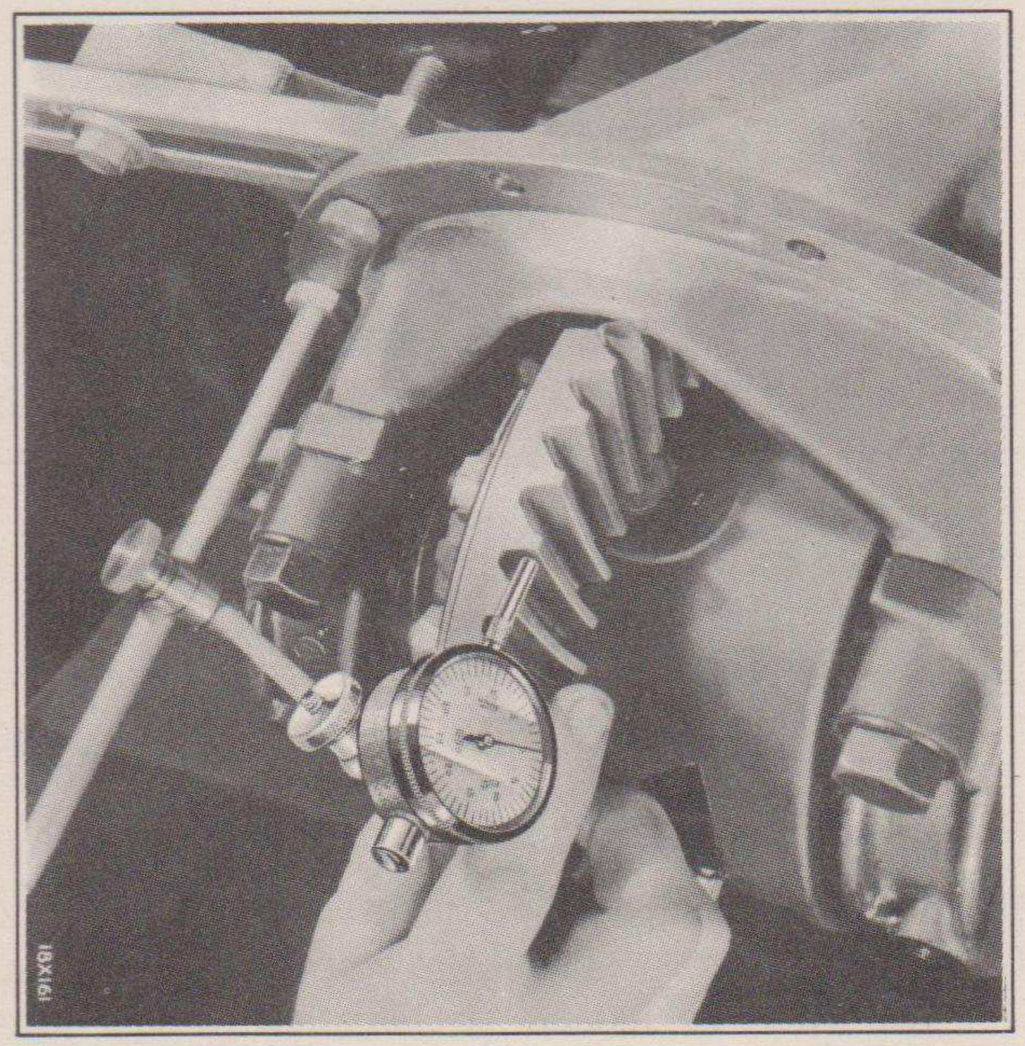


Fig. 57—Checking Clearance Between Drive Gear and Pinion with Indicator (Tool C-430)

(g) Check the clearance of the drive gear with an indicator as shown in Fig. 57. If the clearance is not satisfactory, move the differential assembly to the right or left as required in the manner just described. The correct clearance between the drive gear and the drive pinion is .005" to .010".

If the tooth contact has been changed in making the differential adjustments, it will be necessary to move the drive gear sideways as required for proper tooth contact. The clearance between the drive gear and the drive pinion, however, must be maintained within the specified limits.

63—Drive Gear Thrust Screw

The drive gear thrust screw illustrated in Fig. 58, is adjusted at the factory to allow about .010" clearance between the thrust pad on the screw and the drive gear. This clearance is obtained by turning the thrust pad adjusting screw tight and backing it off ⅛ of a turn. The thrust screw is then arc welded in position so the adjustment cannot be altered. This adjustment is maintained as long as the drive gear pinion has the required amount of clearance. When replac-

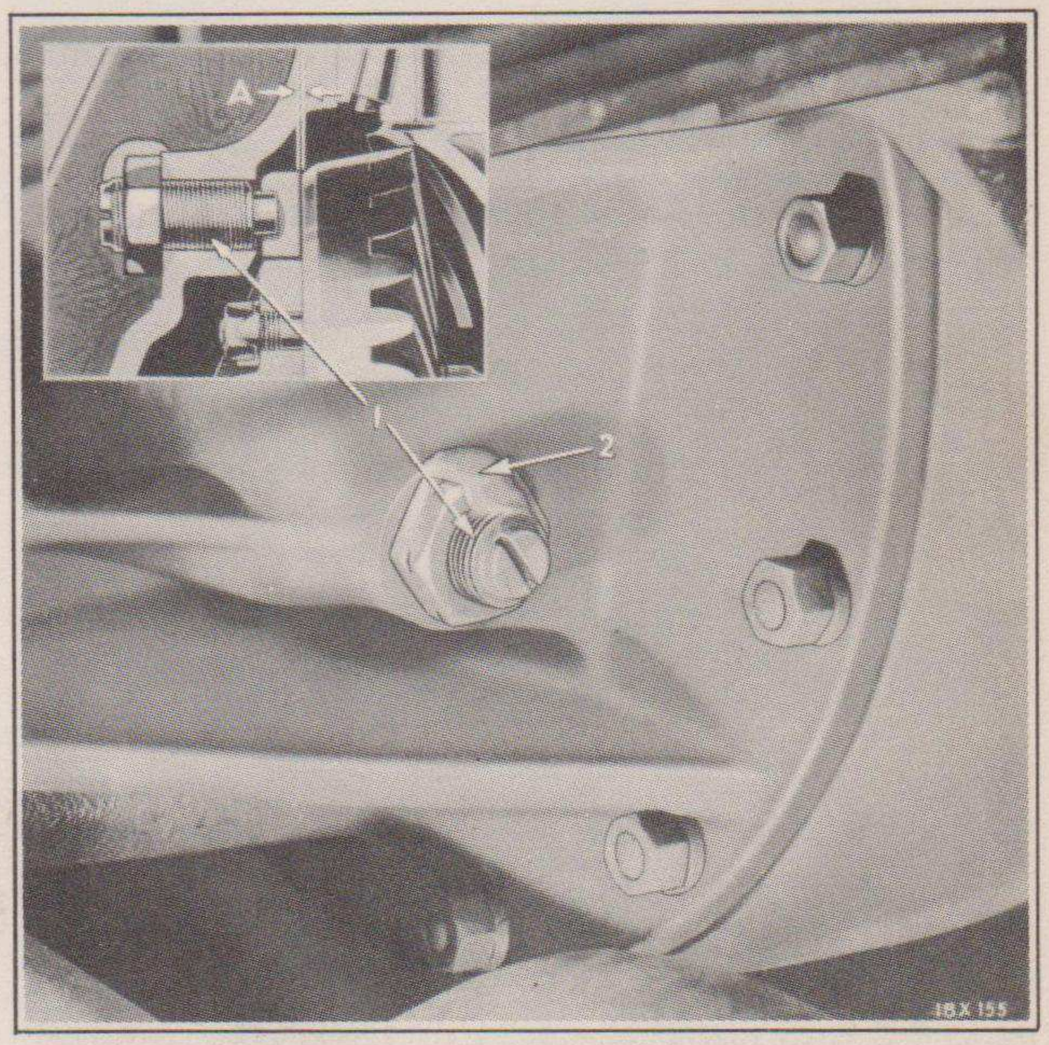


Fig. 58—Drive Gear Thrust Screw
1—Drive gear thrust screw and nut 2—Weld
A—Clearance between drive gear and thrust pad

ing the drive gear and drive pinion, it is good practice to inspect the thrust pad and replace it if found to be worn or damaged. Also, always make sure the thrust pad is in position when installing the differential unit.

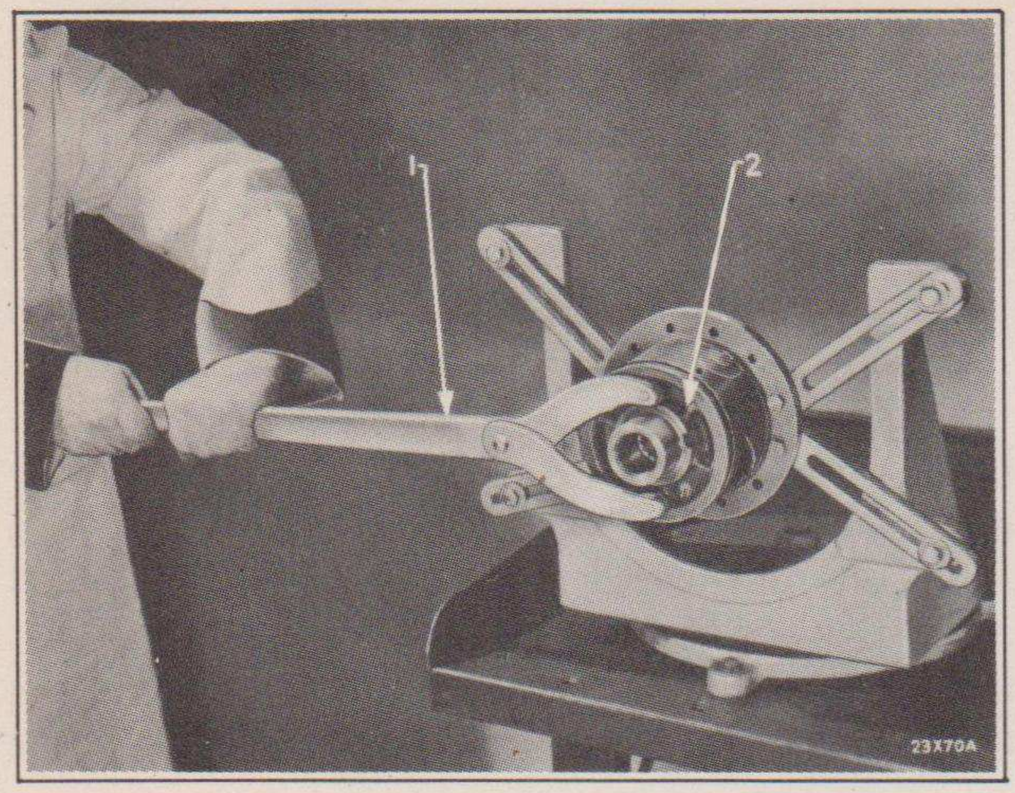


Fig. 53—Removing Differential Case Cap
1—Tool C-525 2—Differential case cap

truck after first removing the axle housing cover and withdrawing the universal drive assemblies or the axle drive shafts as covered in Subjects 33 and 56. If the differential carrier assembly is out of the truck, the assembly should be mounted on a bench stand for making the bearing adjustments.

Bearing Tension

(a) After removing the bearing adjuster locks, loosen the differential bearing cap retaining screws just enough to permit turning the differential bearing adjusters with a suitable bar that will fit in between the lugs on the adjusters as shown in Fig. 56.

(b) Tap the differential bearing caps with a lead hammer to loosen the adjusters and the bearing cups.

(c) Set the bearing adjuster on the left hand side to permit an approximate adjustment of clearance between the drive gear and the drive pinion.

(d) Tighten the right hand bearing adjuster with sufficient force to seat the bearing cups and produce bearing tension, tapping the differential bearing caps with a lead hammer and at the same time turn the adjusters to insure the rollers, the cups and

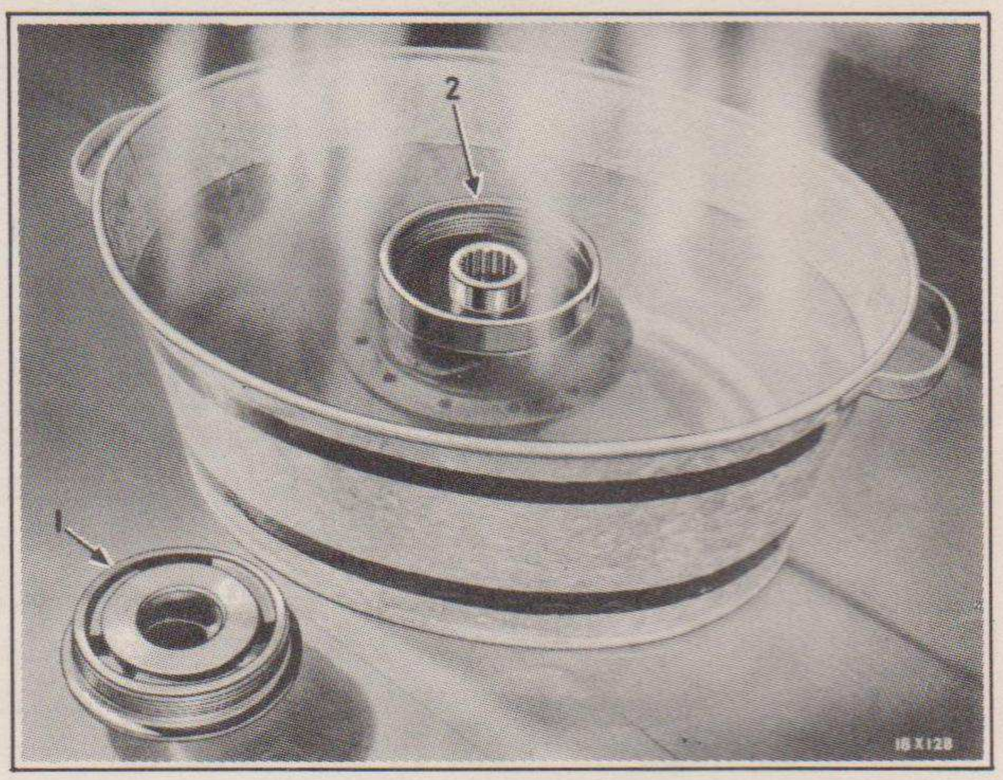


Fig. 55—Installing Differential Case Cap—Expanding the Case
1—Differential case cap 2—Differential case

the adjusters seating properly. Then tighten the bearing cap retaining screws on both sides.

This bearing adjustment should result in a slight drag (.010″ tension) when rotating the drive gear by hand. If the bearing tension is not satisfactory, readjust the right hand adjuster to get the proper tension. Note: It is advisable to remove the drive pinion bearing oil seal when making this adjustment to eliminate oil seal drag.

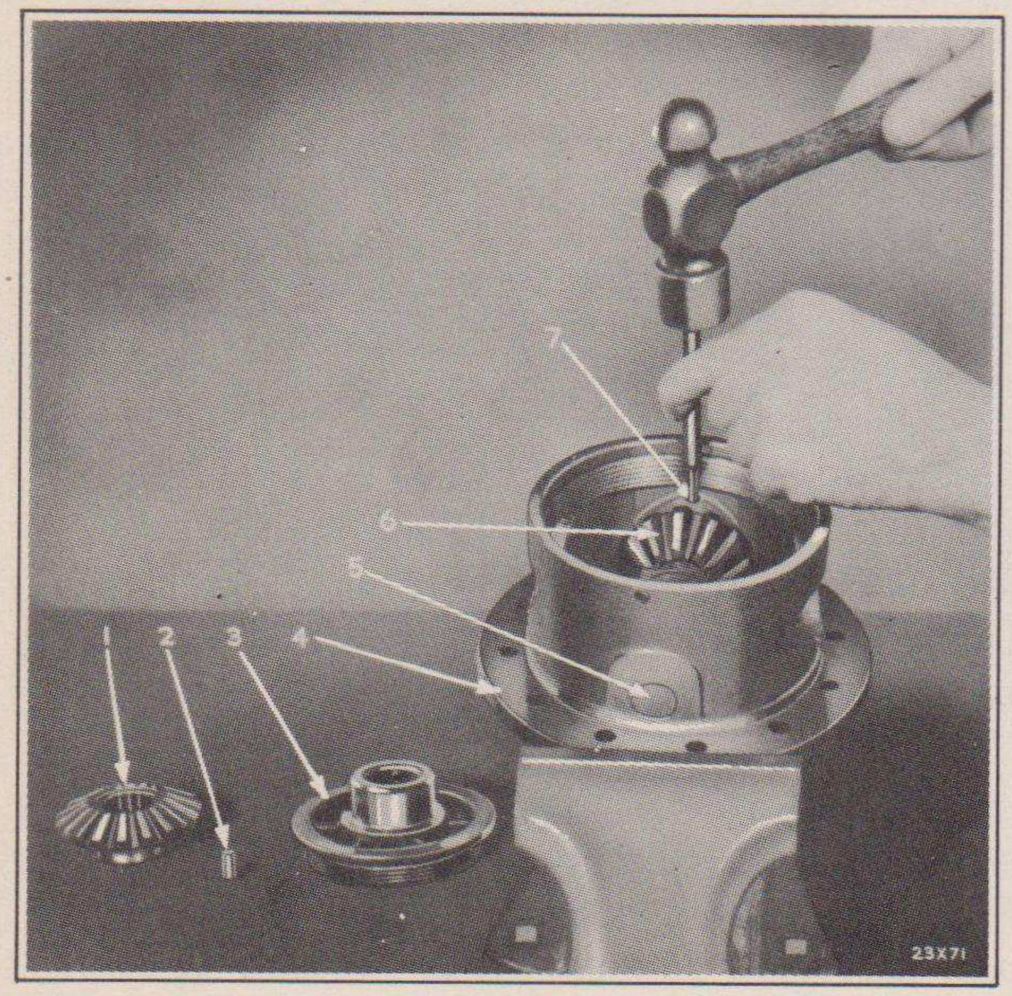


Fig. 54—Removing Differential Pinion Shaft Lock Pin
1—Differential side gear
2—Differential gear case cap lock pin
3—Differential case cap
4—Differential case
5—Differential pinion shaft
6—Differential pinion
7—Differential pinion shaft lock pin

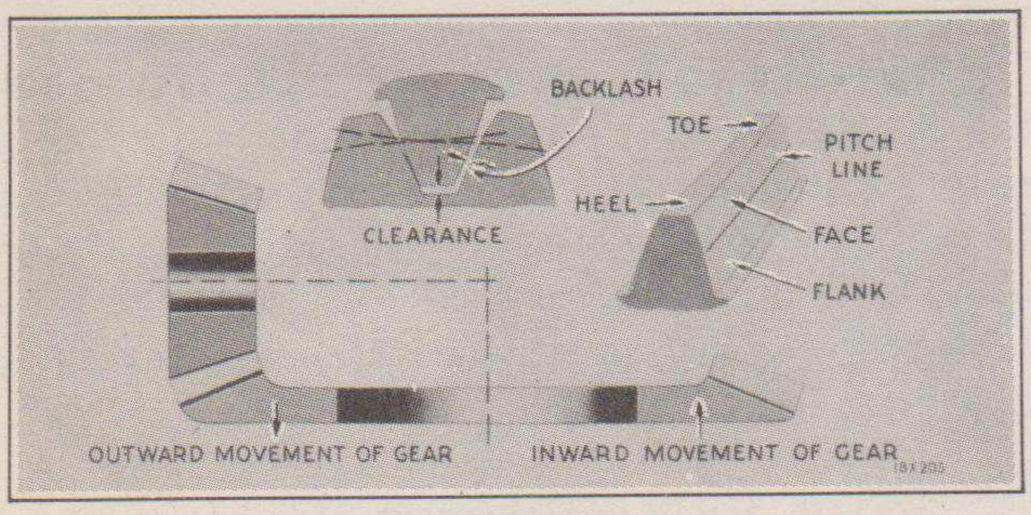
Gear Clearance (Back-Lash)

(e) Loosen the bearing cap retaining screws on both sides and tap the caps with a lead hammer to loosen the adjusters and the bearing cups.

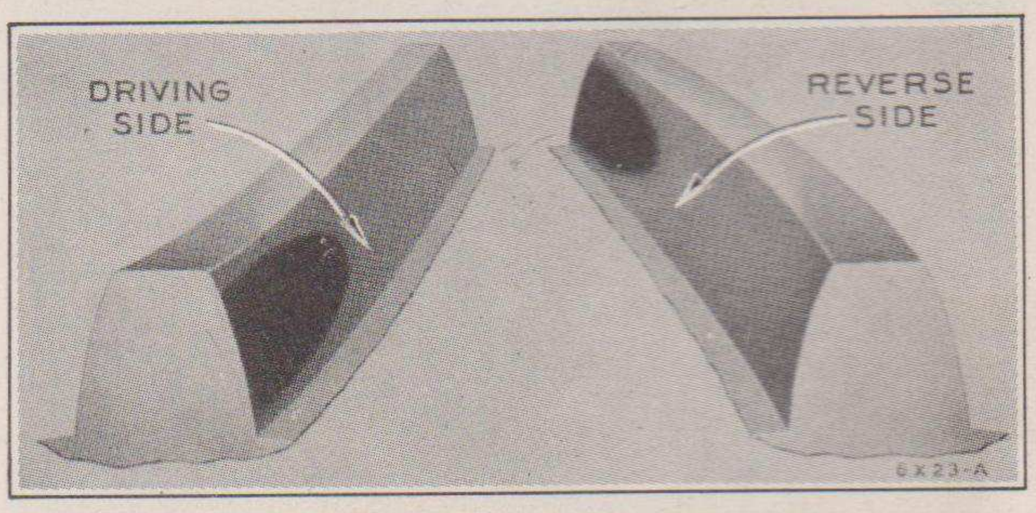
(f) Move the differential assembly to the right

Axle Gear Tooth Contact

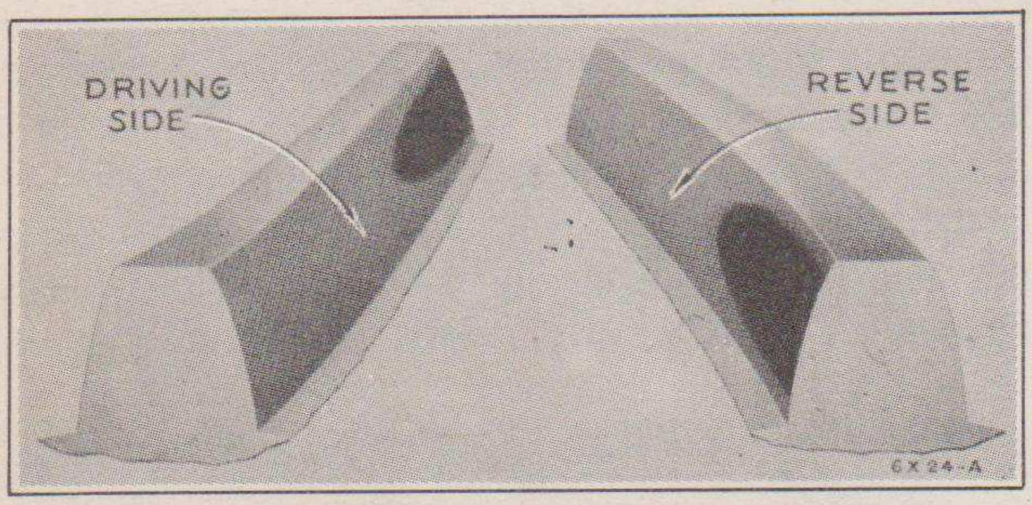
The illustrations presented below, show the various tooth contacts which are obtained by moving the drive gear to the right or left for decreasing or increasing the amount of clearance between the drive gear and the drive pinion. Proper tooth contact is essential for quiet operation and long life of the gears.

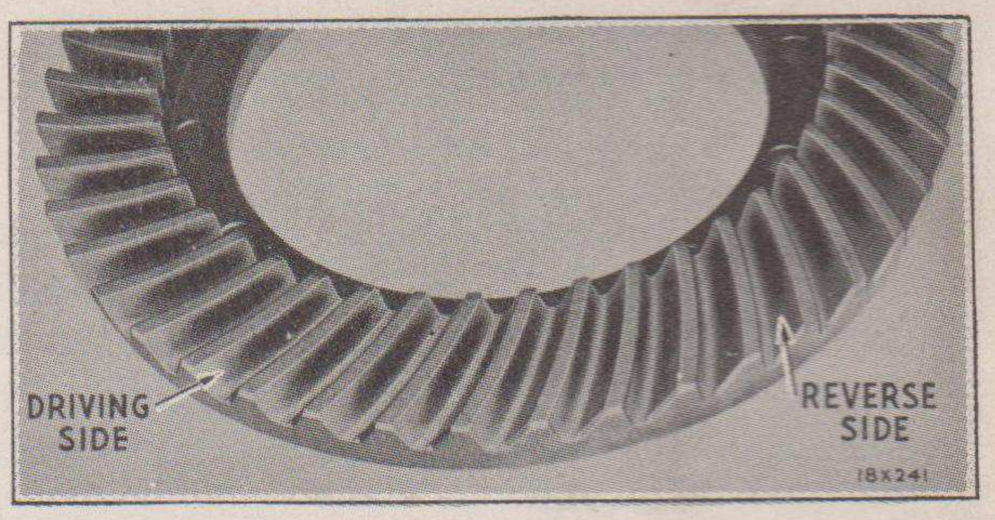


Gear Tooth Nomenclature

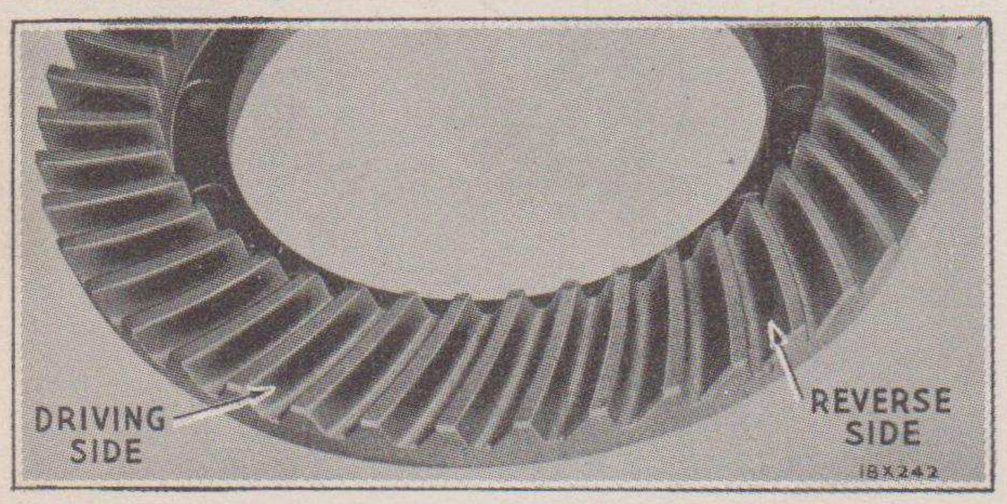


Hypoid gear incorrect bearing with drive bearing at heel end. Gear will eventually break. Move ring gear in toward pinion, maintaining back-lash within the specified dimension.



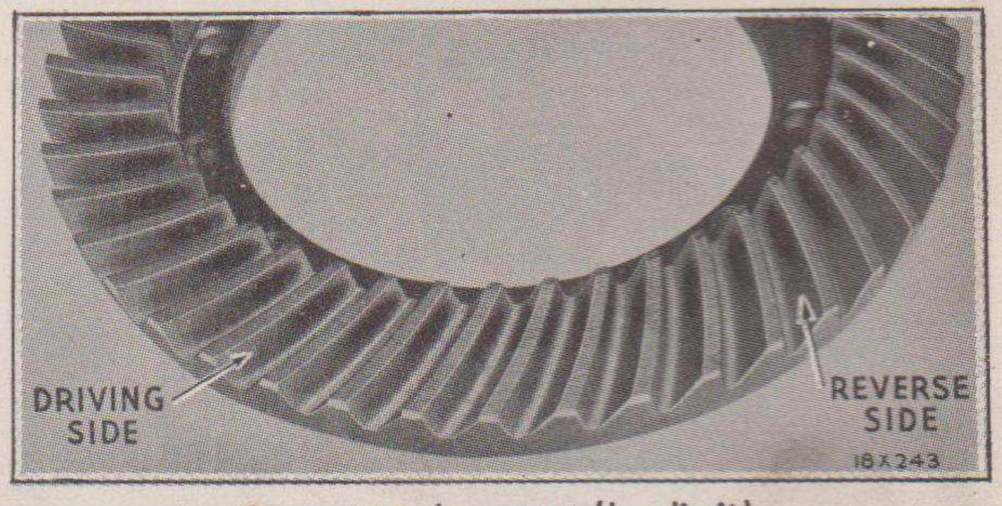


Hypoid gear incorrect bearing with drive bearing at toe end. Gears will eventually break. Move ring gear out, away from pinion, maintaining back-lash within the specified dimension.



Correct tooth contact (high limit)

Correct tooth contact (desired setting). Check by spinning gears with slight drag on ring gear. Gears set as shown give best results for quiet operation and long life.



Correct tooth contact (low limit)

64—Drive Pinion

Removal and Installation

(a) Remove the differential assembly as explained in Subject 61. It is not necessary to remove the differential carrier assembly or the drive pinion if only the drive pinion oil seal is to be replaced.

(b) Remove the propeller shaft companion flange cotter pin, the retaining nut and the washer.

(c) Remove the propeller shaft companion flange using special tool CM-549 as shown in Fig. 59.

(d) Pull out the drive pinion through the gear end of the differential carrier case, being careful not to lose the bearing spacer between the shoulder on the shaft and the bearing next to the flange.

(e) Remove the bearing cone and rollers from the pinion shaft as shown in Fig. 60.

The bearing cone and rollers at the universal joint end of the drive pinion shaft can be re-

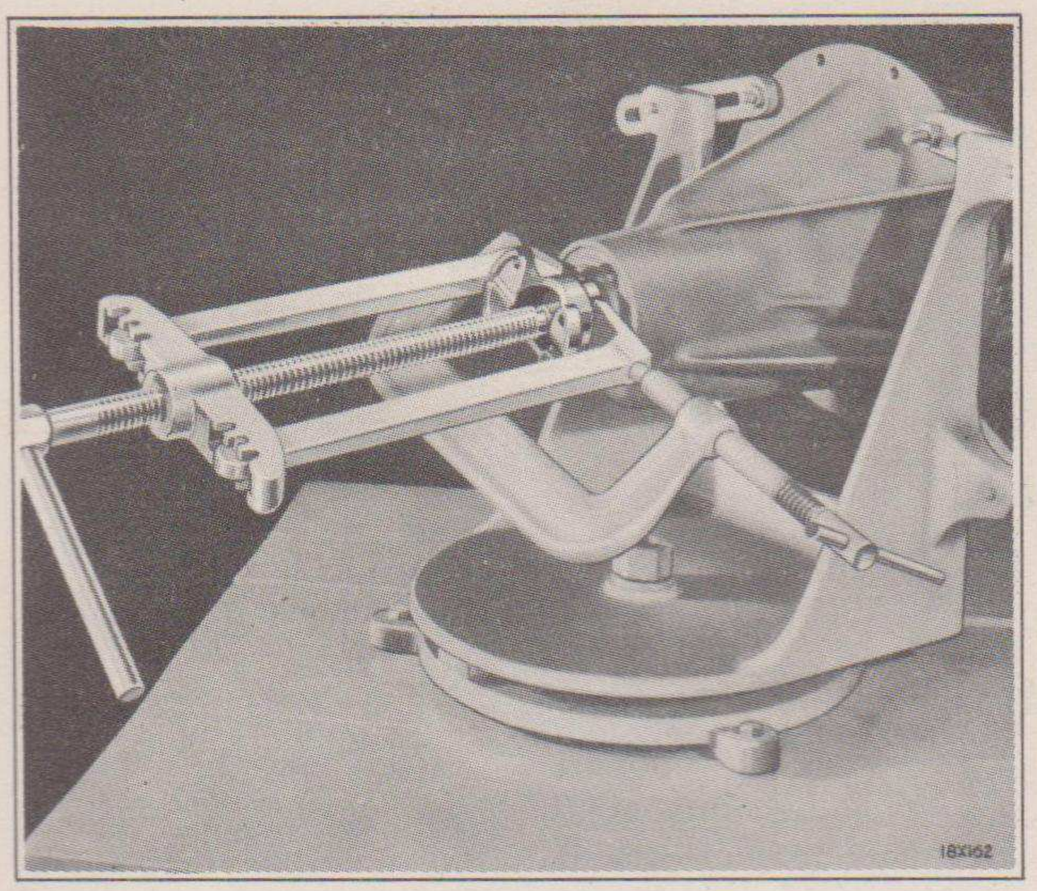


Fig. 59—Removing Propeller Shaft Companion Flange or Yoke (Tool CM-549)

moved from the carrier case after pulling out the oil seal with special tool C-358, See Fig. 61. When removing this oil seal be careful not to lose the washer and oil slinger between it and the bearing cone. The bearing cups can be driven out of the case with a drift and hammer.

Unless the drive gear and drive pinion or the carrier case are replaced with new parts, reassemble the drive pinion with the original bearing spacer. When the drive gear and drive pinion or the carrier case are replaced, adjust the drive pinion bearings as covered in Subject 66.

The oil baffle next to the bearing at the gear end of the pinion shaft should be assembled with a tab engaged in the lower notch of the carrier.

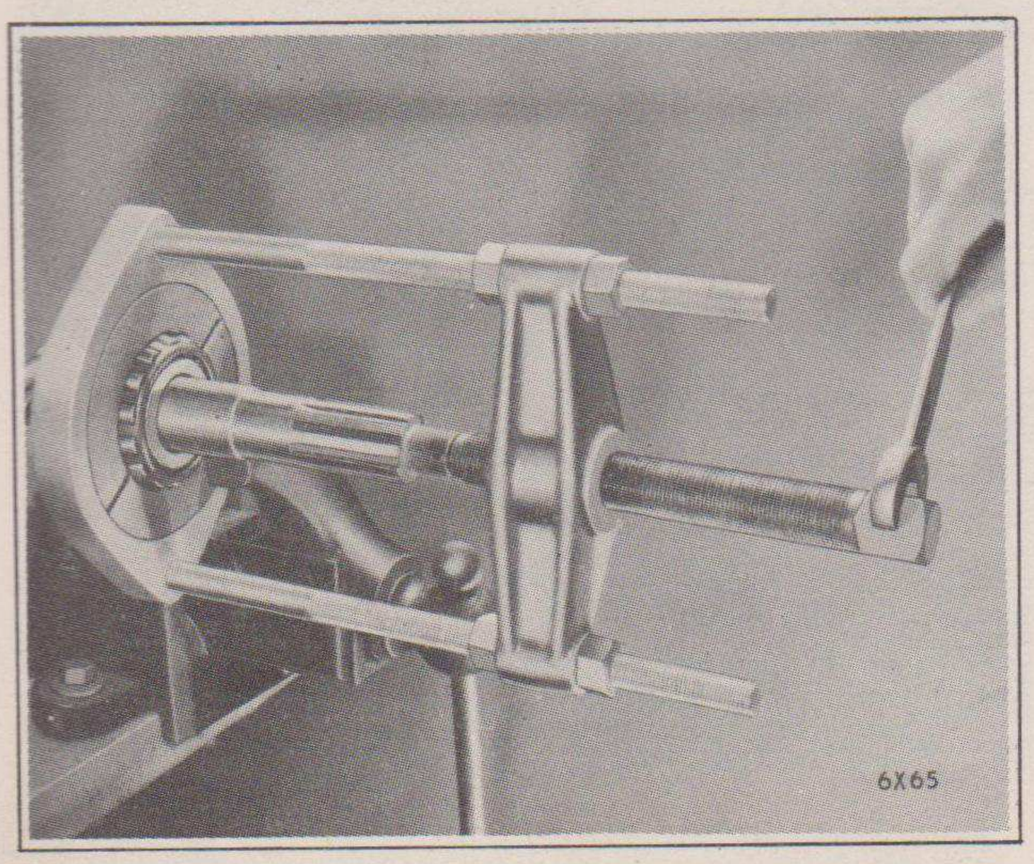


Fig. 60—Removing Drive Pinion Bearing with Tool C-293-U

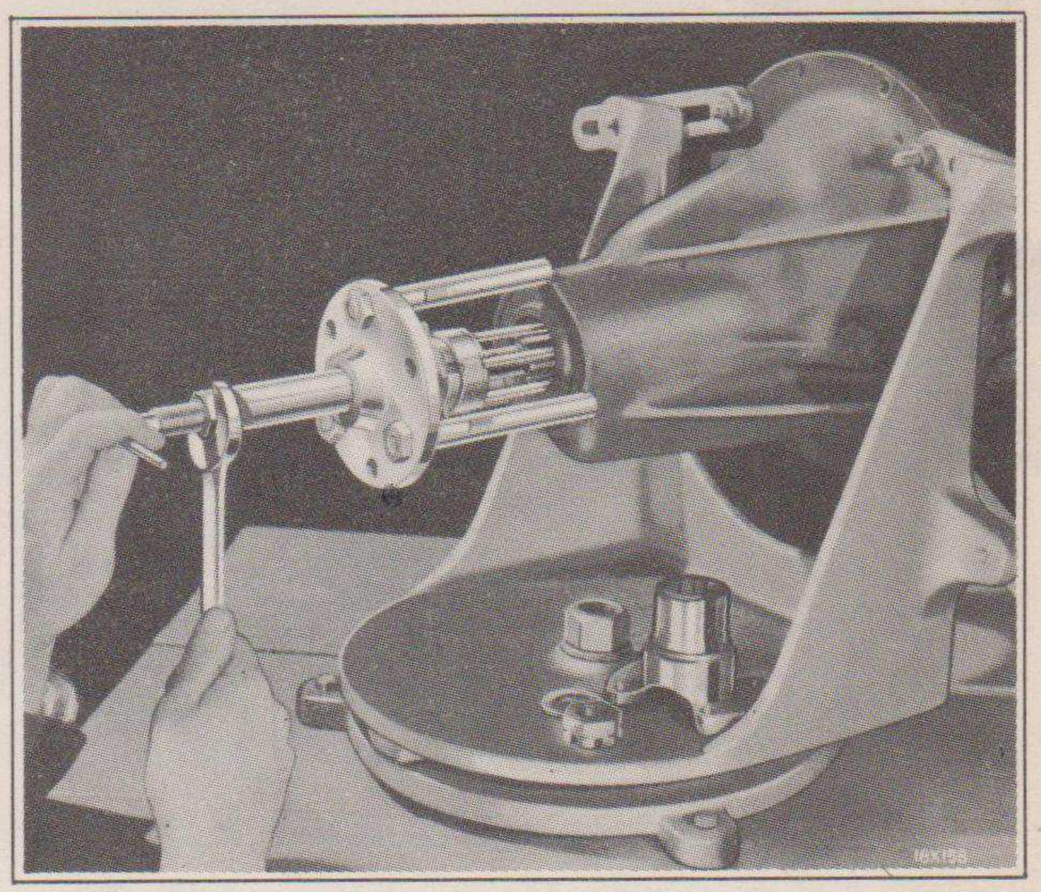


Fig. 61—Removing Drive Pinion Bearing Oil Seal with Tool C-358

The oil slinger should be installed between the propeller shaft companion flange and the washer with the beveled side toward the bearing. Make certain that the bearing adjustments are correct before installing the drive pinion bearing oil seal.

65—Drive Pinion Bearing Oil Seal

Removal and Installation

The drive pinion bearing oil seal can be replaced without removing the differential carrier assembly.

CAUTION: All dirt should be removed from around the oil seal and the end of the carrier casting before starting this operation.

(a) Disconnect the propeller shaft universal joint at the pinion shaft.

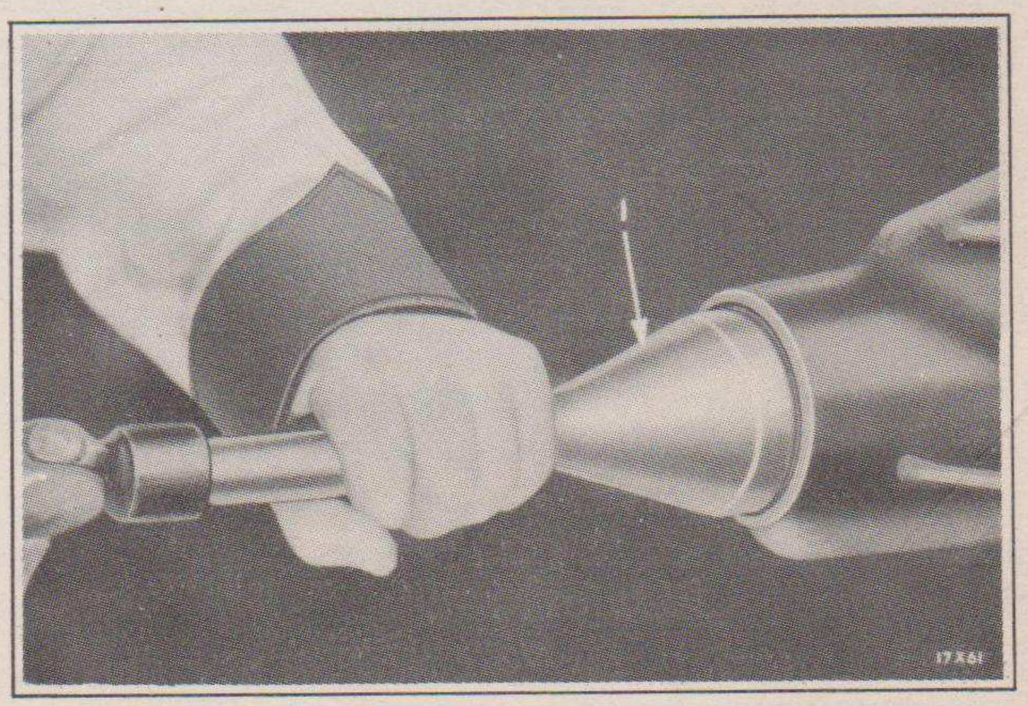


Fig. 62—Installing Drive Pinion Bearing Oil Seal with Tool C-359

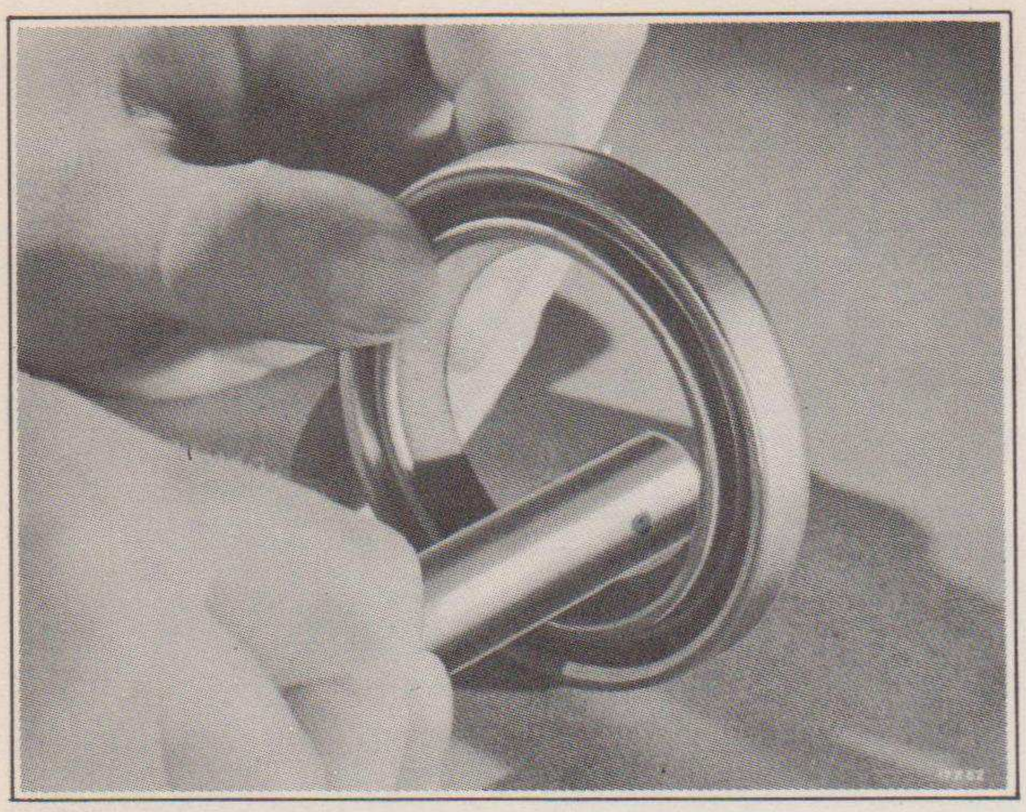


Fig. 63—Rolling Oil Seal

(b) Remove the propeller shaft companion flange nut, holding the flange with spanner wrench No. C-525, and pull the flange off the pinion shaft with special tool CM-549 (Fig. 59).

(c) Remove the drive pinion bearing oil seal by means of special puller tool C-358 (See Fig. 61). Inspect the oil seal and replace with a new one.

The oil seal should be installed with pinion oil seal drift (C-359) so that it will be in tight contact with its seat. See Fig. 62.

Installing Leather Oil Seals

When installing leather oil seals, care must be taken to make certain that the leather is in good condition—soft and pliable. New oil seals should be soaked in thin, warm (not hot) oil for about 30 minutes. Then the leather should be worked by rolling the seal with pressure applied by a smooth bar before installing. See Fig. 63. Inspect the surface of the shaft or other parts where contact is made with the leather to make certain that it is smooth and not worn, as roughness will cause rapid wear of the seal, which results in oil leakage.

66—Drive Pinion Bearing Adjustment

The only occasion for adjusting the drive pinion bearings is when the pinion or the carrier casting is replaced. Adjustment is controlled by the thickness of the drive pinion bearing spacer. The bearings should be adjusted so that when the pinion shaft nut is turned tightly against the propeller shaft companion flange, all rollers in the bearings are tight, but still permit rotating the drive pinion by hand. The drive pinion bearings should be .0015″ to .0025″ tight. To adjust or check the adjustments, the drive pinion must first be removed as outlined in Subject 64 and a spacer inserted behind the bearing nearest the universal joint, of sufficient thickness to cause some end-play. Then proceed as follows:

(a) Place dial indicator (C-430) on the end of the drive pinion shaft and differential carrier as shown in Fig. 64.

(b) Move the shaft endwise to determine the amount of end-play. If the indicator shows, for example, .004″ end-play in the drive pinion, remove the drive pinion bearing spacer, and measure with a micrometer the thickness of the spacer to determine the size of the new spacer to be used. In the present case with .004″ end-play, you would install a new spacer .006″ thinner than the spacer used to make the check just described, in order to give the necessary .002″ draw on the drive pinion bearings.

Suppose, on the other hand, a spacer .1850″ thick were used to check the initial end-play in the drive pinion and the indicator showed .002″ end-play. You would then use a spacer .1810″ thick (.1850″ — [.002″ + .002″] = .1810″) to give the correct bearing adjustment. Spacers in thicknesses of 1790″, .1810″, .1830″, .1850″, .1870″, .1880″, .1910″, and .1930″ are available through the Chrysler Corporation Parts Division.

Before installing the drive pinion bearings,

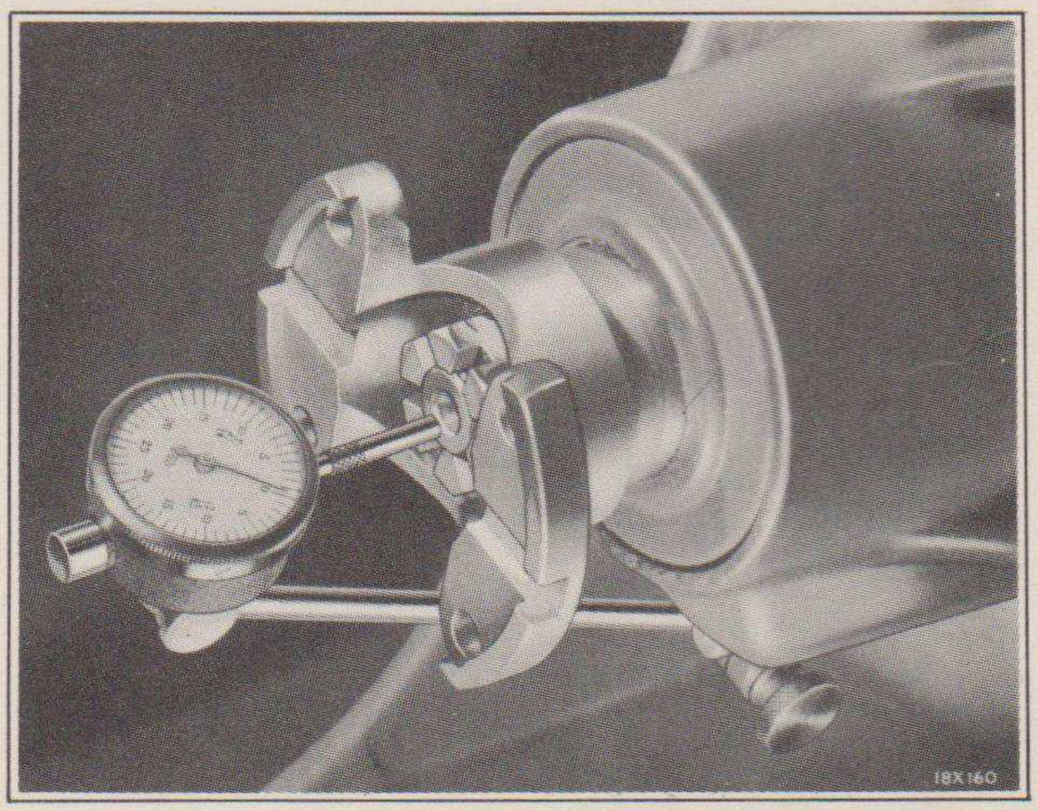


Fig. 64—Checking End-Play of Drive Pinion with Indicator (Tool C-430)

they should be thoroughly lubricated with the proper differential lubricant. Refer to the "Lubrication" section of this Manual for recommendations.

67—Checking Axle Gear Ratio

If the axle ratio of a truck is not known, the approximate ratio may be determined as follows:

Place the transmission gear shift lever in neutral position. Mark one of the tires with chalk, also place a chalk mark on the propeller shaft.

Roll the truck forward so that the road wheels make *exactly one complete revolution*; at the same time have a helper count accurately the number of revolutions the propeller shaft makes, using the chalk mark as a guide. If the propeller shaft makes, for example, 4¾ revolutions to one revolution of the wheels, the approximate gear ratio would be 4.75 to 1. With a gear ratio of 4.89 to 1, the propeller shaft would make approximately 4⅞ revolutions to one of the road wheels.

SERVICE DIAGNOSIS

68—Axle Noises

Continuous Hum

(a) Tire noise on the road. Certain kinds of road pavement surface cause tire noise.

(b) Incorrect adjustment of the wheel bearings, the drive pinion bearings or the differential bearings.

(c) Drive gear (ring gear) and drive pinion tooth contact incorrect.

Hum While Coasting

(a) Inspect condition of wheel bearings.

(b) Inspect drive gear adjustment and readjust if necessary.

Hum with Engine Pulling

(a) Inspect drive gear adjustment and if necessary adjust closer to pinion.

Knocks

(a) Inspect for damaged bearings, chipped gear teeth or metal chips lodged between the teeth on the drive gear and drive pinion.

69—Back-Lash in Drive Line

Before checking an axle for excessive back-lash, make sure all other causes of back-lash have been eliminated, such as:

(a) Engine tune-up; engine must be properly tuned for smooth operation.

(b) Clutch disc loose on clutch shaft.

(c) Excessive play in transmission gears.

(d) Universal joints worn or flanges loose on shafts.

See Subject 275 in the "Transmission" section for additional causes of back-lash in the drive line.

Check Axle For:

(a) Loose driving flanges on wheel hubs.

(b) Excessive wear at splined end of universal drive assemblies or axle drive shafts.

(c) Excessive clearance between drive gear and drive pinion.

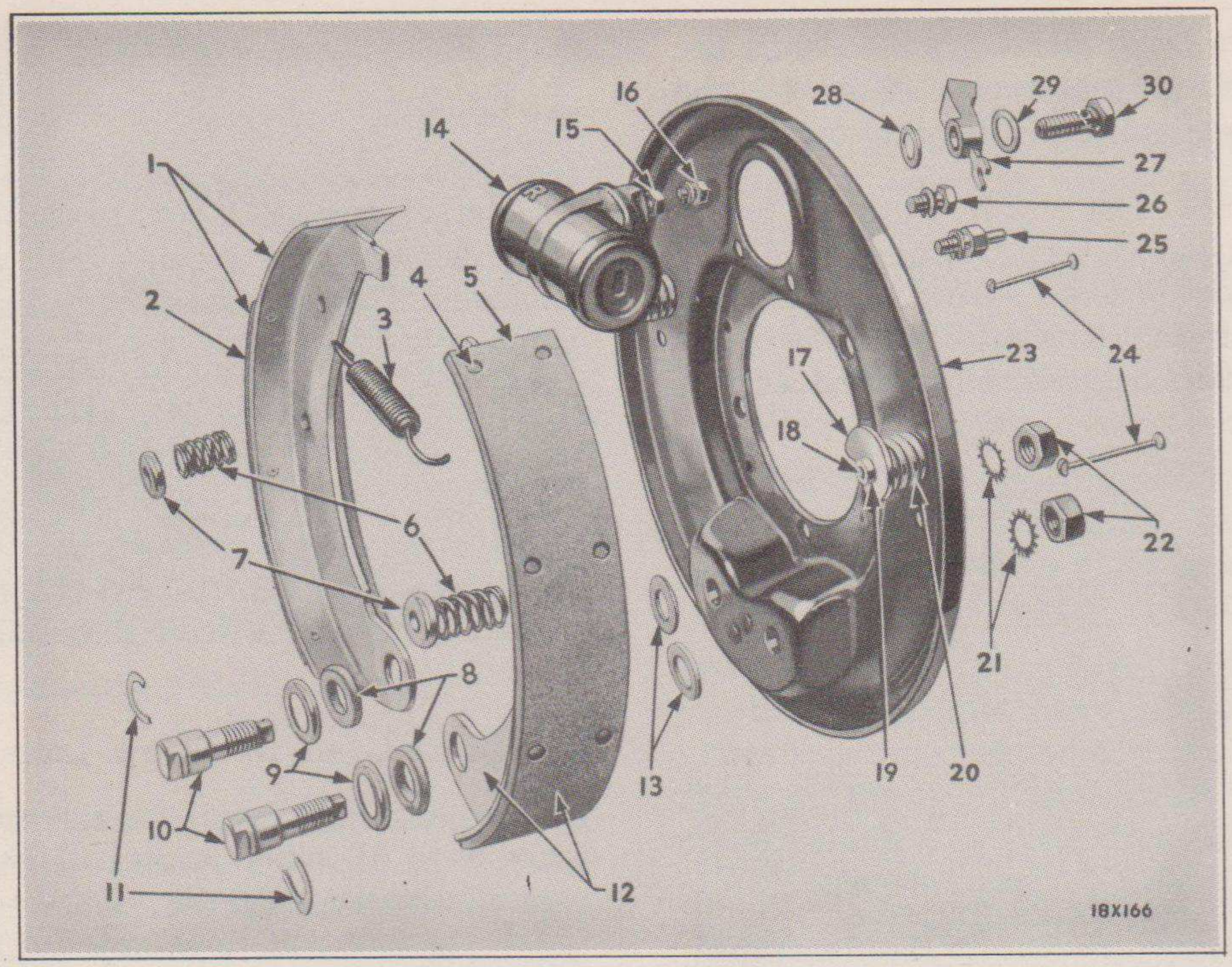


Fig. 65—Wheel Brake

1—Brake shoe and facing—rear
2—Brake shoe facing (lining)—rear
3—Brake shoe return spring
4—Brake shoe facing rivet
5—Brake shoe facing (lining)—front
6—Brake shoe guide rod spring
7—Brake shoe guide rod spring retainer
8—Brake shoe anchor bolt oil washers
9—Brake shoe anchor bolt oil washer retainers
10—Brake shoe anchor bolts
11—Brake shoe anchor bolt "C" washers
12—Brake shoe and facing—front
13—Brake shoe anchor bolt spacers
14—Wheel cylinder assembly
15—Wheel cylinder bleeder screw
16—Wheel cylinder bleeder screw cap screw and lockwasher
17—Brake shoe adjusting cam
18—Brake shoe adjusting pin wick
19—Brake shoe adjusting pin
20—Brake shoe adjusting cam spring
21—Brake shoe anchor bolt nut lockwashers
22—Brake shoe adjusting bolt nuts
23—Brake support
24—Brake shoe guide rod
25—Front wheel cylinder mounting screw and lockwasher—front
26—Wheel cylinder mounting screw and lockwasher
27—Front wheel cylinder inlet connection
28—Wheel cylinder inlet connection gasket
29—Wheel cylinder inlet connection bolt gasket
30—Wheel cylinder inlet connection bolt

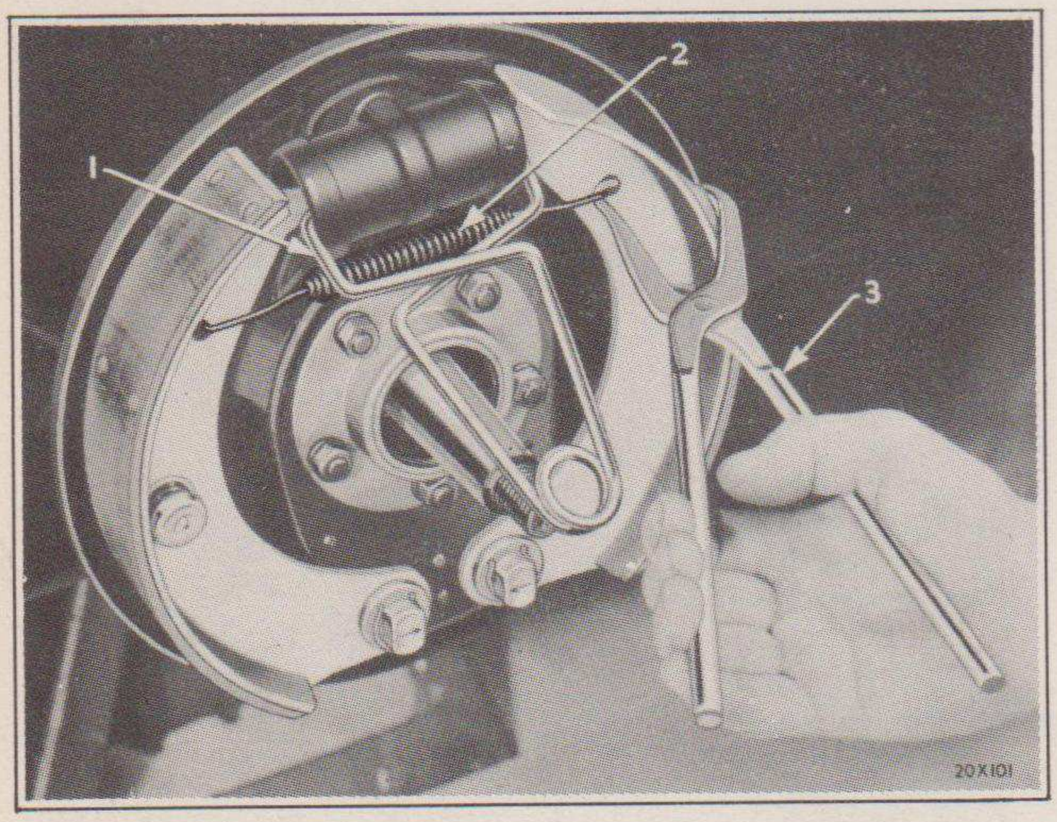


Fig. 66—Removing Brake Shoe Return Spring

1—Tool C-416
2—Wheel brake shoe return spring
3—Tool C-812

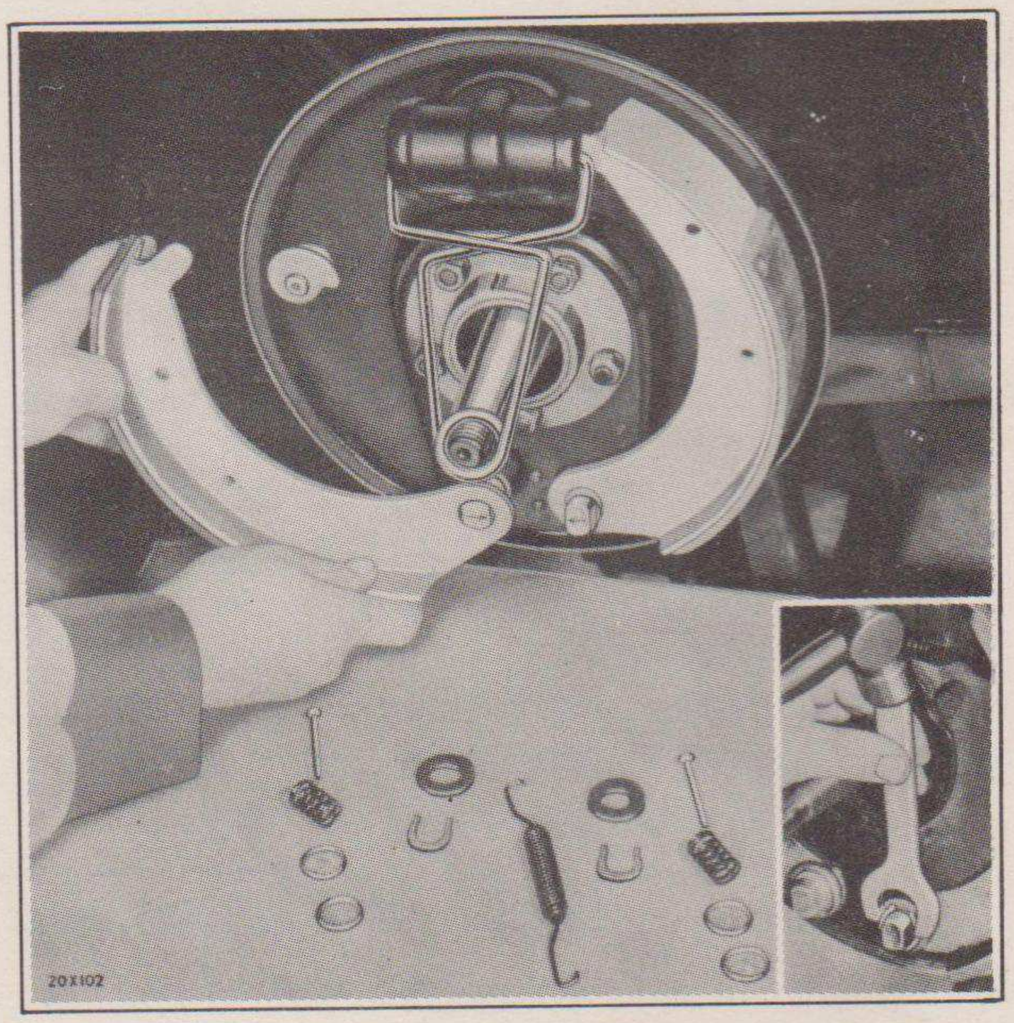


Fig. 67—Removing Brake Shoe

Wheel cylinder clamp C-416
Anchor bolt lock removing tool C-448

BRAKES

The foot brakes are of the hydraulic internal expanding four-wheel type operated by a foot pedal to the right of the steering column. The hand brake is of the external contracting type consisting of a band contracting around a drum on the rear of the transmission shaft and operated by a lever located to the right of the gear shift lever.

FOOT BRAKES

The foot brakes provide equalized brake shoe pressure at all four wheel brake drums.

Connected to the brake pedal is a piston which operates within a cylinder known as the master cylinder. When the brake pedal is depressed, the master cylinder piston forces the liquid through the tubes which lead to the four wheel cylinders (Fig. 65). The liquid is forced, by pedal pressure, between the inner ends of two pistons in each of the four wheel cylinders. The force of the liquid moves these pistons in opposite directions. The pistons, in turn, push the brake shoes against the brake drums.

Adjustments are provided to compensate for wear of the lining attached to the brake shoes. However, due to the principle of design, no adjustment is required or provided to equalize the brake shoe pressure.

70—Brake Shoes

Removal and Installation

(a) Block the brake pedal in the released position to prevent downward movement of it.

(b) Remove the wheel and brake drum assembly as explained in Subjects 43 and 58.

(c) Remove the brake shoe return springs. Avoid bending the spring ends by using a suitable tool as shown in Fig. 66.

(d) Install wheel brake cylinder clamp to prevent forcing the pistons out of the wheel cylinder.

(e) Remove the brake shoe anchor bolt "C" washers, oil washer retainers, oil washers, guide spring retainers, guide springs and the brake shoe. See Fig. 67.

When installing the brake shoes, care must be exercised to prevent leakage of brake fluid on the brake lining. By using the special wheel cylinder clamps, C-416 (Fig. 66), the pistons are prevented from leaving the wheel cylinder. However, if one of the pistons should be accidentally forced out of the cylinder, the brake lines should be bled as explained under Subject 75.

Brake Shoe Return Springs

The brake shoe return springs should be inspected for tension each time the brakes are relined. Weak, damaged or broken springs should be replaced. Both front and rear wheel return springs should be uniform in tension.

Brake Shoe Alignment

The maximum braking effect can only be procured if the entire length and width of the brake shoe lining contacts the surface of the brake drum. This alignment can be upset by a sprung brake support, bent shoe or anchor bolt, which does not protrude at right angles to the surface of the support.

An examination of the lining will indicate whether or not the brake shoe is out of alignment and the affected part should be straightened or replaced.

71—Brake Lining

One piece of brake lining is riveted to each brake shoe (2 shoes at each wheel). When the brakes are applied by pressing down on the brake pedal, the lining contacts the inside surface of the brake drum. The friction thus created, tends to slow or stop the vehicle, depending on the amount of pressure applied at the brake pedal.

Because friction between the brake lining and drum is utilized as a means of stopping the vehicle, the lining on the brake shoes will gradually wear and eventually require replacement depending, of course, on the amount and severity of brake application.

Brake lining should be replaced when it has worn down even with the rivet heads which hold it to the brake shoes. If the lining is not replaced, metal to metal contact may score the brake drums, necessitating refacing of the drums or replacement in extreme cases.

Grease, oil or brake fluid on the brake shoe lining destroys the effectiveness of the brakes and results in hard pedal pressure, grabbing, unequal braking or excessive noise. It is not practical to attempt to clean brake lining impregnated with such substances, with gasoline or grease solvents, because only temporary results can be obtained. A complete relining is recommended after eliminating the cause of the leakage, which can usually be traced to worn oil seals in the wheel hubs. See "Installing Leather Oil Seals," Subject 65.

Replacing Brake Lining

IMPORTANT: For satisfactory brake operation, always reline the brake shoes for BOTH front wheels with lining of the same material. This also applies to the rear wheels; always install new lining of the same material on both brake shoes in BOTH rear wheels.

To replace brake lining, the brake shoes must first be removed as explained in Subject 70.

(a) Remove the old lining by punching out the rivets.

(b) Rivet the lining to the brake shoes with the proper type of rivets. Never use aluminum rivets.

(c) Hold the lining on the brake shoe with a suitable clamp as shown in Fig. 68.

(d) Countersink the rivet heads in the lining approximately two-thirds the thickness of the lining.

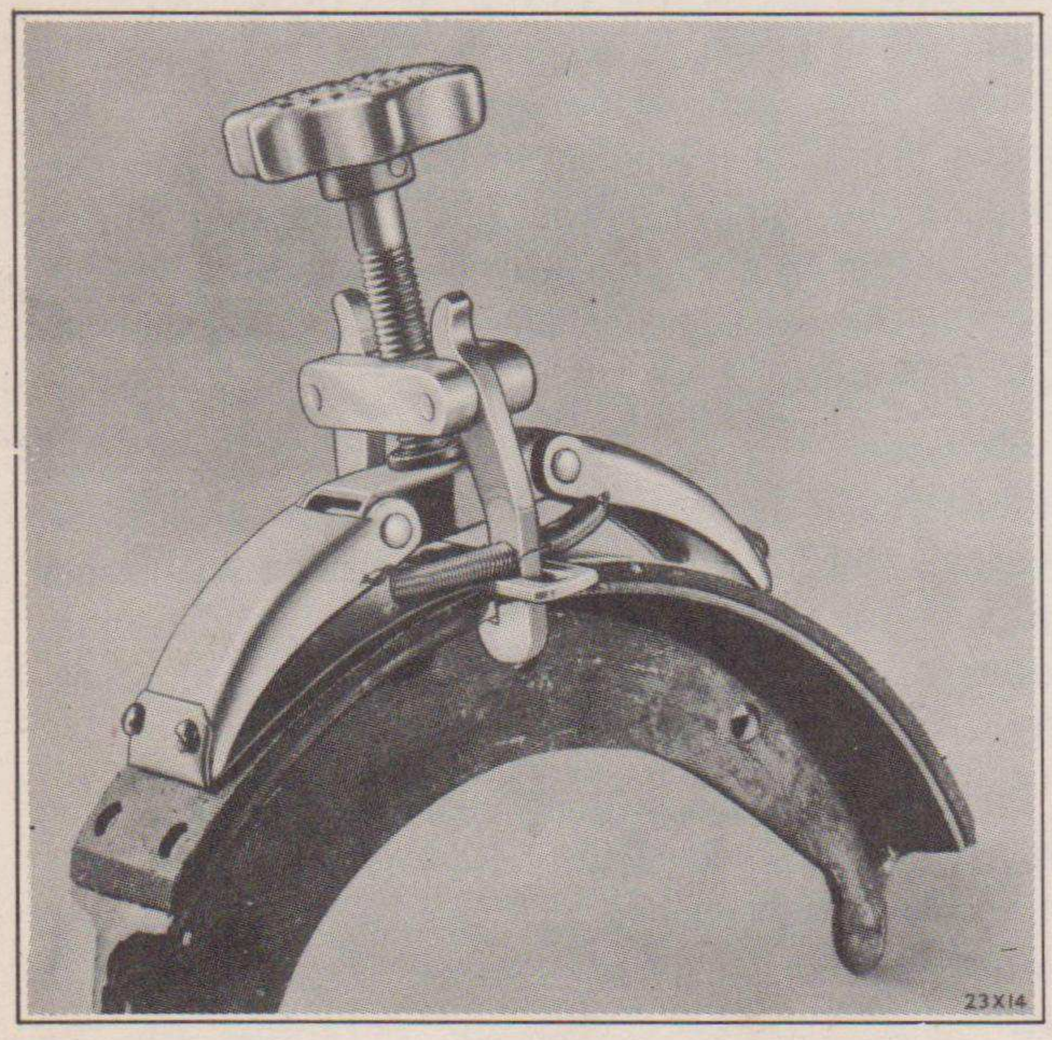


Fig. 68—Stretching Brake Shoe Facing with Tool C-557

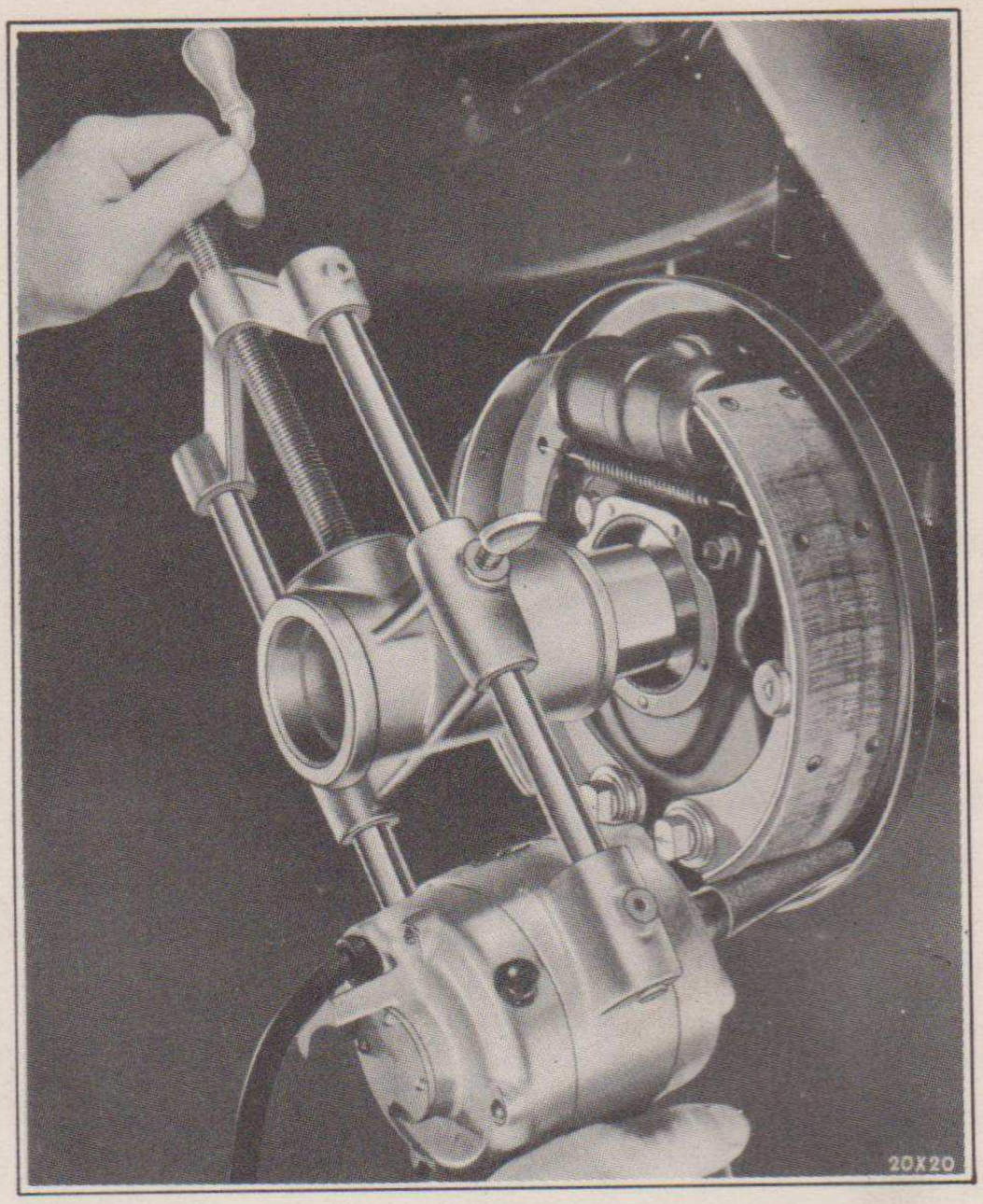


Fig. 69—Grinding Brake Shoe Facing (Tool MT-44)

(e) Chamfer the end of the lining back about ¾" from the top and bottom, and remove high spots or burrs around rivet holes with a grinding tool (Fig. 69) or a fine file. *Do not use emery paper.*

(f) Reinstall the brake shoes on the brake support.

(g) The brake shoes should then be adjusted as explained in Subjects 73 or 74.

Satisfactory brakes depend upon these factors:

(a) The drum must be concentric with the wheel hub.

(b) The brake shoe lining must be concentric with the brake drums.

Make sure that the brake drum is smooth and concentric with the wheel hub. If the drum is scored or an eccentric condition is found, it should be remachined in a drum reconditioning machine.

See "Service Standards" section of this manual for brake lining size.

ADJUSTMENTS

(Foot Brakes)

Brake shoe adjustments are divided into two classes, namely, minor and major.

A minor brake shoe adjustment is made by

moving the "toes" of the brake shoes. The cam for adjusting the "toes" of the shoes can be reached from the outside of the brake support (see Subject 72).

A major adjustment is made by moving both the "heel" and "toe" of the brake shoes to centralize the shoes in relation to drum diameter. See Subjects 73 and 74.

The "toe" of the brake shoe is the end that fits into the wheel cylinder.

The "heel" is the opposite end attached to the anchor bolt.

72—Minor Brake Adjustment

A minor brake shoe adjustment should be made when the brake drums are at room temperature; otherwise the brakes might drag.

(a) Check the total brake pedal travel. See Fig. 70. The total travel of the brake pedal is the result of the following:

A. Travel of the piston push rod before touching the piston in the master cylinder.

B. Travel of the piston required to cover the relief port.

C. Travel of the brake shoes to contact the brake drums.

Brake pedal travel "A" is termed "Free Play" and should be approximately $\frac{7}{16}$". This pedal free play may be felt readily by hand and is the movement of the pedal before the piston push rod touches the master cylinder piston. *If necessary* this adjustment can be made by changing the length of the master cylinder piston push rod.

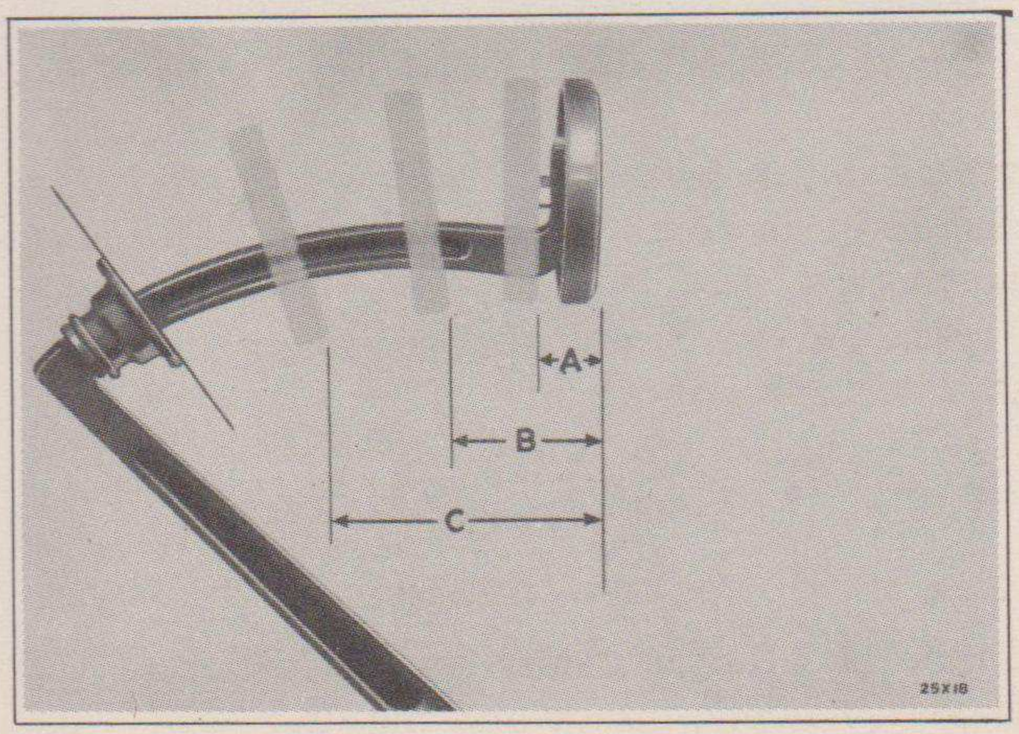


Fig. 70—Brake Pedal Free Play

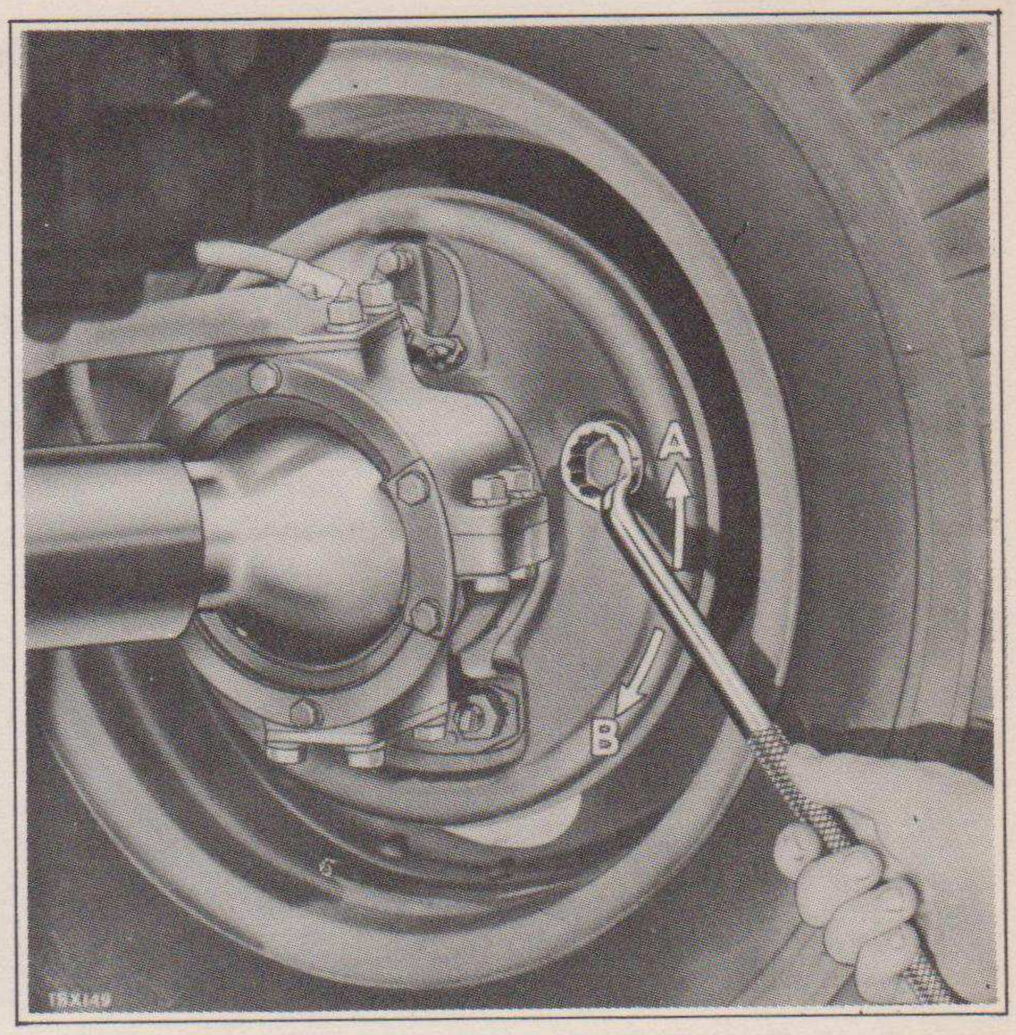


Fig. 71—Turning Brake Shoe Cams
A—Increasing clearance
B—Deceasing clearance

The travel of the piston "B" can best be determined by looking into the master cylinder reservoir through the cover plug opening while moving the pedal *slowly*. After the "Free Play" is taken up, fluid should be forced up through the relief port (B, Fig. 83) until the pedal has moved through an additional $\frac{9}{16}$" (approximately), making an accumulated pedal travel of about 1" required to close the relief port with the piston cup. If fluid does not come up through the relief port, or if the flow stops at a pedal travel of much less than 1", the free play should be checked. If the free play is not the cause, the master cylinder should be disassembled and inspected for swollen cups, etc.

The additional pedal travel, "C," of approximately ¼" is required to move the brake shoes outward against the brake drums. The total pedal travel required to set the shoes should be approximately 1¼" with properly adjusted brakes. Brake shoe cam adjustment will usually rectify excessive pedal travel.

(b) Turn the brake shoe adjusting cam (Fig. 71) until the front shoe lining is solid against the brake drum and the wheel is locked, then back off the cam until the wheel may be spun without interference.

(c) Turn the cam on the rear shoe at the top

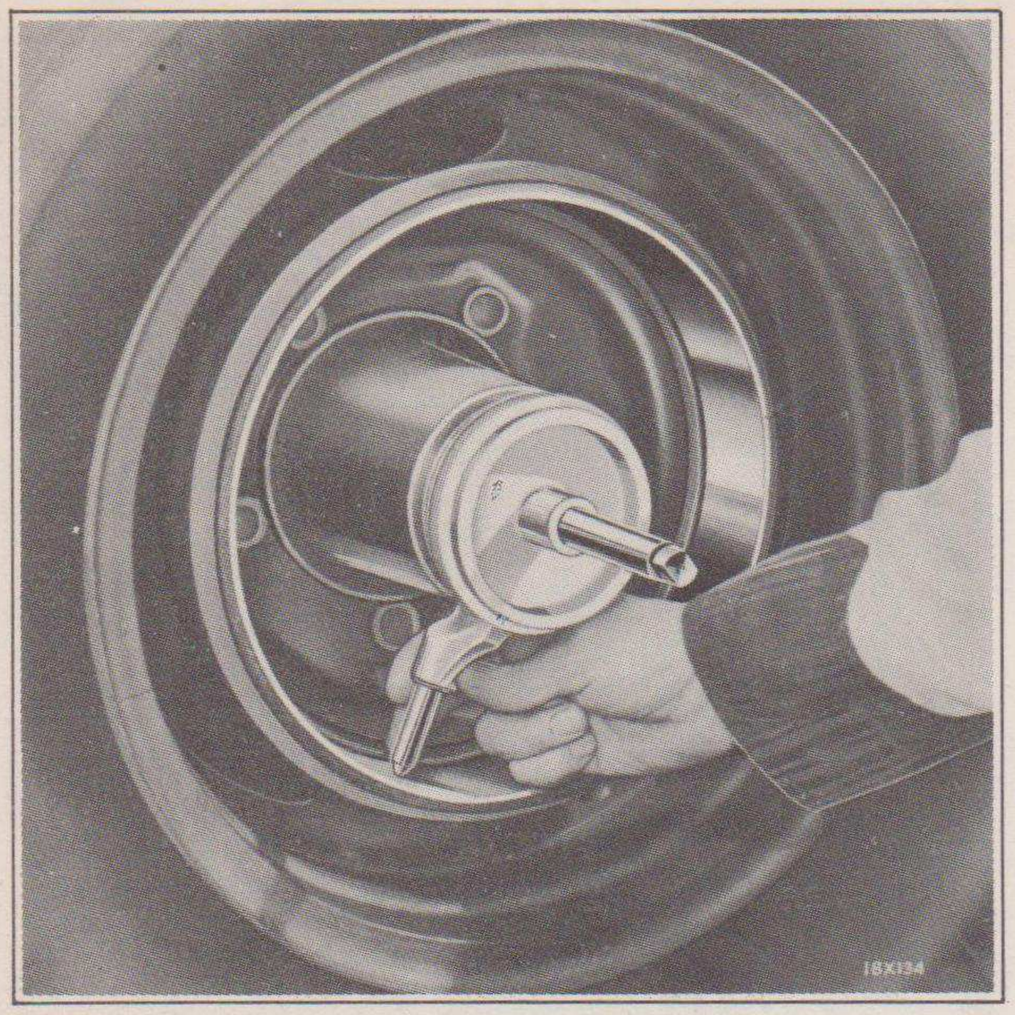


Fig. 72—Checking Brake Drum
(Tool MT-34-U)

"out" until the wheel is locked, then back off until free.

(d) Follow the same procedure at all four wheels.

After completing the foregoing operations, apply and release the brakes. Then check each wheel to make sure the brakes are not too tight.

(e) Check and refill the master cylinder supply tank. The fluid level should not be allowed to go lower than ½" below the bottom of the reservoir cover.

73—Major Brake Adjustment

A major brake adjustment is necessary whenever the brake shoes have been relined or removed for any other purpose, or the brake drums have been resurfaced or replaced.

The brake shoe lining should make full contact with the brake drum in order to obtain the greatest braking efficiency. Therefore, all traces of rough or high spots on the lining should be removed before making a major adjustment.

Rough or high spots can be quickly and easily removed by using a brake lining re-facing tool as illustrated in Fig. 69. The lining should be faced to full drum diameter.

The following instructions for making a major brake adjustment are based on use of a special brake gauge (MT-34U) obtainable from the Miller Tool and Mfg. Co., Detroit, Mich. In Subject 74, instructions are given for checking the brake anchor adjustment without special tool MT-34U.

(a) Remove the wheel and hub assemblies. See Subjects 43 and 58.

(b) Remove the brake shoe return springs and test the spring tension by comparing with a new spring.

(c) Inspect the linings for exposed rivet heads, abnormal wear and glazed braking surface, also for uniform material on the opposite wheel.

(d) Clean the brake drums, and examine the inside surface of the drums. If they are scored or out of round, they should be resurfaced.

(e) Install the brake shoe return springs and set the shoe adjusting cams in the released position.

(f) Check the inside diameter of the brake drums with the brake drum gauge as shown in Fig. 72. Then set the brake shoe gauge arbor so that the finger marked "Drum Diameter" is just in contact with the point of the brake drum gauge pin. See Fig. 73. Place the proper adapter bushing

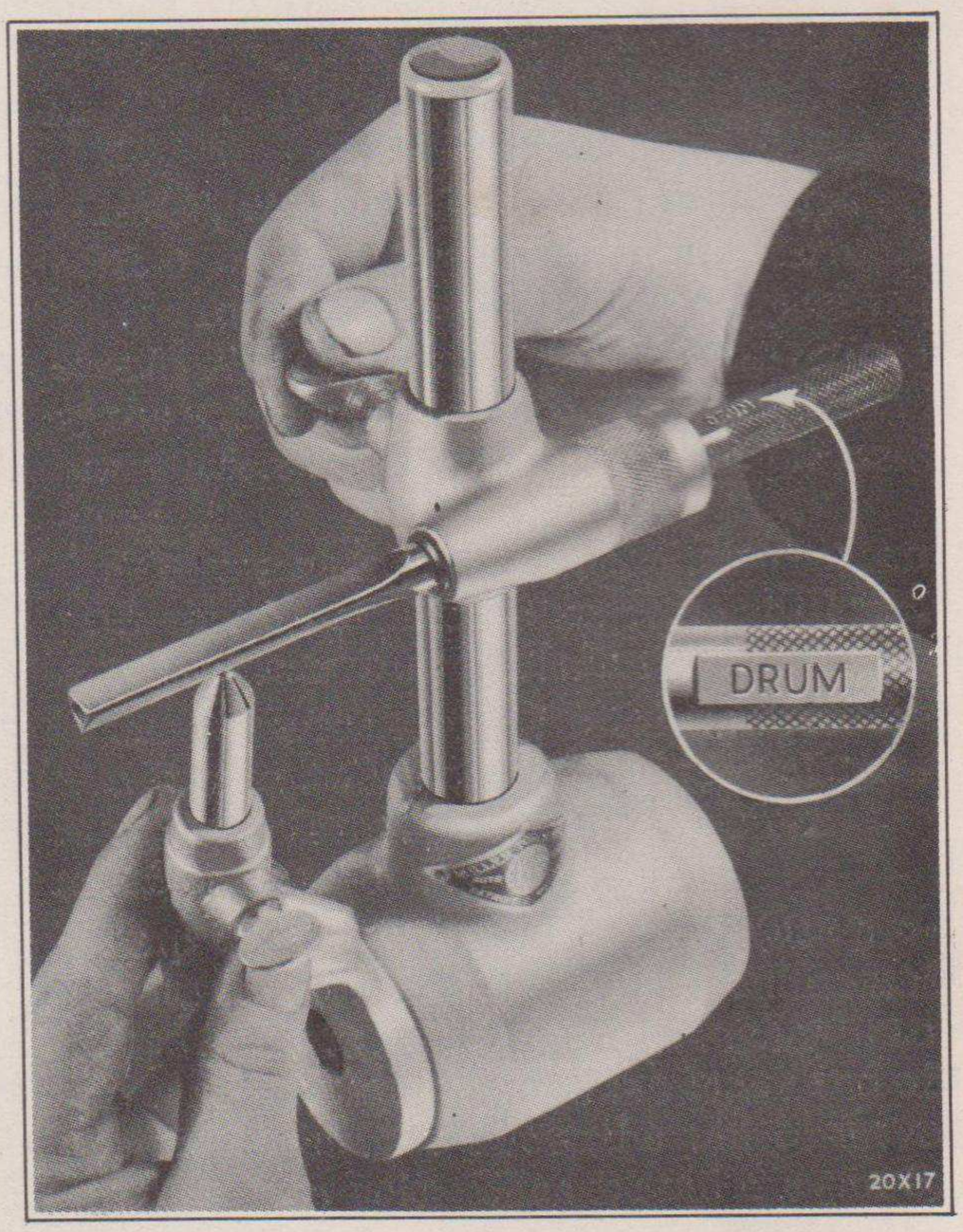


Fig. 73—Setting Brake Gauge
(Tool MT-34-U)

on the front axle steering knuckle or rear axle housing and slide the brake shoe gauge over the adapter bushing.

(g) Place the gauge on the point marked "toe" and check the clearance between the lining and drum at the "toe" of the brake shoe as illustrated in Fig. 74. Turn the "toe" adjusting cam until the lining at the "toe" of the brake shoe just contacts the gauge arbor. The "toe" of the shoe is then properly adjusted and will have .012" clearance between the lining and the drum. The pointed edges of the brake gauge (three pointed arbor) are the gauging edges. The "toe" edge of the gauge is machined for .012" clearance.

(h) On the head of each anchor bolt an arrow is stamped to indicate the position of the brake shoe anchor bolt cam. If the arrows do not point toward each other, loosen the anchor bolt nut and turn the anchor bolts until they do. *These arrows must point toward each other before starting to adjust the brake shoes.* See Fig. 75. The anchor bolts must be turned, from that position, in the correct directions in order to *decrease* the clearance between the brake shoe lining and the drum at the "heels" of the brake shoes. The correct procedure is to turn the right hand anchor bolt of any pair *counter-clockwise* and the left hand anchor bolt of the same pair *clockwise*, to

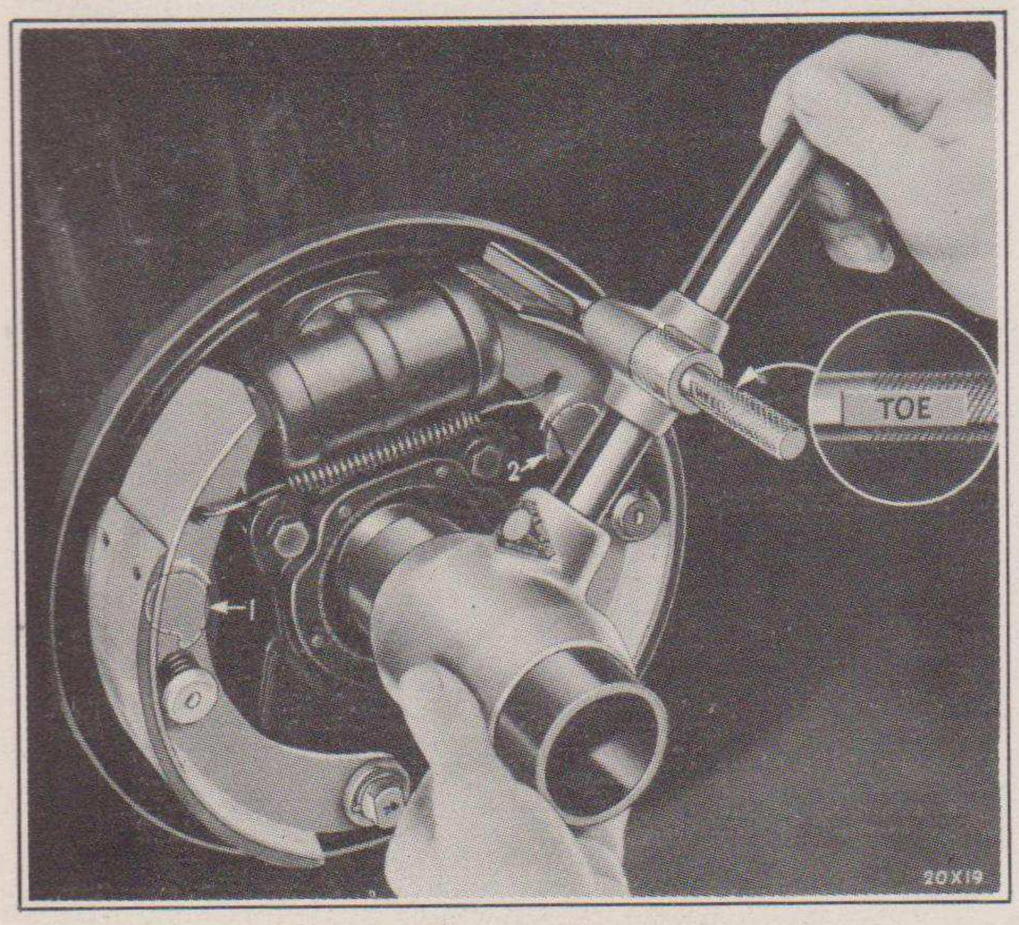


Fig. 74—Checking Brake Shoe Toe Adjustment
(Tool MT-84-U)
1 and 2—Brake shoe adjusting cams

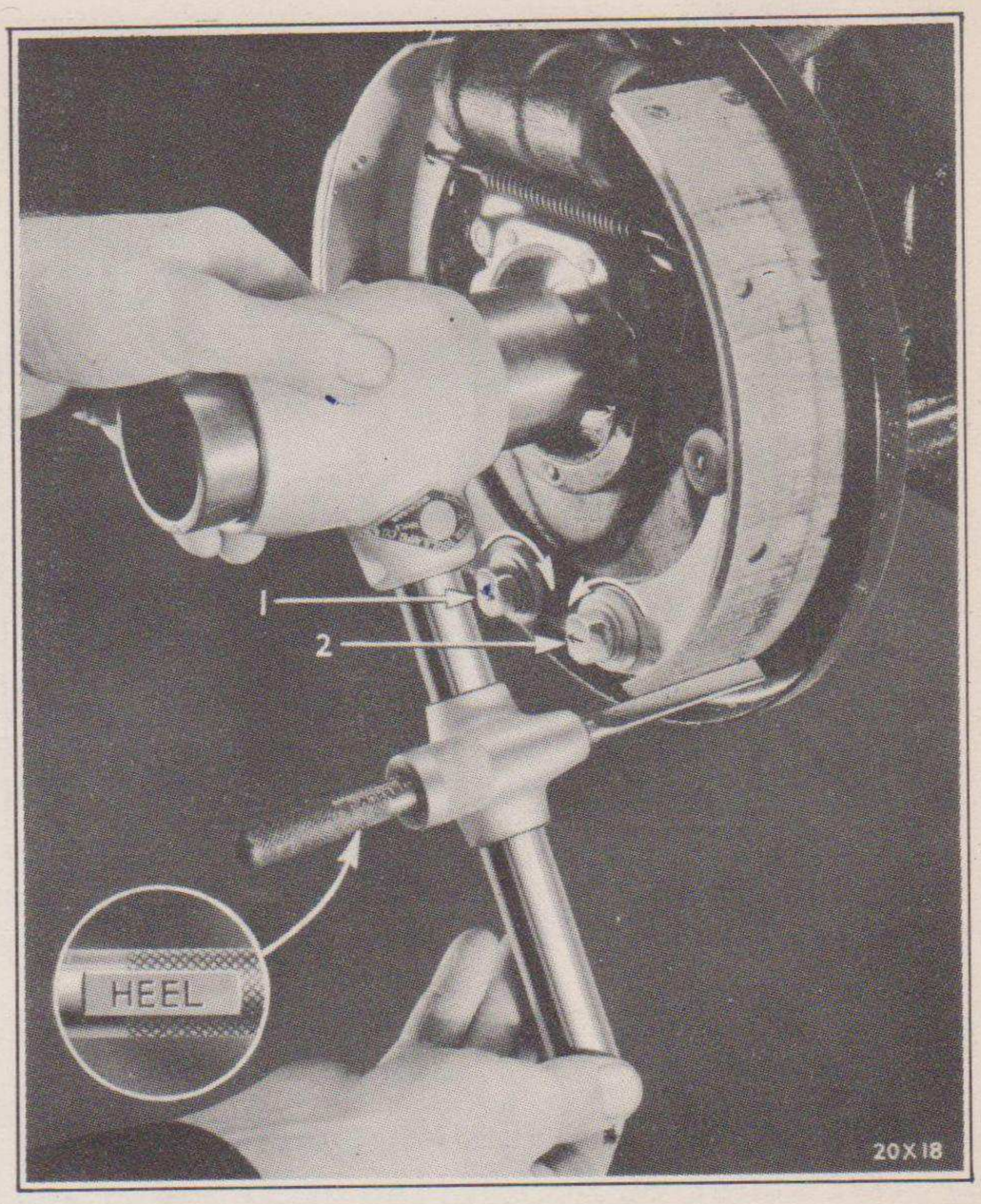


Fig. 75—Checking Brake Shoe Heel Adjustment
(Tool MT-34-U)
1 and 2—Wheel brake shoe anchor bolts

tighten the brakes. See Fig. 75. When turning the anchor bolts as directed, the "heels" of the brake shoes will move downward and outward.

(i) If necessary, turn the anchor bolts until the "heels" of the brake shoes just contact the "heel" adjusting finger of the brake shoe gauge arbor as shown in Fig. 75. (The correct .006" "heel" clearance is machined into the brake shoe gauge arbor.)

(j) As the anchor bolts are being adjusted for correct "heel" clearance, the "toe" adjustment will also change. Therefore, change the heel adjustment gradually and at the same time keep the "toe" clearance at .012" as the anchor bolt adjustment progresses.

(k) When the clearance at the "heel" and "toe" are .006" and .012" respectively, the brake shoes are properly centralized.

(l) Install wheel and hub assemblies.

(m) Check the fluid level in the brake master cylinder and add fluid if necessary.

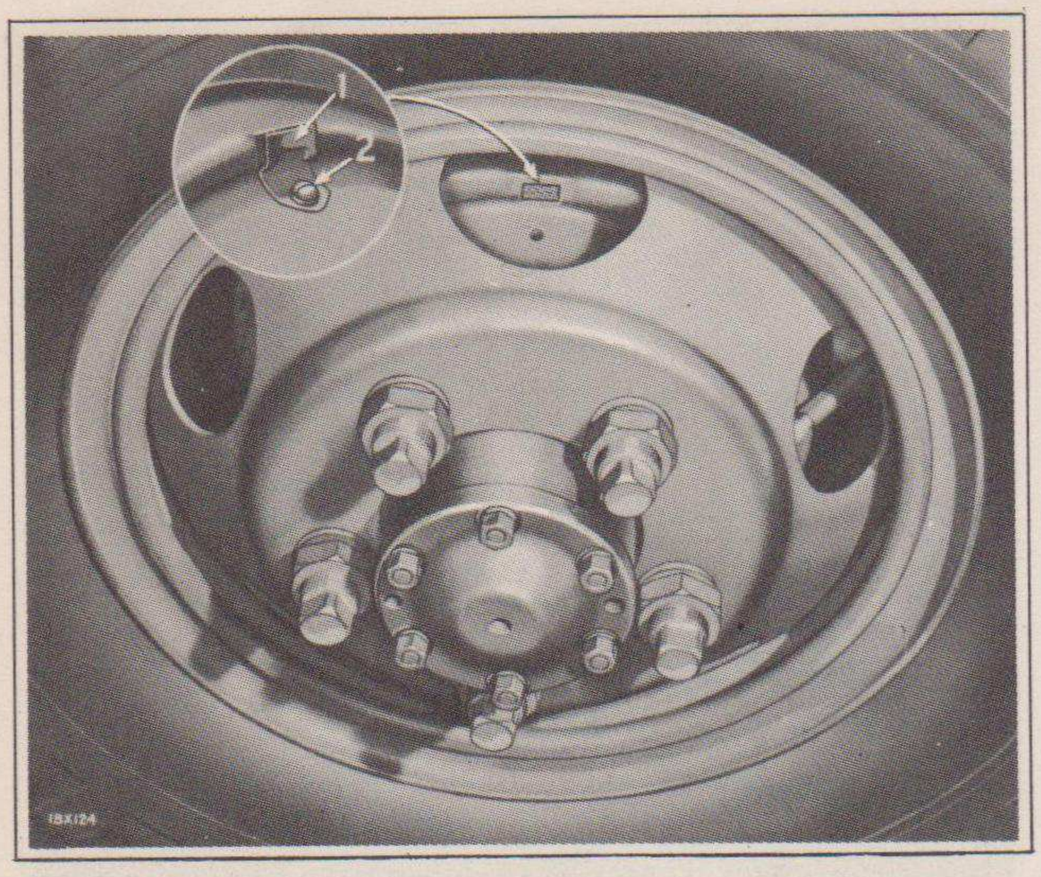


Fig. 76—Wheel Brake Inspection Hole

1—Brake drum inspection hole cover
2—Brake drum inspection hole cover screw and lockwasher

74—Brake Inspection Hole

In the absence of a brake shoe gauge (MT-34U) as described in Subject 73, the brake inspection hole (Fig. 76) may be used to check the brake anchor adjustment. Ordinarily a minor brake adjustment (Subject 72) will provide proper brake operation making it unnecessary to change the anchor bolt adjustment. This can be determined by moving the shoe adjusting cam "out" until the clearance between the lining and the drum at the "toe" of the shoe is .012", using a feeler gauge through the brake inspection hole. Then if the clearance at the "heel" of the brake shoe is .006" when the "toe" is properly adjusted, the anchor bolt adjustment should not be changed, as the shoe is properly centralized for full lining contact.

If the brakes are relined or the drums are replaced or resurfaced the anchor bolts should be turned (before drums are installed) so that the arrows on the heads of any pair of anchor bolts point toward each other. See Fig. 75. This is important as the arrows indicate the correct positions of the anchor bolt cams for proper movement of the shoes when the brakes are applied.

To check the brake anchor adjustment, using .006" and .012" feeler gauges through the brake inspection hole, proceed as follows:

(a) Turn the shoe adjusting cam at the "toe" of the brake shoe until the clearance (using a feeler gauge inserted through the inspection hole) is .012".

(b) Turn the drum until the inspection hole is at the "heel" of the brake shoe and check the "heel" clearance with a feeler gauge. The clearance should be .006".

(c) If necessary to change the position of anchor bolt, turn the right-hand bolt of any pair *counter-clockwise* and the left-hand bolt of the same pair *clockwise* to *decrease* clearance between lining and drum. See Fig. 77.

(d) If necessary to move anchor bolt to obtain correct clearance at the "heel," move the anchor bolt gradually and at the same time watch the clearance at the "toe" of the shoe and keep it at .012" as the anchor bolt adjustment progresses. When the two adjustments (.006" at the "heel" and .012" at the "toe") are obtained, the brake shoes will be properly centralized.

75—Bleeding Brake Lines

When any part of the braking system is disconnected for any reason, or the fluid level is allowed to get too low, it is necessary to bleed the brake lines at all four wheel cylinders. Air in the braking system seriously impairs braking

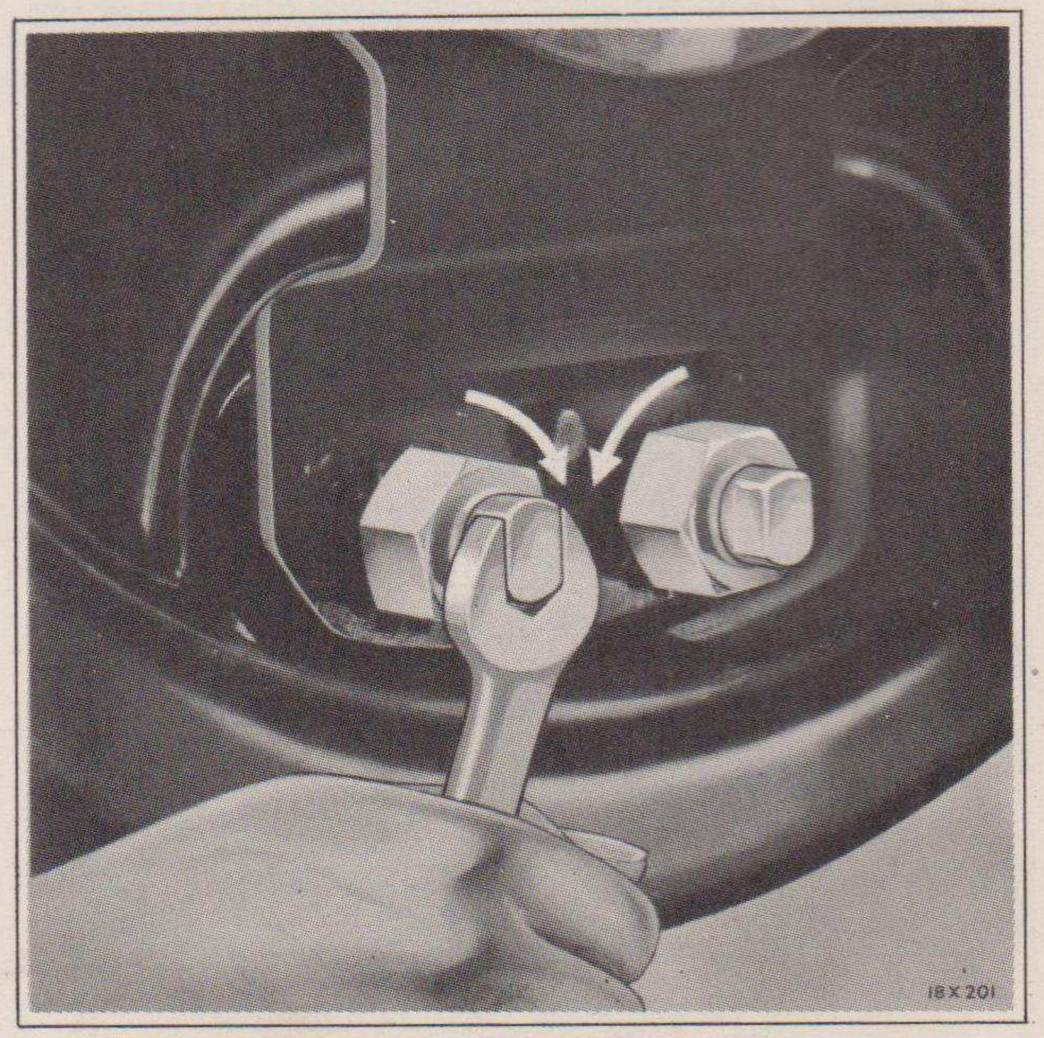


Fig. 77—Brake Shoe Anchor Bolt Adjustment

efficiency, resulting in soft, spongy pedal action.

To bleed the lines, proceed as follows:

(a) Fill the reservoir with fresh brake fluid and attach a short length of rubber hose to the bleeder screw after removing the cap screw in the center of the wheel cylinder where it protrudes through the brake support. See Fig. 78.

(b) Allow the free end of the hose to be submerged in a clean glass container of brake fluid and unscrew the bleeder screw ½ to ¾ of a turn.

(c) The master cylinder reservoir must be kept full of fluid during the bleeding operation.

If the filler cap of the reservoir is left off during the bleeding operation, it will be possible to watch the fluid to see that it does not get below the halfway point. It is best, however, to use an automatic refiller (Fig. 79) to prevent the master cylinder from running dry during the bleeding operation.

(d) Depress the brake pedal slowly through half the limit of its travel. Allow the pedal to return to its released position, and depress it again or until fluid runs out of the bleeder hose in a continuous stream, *without air bubbles*. If an automatic refiller is not used, the foot pedal can be given from six to ten half-strokes before it is necessary to refill the master cylinder.

Fig. 79—Filling Brake Master Cylinder with Automatic Refiller (Tool C-362)

(e) Bleed one wheel cylinder at a time to make sure that all air is expelled from the system. When all air bubbles have been forced out of the line, *close the bleeder screw tightly before taking the bleeder hose out of the fluid, and install the bleeder screw cap screw.*

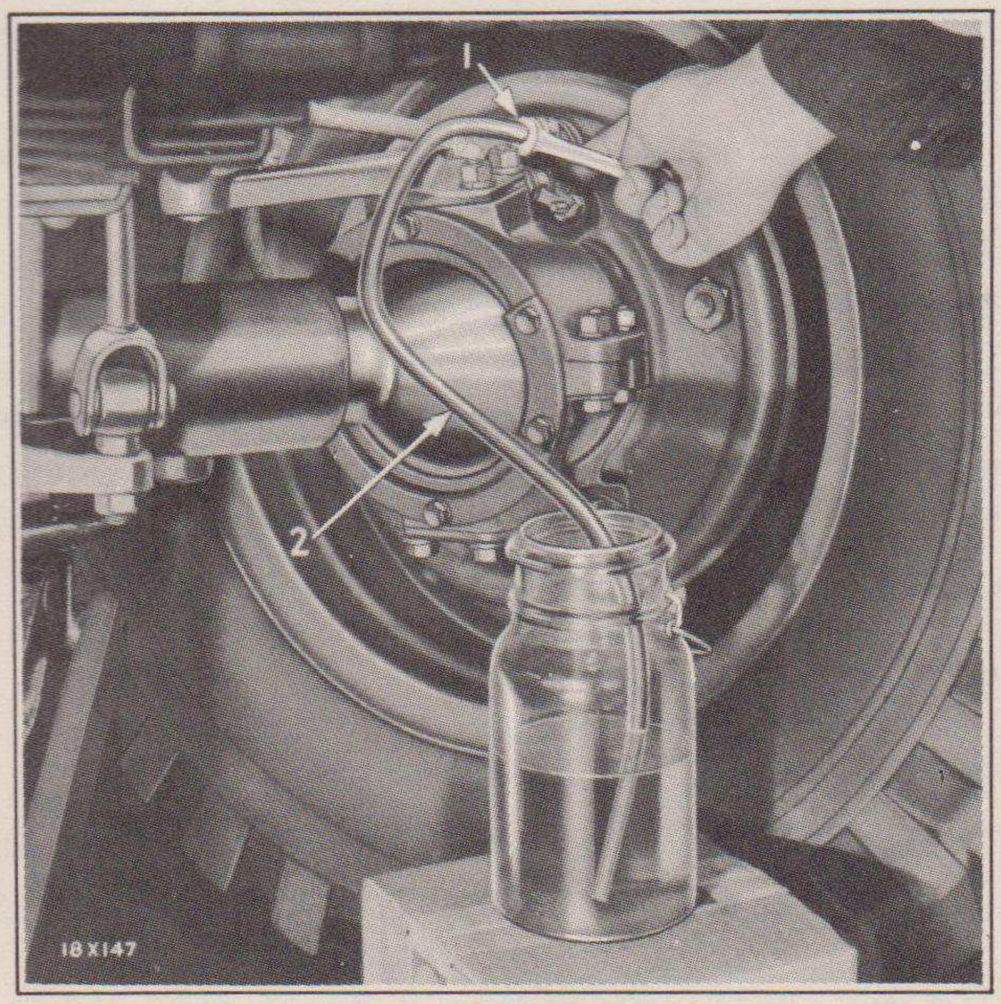


Fig. 78—Bleeding Brake Lines
1—Bleeder screw 2—Bleeder hose

76—Wheel Cylinders

Removal and Disassembly

(a) Remove the wheel, hub and drum as explained in Subjects 43 and 58.

(b) Block the brake pedal in the released position to prevent downward movement of it.

(c) Disconnect the brake fluid hose at the wheel cylinder, being careful not to damage or lose the two gaskets at the inlet connection.

(d) Remove the brake shoe return spring.

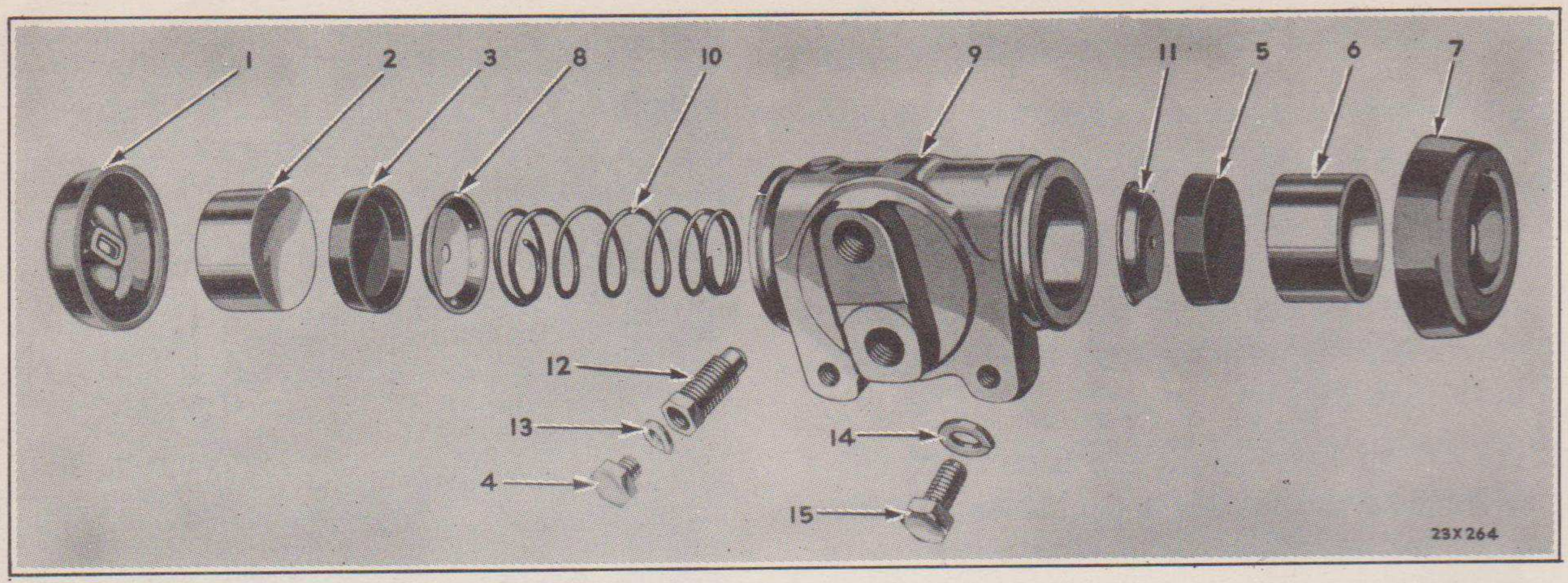


Fig. 80—Brake Wheel Cylinder (disassembled view)

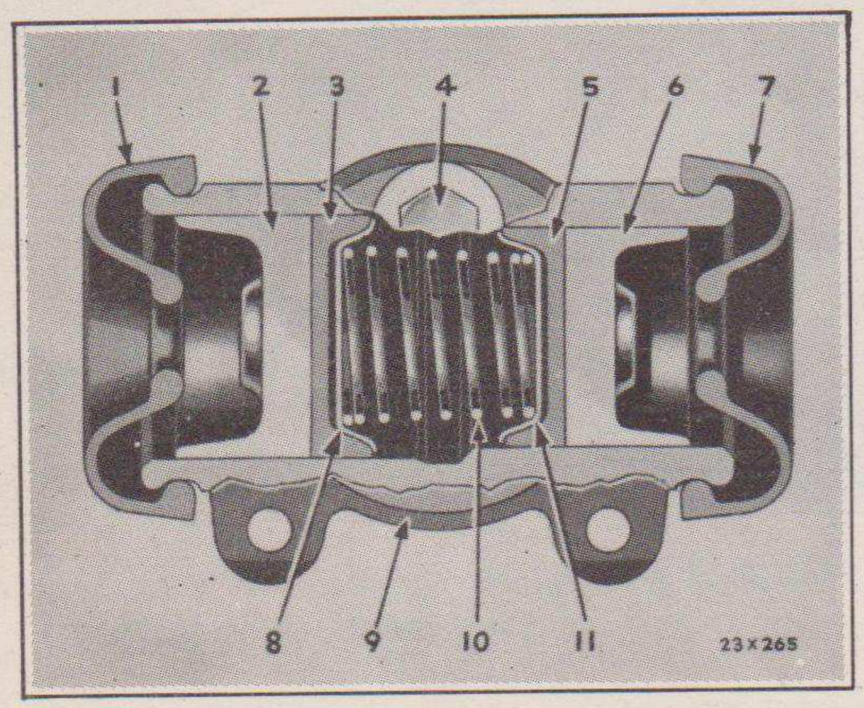


Fig. 81—Brake Wheel Cylinder (assembled view)

Figs. 80 and 81—Brake Wheel Cylinder

1—Boot
2—Piston (large) rear
3—Piston cup (large) rear
4—Bleeder screw cap screw
5—Piston cup (small) front
6—Piston (small) front
7—Boot
8—Piston cup expander (service only) large—rear
9—Cylinder (body)
10—Piston cup spring
11—Piston cup expander (service only) small—front
12—Bleeder screw (valve)
13—Bleeder screw cap screw lockwasher
14—Cylinder to brake support screw lockwasher
15—Cylinder to brake support screw

(e) Rock the brake shoes so the upper ends pull out of the brake cylinder boots.

(f) Remove the cap screws which hold the brake cylinder body to the brake support.

IMPORTANT: Do not allow any brake fluid to come in contact with the brake lining, either from dripping or from soiled hands.

(g) Roll the rubber boot off each end of brake cylinder.

(h) Pistons, cups and internal parts may then be removed from the brake cylinder. See Figs. 80 and 81.

Assembly and Installation

Before assembling the wheel cylinder parts, clean the cylinder body inside and outside thoroughly, and wash all parts in alcohol. Absolute cleanliness is important because the slightest trace of grit or dirt can cause scratches in the cylinder which in turn will damage the piston cups resulting in fluid leakage and improper brake operation. Work on a clean bench where no dirt or grit can be picked up. See Fig. 82 for proper method of refinishing a brake cylinder.

Coat the walls of the cylinder and internal parts with *brake fluid* while assembling the wheel cylinder. *Never use mineral oil or any type of mineral lubricant for this purpose.*

After the wheel cylinder has been installed on the brake support install the wheel and hub. In connecting the brake hose, be certain that the contacting surfaces are clean and the two gaskets are in place with the gasket having the larger hole next to the head of the retaining screw. Then bleed the lines as explained in Subject 75 and adjust the brakes for proper clearance. See Subject 72.

77—Master Cylinder

Removal and Disassembly

(a) Disconnect the wires at the signal switch on the master cylinder, simply by pulling them out of the sockets.

(b) Disconnect the brake tube at the master cylinder.

(c) Remove the cotter and clevis pins, which connect the piston push rod and pedal.

(d) Remove the bolts which hold the master cylinder body to the chassis and lift out the master cylinder assembly.

(e) Remove the large boot strap and roll the large end of the boot off the master cylinder body. The piston push rod will then drop out of the cylinder.

Note: If replacing a boot only, perform operations (c) and (e), also remove the small boot strap.

IMPORTANT: Unless replacement of a piston push rod or push rod end is necessary, do not change adjustment of the end piece. This is seldom, if ever, required. The factory adjustment is correct and permits the piston cup to just pass the relief port (B, Fig. 83) and yet avoid covering the supply port when the pedal is in the released position.

(f) Clean the outside of the master cylinder assembly.

(g) Remove the reservoir filler plug and drain out all brake fluid.

(h) Remove the lock ring in the open end of the cylinder. See Figs. 83 and 84.

(i) Pull out the piston stop washer and piston.

(j) Tip the open end of the cylinder downward and the piston return spring and the valve assembly will come out.

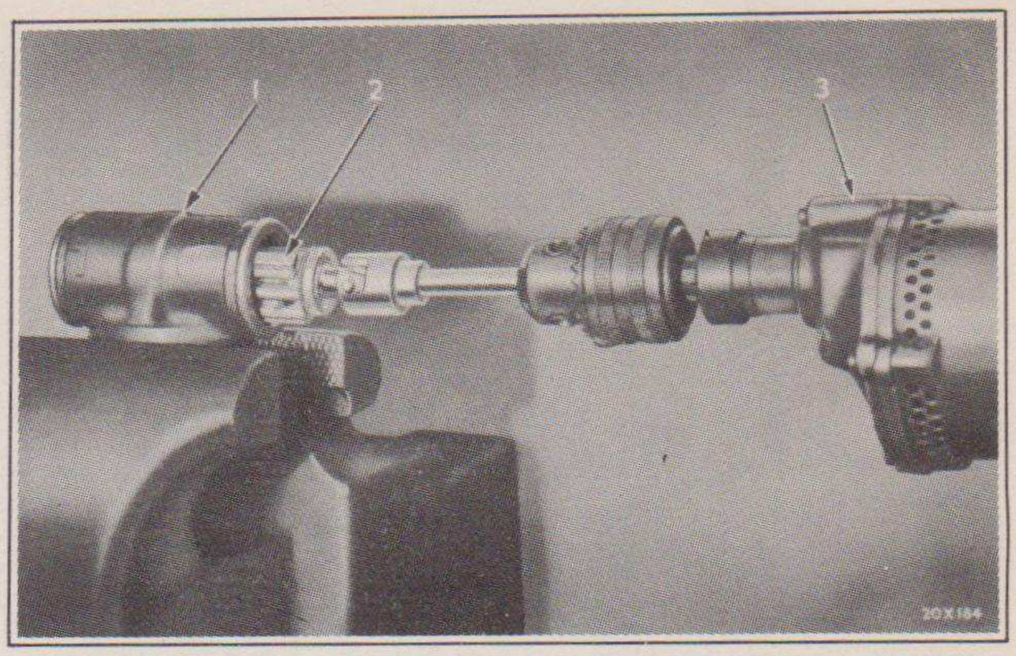


Fig. 82—Refinishing Brake Cylinder

1—Brake cylinder 2—Tool C-815-S
3—Electric drill

Assembly and Installation

When working on the brake master cylinder, maintain absolute cleanliness. Wash all parts in alcohol before starting to assemble them and do the work on a clean bench where no grit or dirt will be picked up. Dirt can cause scratches in the cylinder which in turn will damage the piston cup causing fluid to leak or otherwise affect brake operation.

IMPORTANT: Never allow brake cylinder parts to come in contact with mineral oil or lubricating stock. Use only clean brake fluid.

To assemble, first install the valve assembly and spring, then the piston cup, stop washer and piston. Continue to assemble other parts in the sequence shown in Fig. 84.

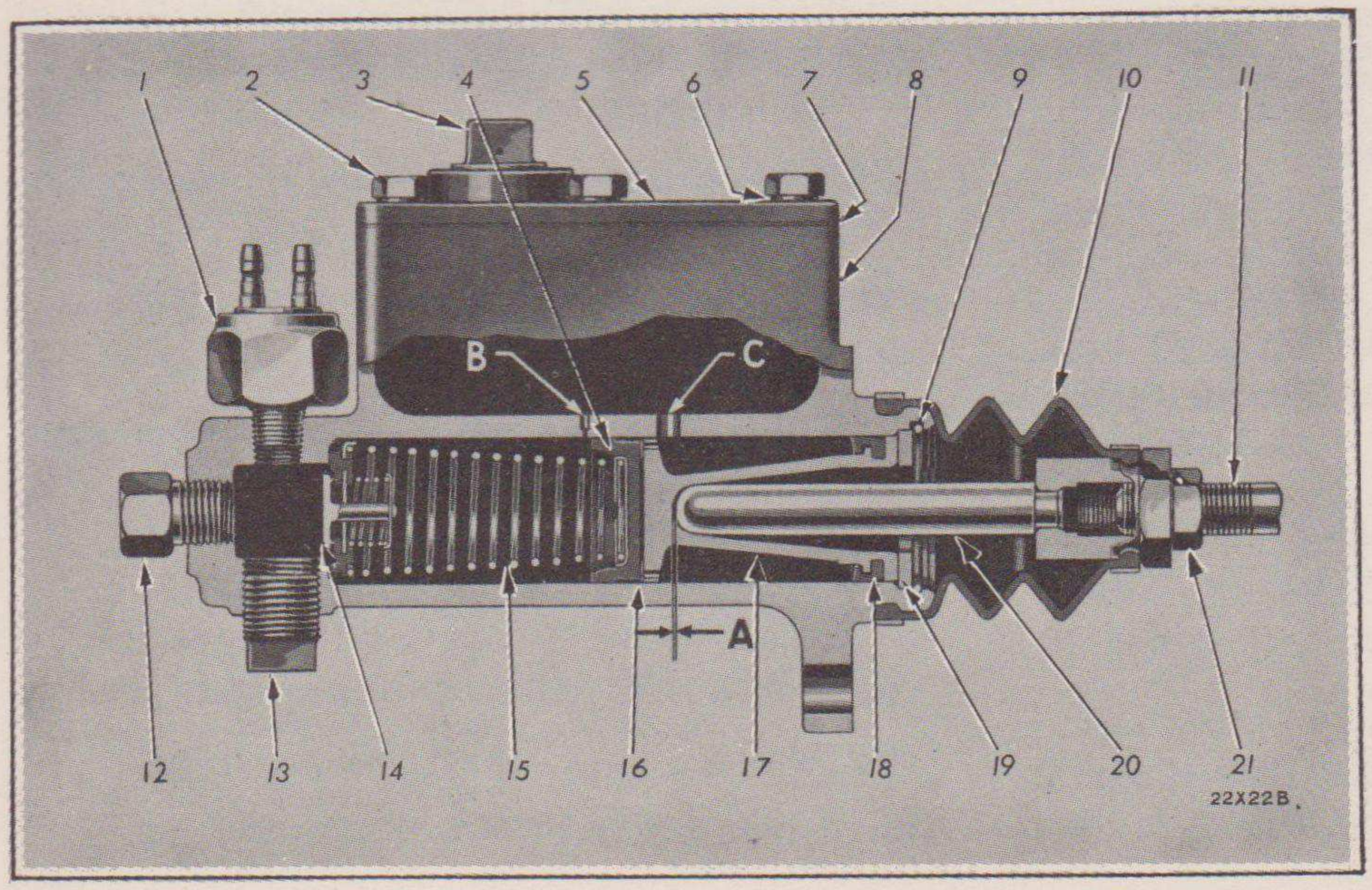


Fig. 83—Brake Master Cylinder
(assembled view)

1—Signal lamp switch
2—Cover screw
3—Filler plug
4—Piston cup
5—Cover
6—Cover screw gasket
7—Cover gasket
8—Master cylinder and supply tank body
9—Piston stop lock wire
10—Boot
11—Piston push rod end
12—Outlet connection
13—Hole plug
14—Valve assembly
15—Piston return spring
16—Piston washer
17—Piston
18—Piston secondary cup
19—Piston stop
20—Piston push rod
21—Piston push rod end lock nut
A—Free pedal movement
B—Relief port
C—Port

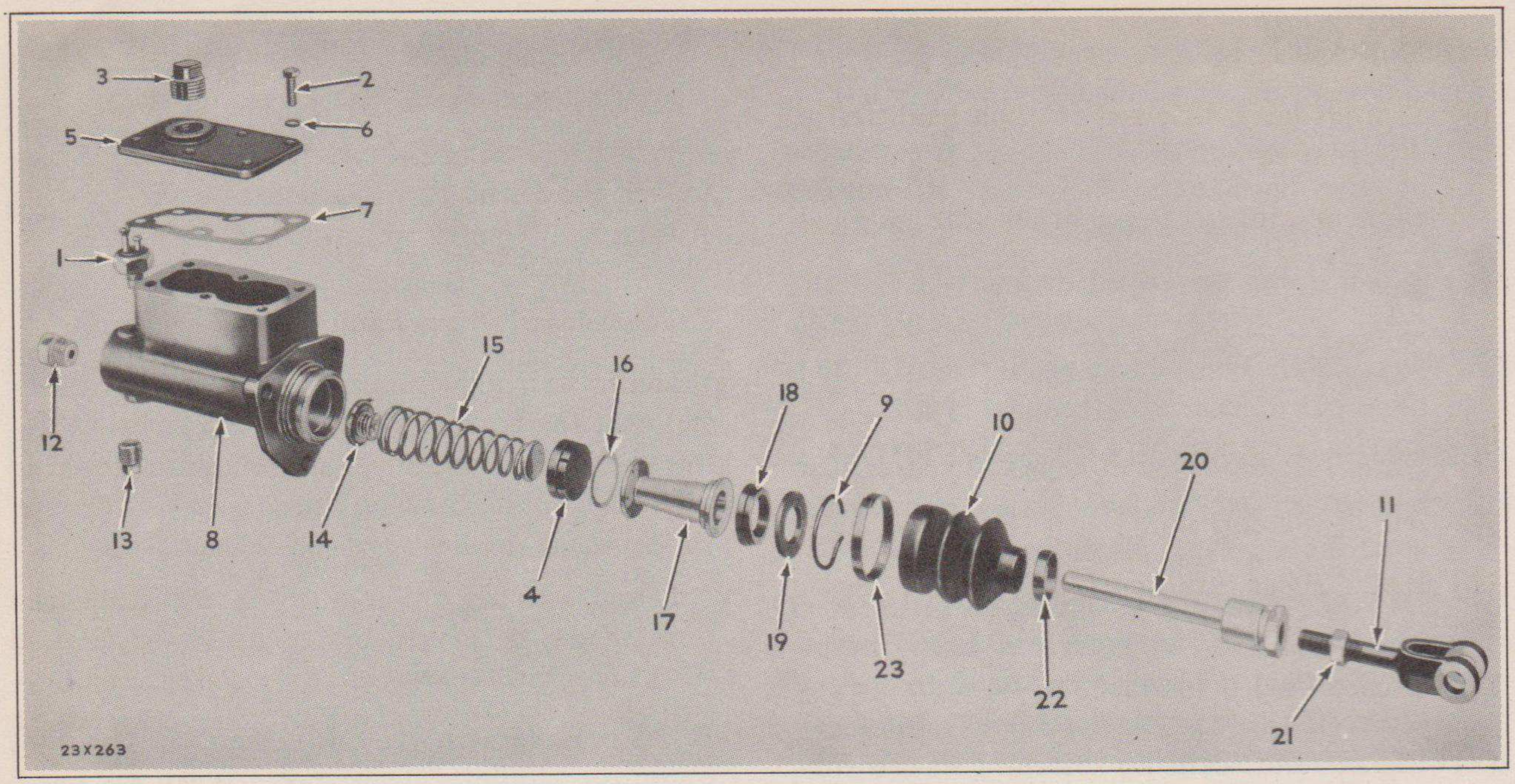


Fig. 84—Brake Master Cylinder (disassembled view)

1—Signal lamp switch
2—Cover screw
3—Filler plug
4—Piston cup
5—Cover
6—Cover screw gasket
7—Cover gasket
8—Master cylinder and supply tank body
9—Piston stop lock wire
10—Boot
11—Piston push rod end
12—Outlet connection
13—Hole plug
14—Valve assembly
15—Piston return spring
16—Piston washer
17—Piston
18—Piston secondary cup
19—Piston stop
20—Piston push rod
21—Piston push rod end lock nut
22—Strap—small
23—Strap—large

Install the master cylinder assembly on the chassis and fill it with brake fluid. Then bleed the brake lines at *all* four wheels as explained in Subject 75.

If the master cylinder push rod requires adjustment, refer to Subject 72.

SERVICE DIAGNOSIS

(Foot Brakes)

78—No Brakes

(a) Worn lining, improperly adjusted brake shoes, air in system, insufficient fluid in system.

(b) Check the system for fluid leaks, check the master cylinder push rod adjustment.

79—Brakes Drag

(a) Check the master cylinder push rod adjustment to insure that the relief port is open.

(b) Piston cups swollen by use of mineral oil.

(c) Dirt in the master cylinder bleeder hole.

(d) Brake shoe clearance insufficient.

(e) Plugged brake line.

80—One Brake Drags

(a) Weak, damaged, or broken brake shoe return spring.

(b) Improperly adjusted brake shoes, too close to drum.

(c) Brake shoe sticking on anchor bolts.

(d) Loose wheel bearings.

(e) Wheel cylinder piston or piston cups sticking in wheel cylinder.

81—Truck Pulls To One Side

(a) Improperly adjusted brake shoes.

(b) Lining on one wheel grease soaked.

(c) Brake support loose on the axle.

(d) Improperly inflated tires.

(e) Linings have different friction qualities on different shoes.

(f) Dent or kink in lines, brake line plugged.

(g) Worn lining or scored drums.

(h) Loose front spring clips.

82—Springy or Spongy Pedal Operation

(a) Air in system.

(b) Brake shoes improperly adjusted.

83—Brake Pedal Jams

(a) Use of fluids causing softening of the rubber cups, and extruding of the rubber between the piston and cylinder walls or in the holes in the master cylinder piston. Use new rubber cups and master cylinder piston washer.

(b) Install piston cup expanders (8 and 11, Figs. 80 and 81) in the wheel cylinders, if not so equipped, for trucks operating in atmospheric temperatures below 0°F.

HAND BRAKE

The hand brake consists of a band contracting around a brake drum mounted on the transmission shaft at the rear of the transmission. It operates independently of the foot brakes and applies equal braking force to the rear wheels through the differential. The hand brake is used principally for holding the truck while parked.

84—Hand Brake Band

Removal and Installation

(a) Remove the large adjusting bolt nuts (5, Fig. 85).

(b) Remove the bracket adjusting screw nuts.

(c) Remove the anchor adjusting screw and pull the band assembly away from the transmission and over the propeller shaft after unhooking the large adjusting bolt.

When installing the hand brake band, be sure to lock the anchor adjusting screw with a wire. Adjust the band as explained in Subject 85.

Relining Hand Brake Band (Band Removed)

When re-lining the hand brake band, it is essential that the correct grade and thickness of lining be used to procure the maximum braking efficiency. See "Service Standards" section of this manual for lining specifications.

If not already tailored to fit the band, the lining must be cut to the required length and rivet holes drilled and counterbored at least one-half the thickness of the lining in both ends to coincide with the holes in the end of the band when the lining is snugly placed around the inside surface. The lining should be rivited to the band at the extreme ends, and then the other rivets applied, starting from each end alternately and working toward the center until completed.

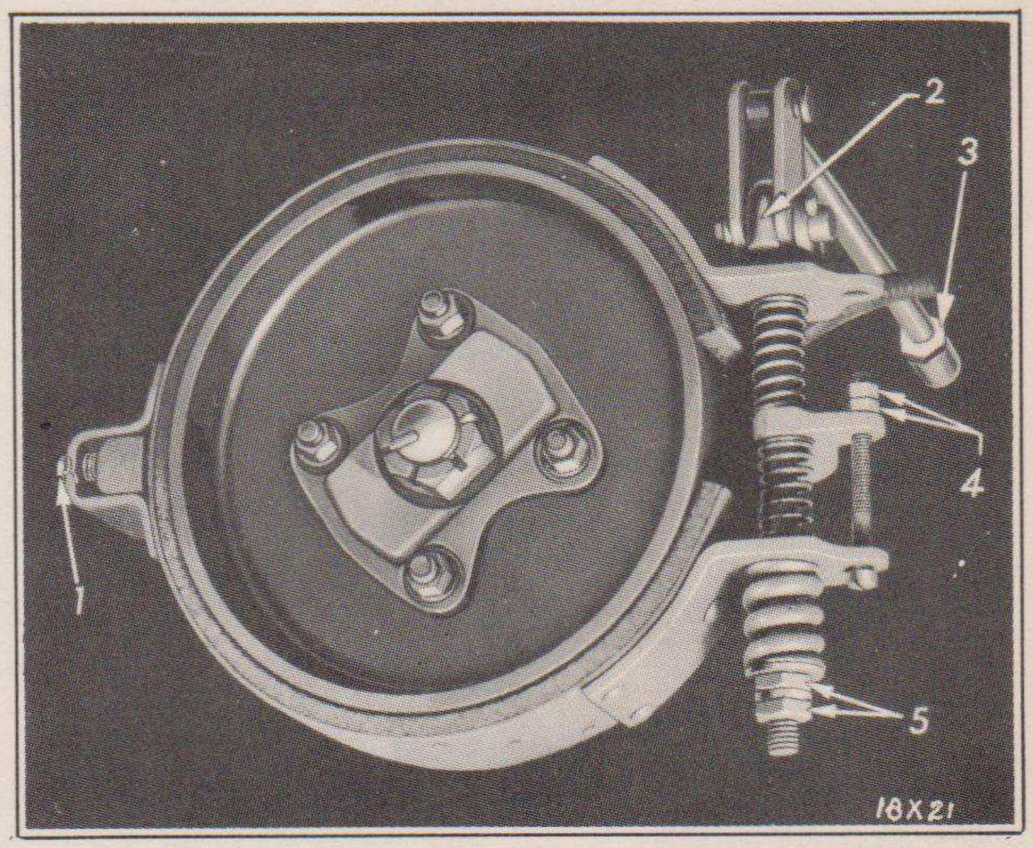


Fig. 85—Hand Brake
1—Anchor screw
2—Adjusting bolt
3—Rod yoke locknut
4—Bracket adjusting screw nuts
5—Adjusting bolt nuts

After re-lining, the brake band contour must conform to the shape of the drum. Excessive squeal or chatter may be eliminated by bending the "toe" ends of the band (opposite the anchor) slightly away from the drum.

SGV TD

85—Hand Brake Adjustment

Hand brake adjustments can be made underneath the truck of follows:

(a) Set the hand brake lever in the fully released position.

(b) Remove the anchor screw lock wire and adjust the screw so the band and drum have .010″ to .012″ clearance at the anchor (1, Fig. 85).

(c) Lock the anchor adjusting screw with a lock wire.

(d) Back off the adjusting bolt lock nuts (5, Fig. 85) until free.

(e) Turn the bracket adjusting screw nut (4) after loosening the lock nut until the band and drum have .010″ to .012″ clearance.

(f) Lock the guide bolt in place with lock nut.

(g) Tighten the adjusting bolt nuts (5) until the tension on the guide bolt is just relieved at either end.

(h) Lubricate all frictional surfaces of the hand brake linkage with engine oil.

Free play between the side of the anchor bracket at the center of the band and the anchor must not be more than .005″, otherwise band distortion may result on brake application. This free play, if excessive, may be reduced by compressing the saddle in a vise or tapping with a hammer against a block or anvil.

CLUTCH

The clutch is of the single dry-plate type. See Figs. 89 and 90. A steel cover bolted to the flywheel encloses the clutch disc, the pressure plate, pressure springs and fingers.

The driving disc is spring-cushioned, with facings riveted to both sides. The coil springs in the clutch disc absorb power shocks, thereby cushioning the power to the driven mechanism.

The clutch release bearing is of the ball type packed with lubricant during manufacture and no further lubrication is required.

CAUTION: Do not wash the clutch release bearing in kerosene, gasoline or any other similar grease solvent, which would dissolve the lubricant packed in the bearing.

86—Clutch Disc

Removal

(a) Remove the floor board.
(b) Remove the transmission. See Subject 261.
(c) Remove the clutch housing pan.
(d) Remove the clutch release bearing.
(e) Mark the clutch cover and flywheel (2, Fig. 86) and remove the bolts which hold the clutch cover to the flywheel.

The clutch cover and disc assembly can then be removed from the clutch housing.

Installation

(a) Coat the pilot bearing in the end of the crankshaft and the end of the transmission main drive pinion with short fiber wheel bearing grease medium. Also pack ½ teaspoonful of this grease in the reservoir back of the pilot bushing in the crankshaft.

(b) Clean the surfaces of the flywheel and pressure plate thoroughly, making certain that no oil remains on these parts. See Fig. 87.

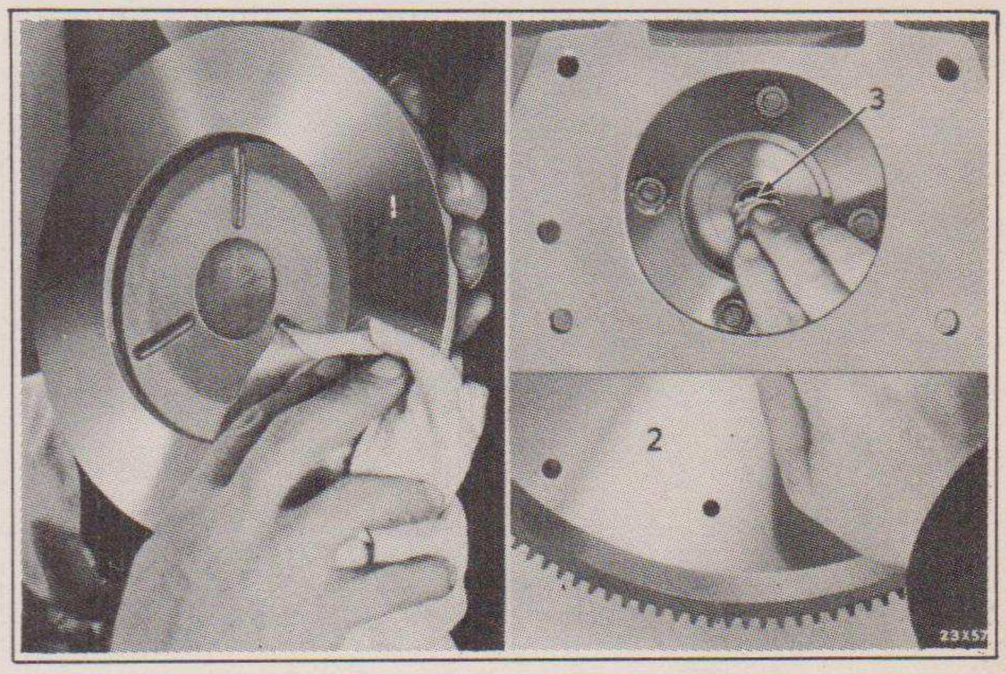


Fig. 87—Cleaning Clutch Friction Surfaces and Lubricating Pilot Bushing

1—Clutch pressure plate
2—Engine flywheel
3—Transmission main drive pinion pilot bushing

(c) Hold the clutch cover plate and disc in place and insert the special clutch aligning tool No. C-360 (Fig. 88) through the hub of

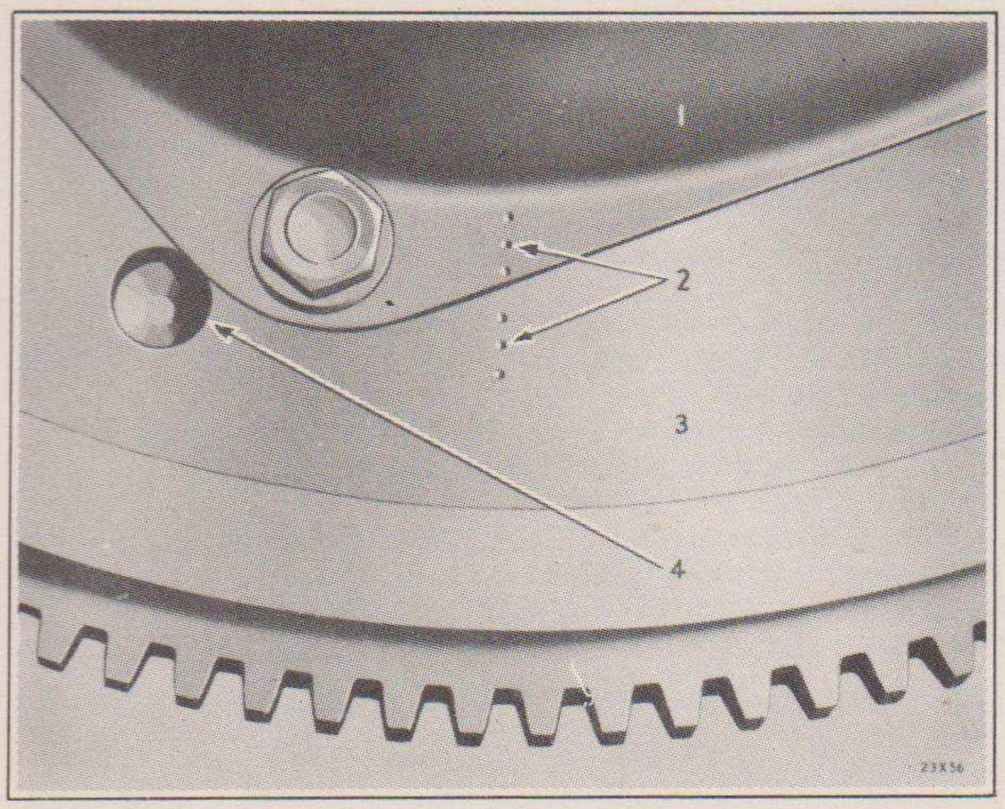


Fig. 86—Punch Marks on Clutch Cover and Flywheel

1—Clutch cover
2—Punch marks
3—Engine flywheel
4—Balance drilling in engine flywheel

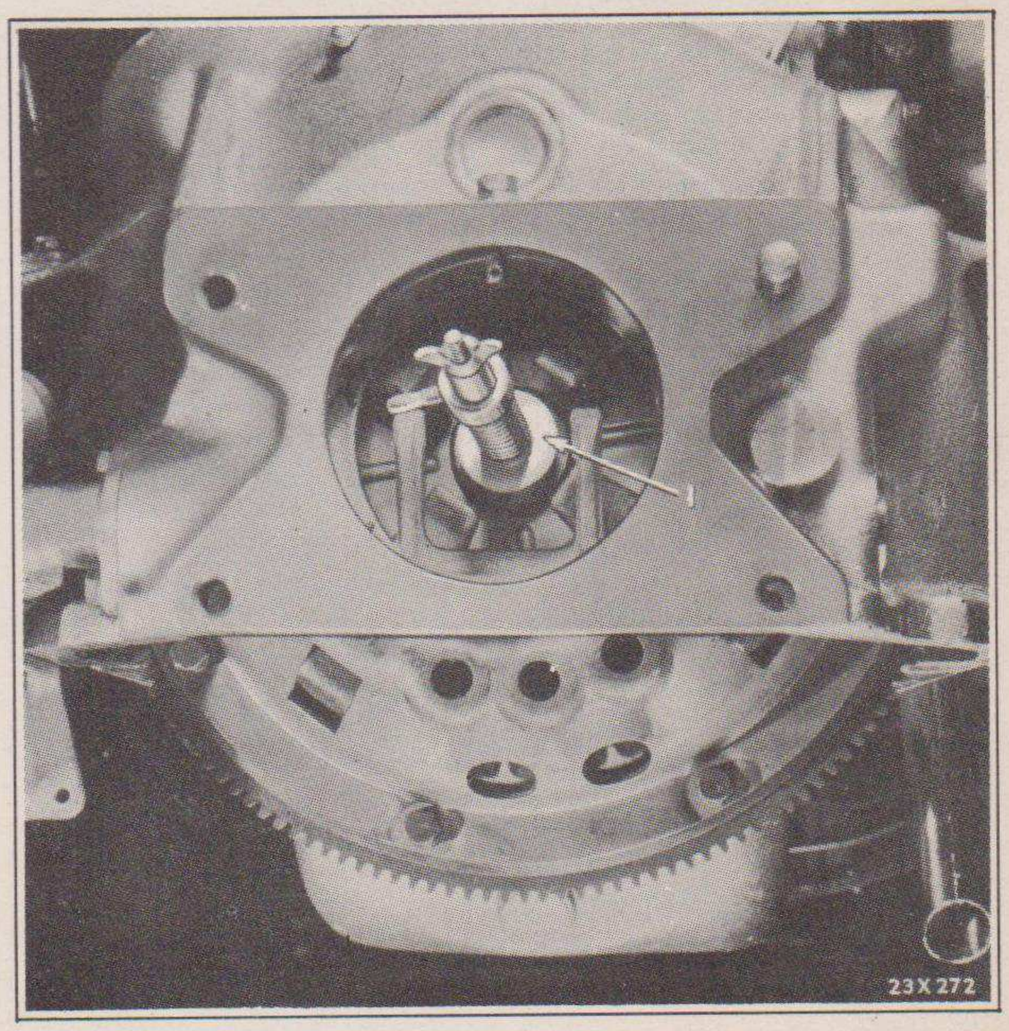


Fig. 88—Clutch Disc Aligning Arbor (1—Tool C-360)

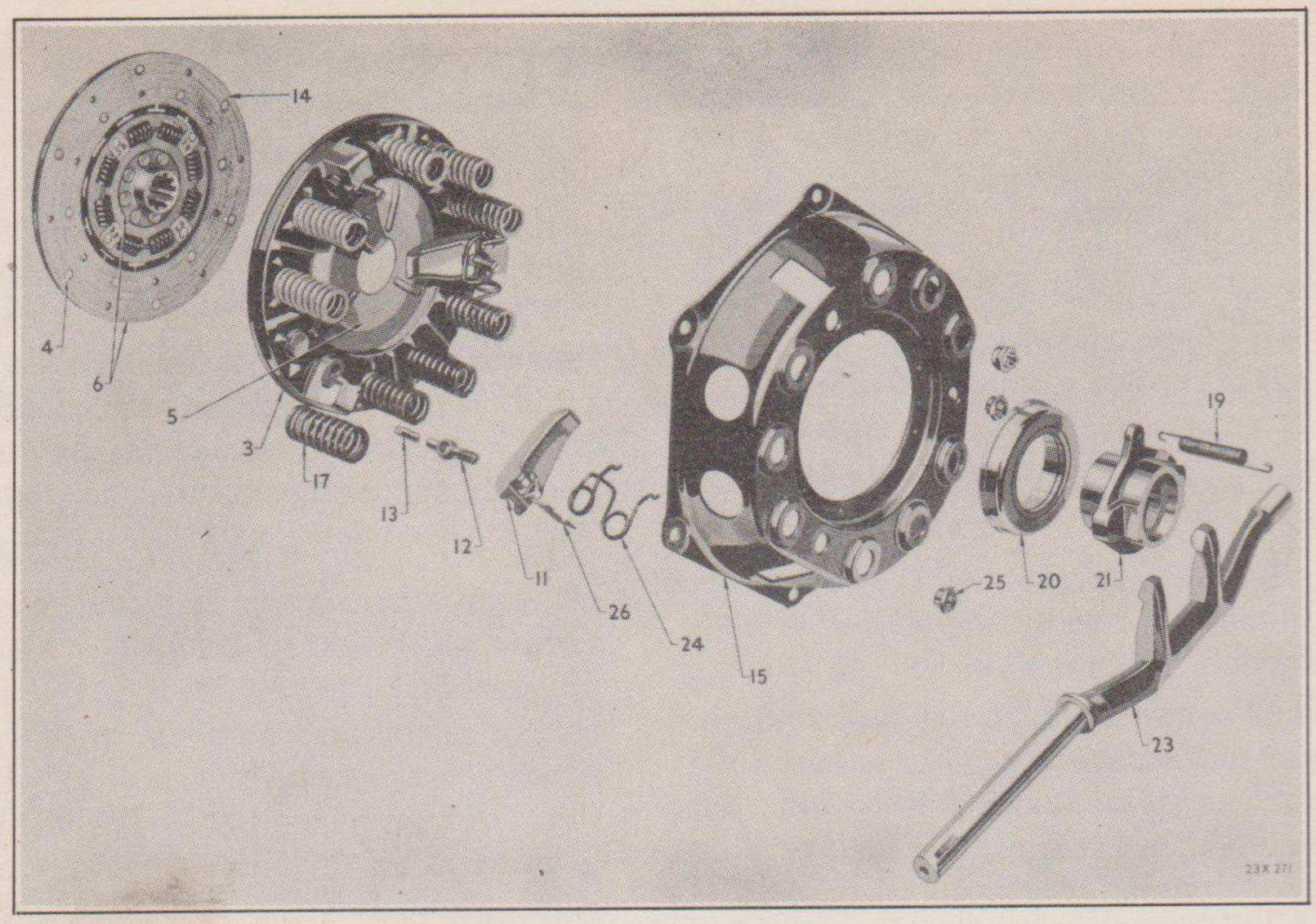


Fig. 89—Clutch (disassembled view)

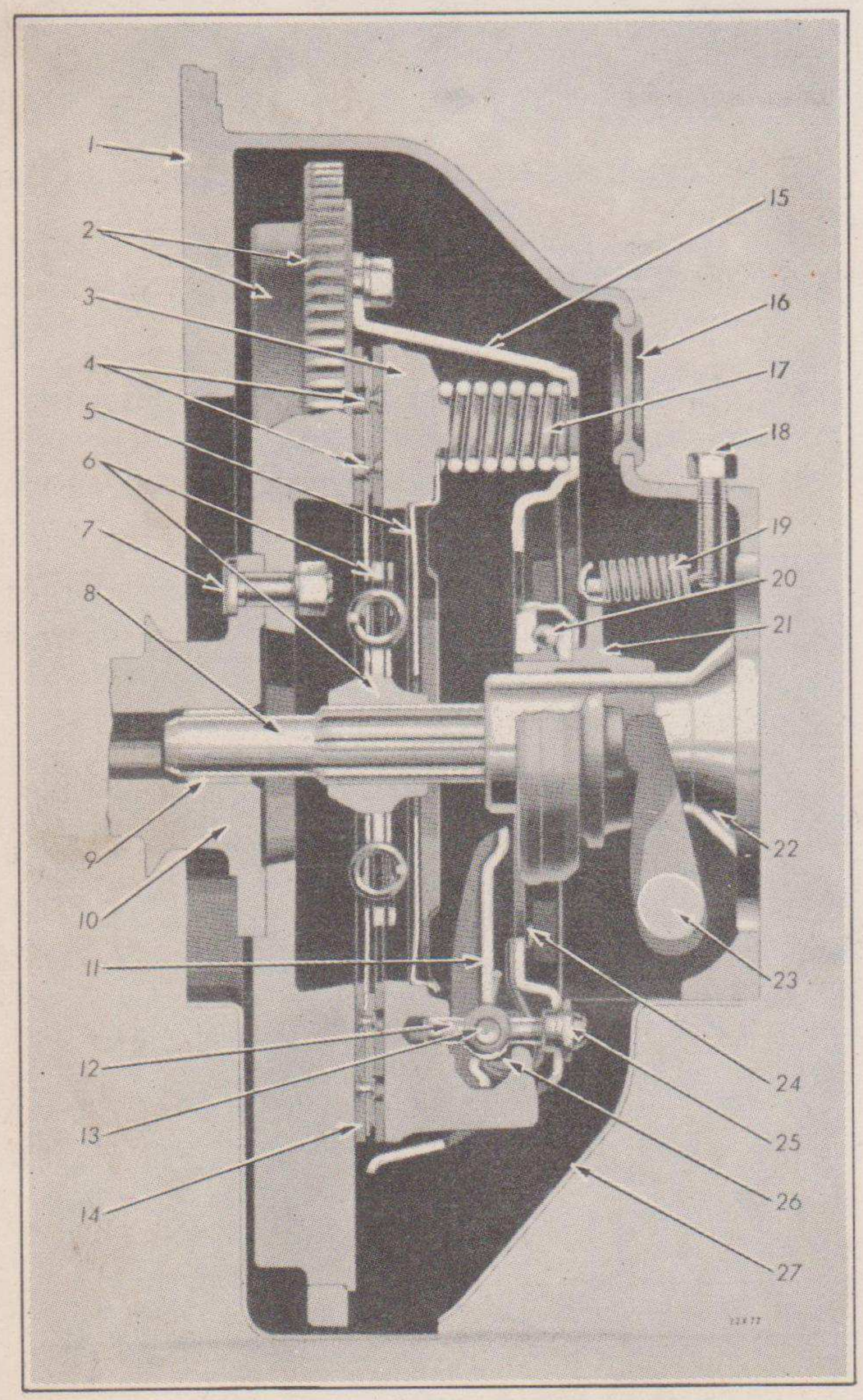


Fig. 90—Clutch (assembled view)

Figs. 89 and 90—Clutch

1—Housing
2—Engine flywheel and ring gear
3—Pressure plate
4—Disc facing rivets
5—Pressure plate baffle
6—Disc assembly
7—Engine flywheel bolt
8—Transmission drive pinion
9—Engine crankshaft bushing (transmission drive pinion pilot bushing
10—Engine crankshaft
11—Release lever
12—Release lever eye bolt
13—Release lever pin
14—Disc facing
15—Cover
16—Housing hole plug
17—Pressure spring
18—Release bearing pull back spring screw
19—Release bearing pull-back spring
20—Release bearing
21—Release bearing sleeve
22—Transmission drive pinion bearing retainer
23—Release fork
24—Release lever spring
25—Release lever eye bolt nut
26—Release lever strut
27—Housing pan

the driving disc and into the drive pinion pilot bearing in the crankshaft. If the aligning tool is not used, a transmission drive pinion may be substituted.

(d) Bolt the clutch cover plate loosely to the flywheel, lining up the marks on the cover and flywheel.

(e) The clutch cover bolts should then be tightened a few turns each in progression until they are all tight. It is advisable to use a tension indicating wrench. Tighten the bolts to 15-20 foot pounds.

(f) Install the clutch release bearing and hook up the release bearing pull back spring.

The transmission may then be installed by guiding it into place with pilot studs. See Subject 261. Care must be taken not to bend or "dish" the clutch disc. Use a floor jack to help guide the transmission drive pinion through the disc.

After the transmission is installed, check the clutch pedal free play as explained in Subject 89.

Refacing Clutch Disc

When installing facings on the clutch disc, only new facings of the proper thickness, size and material should be used. Slight variations in thickness of clutch facings will inevitably result in clutch difficulties. Clutch facings on either side of the disc are individually riveted to the plate. That is, each of the two facings is fastened to the disc, with a separate set of rivets to avoid the possibility of shifting of the disc and shearing off the rivet heads.

When removing old facings, the rivets should be *drilled* out; punching them out will damage the clutch cushion springs. Care should be taken to see that the clutch cushion springs to which the rivets are fastened are not bent from the original position. Bending the cushion springs will invariably result in clutch difficulties.

Do not allow any grease or oil to come in contact with the friction surfaces of the clutch disc. Even greasy hands touching the friction surfaces will transfer a sufficient amount of grease in many instances to cause, after a short time of driving, a chattering or grabbing clutch.

87—Clutch Cover and Pressure Plate

Proper operation of the clutch is chiefly dependent upon accurate adjustment of the release levers. They must all be adjusted to exactly the same pre-determined height above the machined surface of the pressure plate, so that the plate will remain parallel with the flywheel when the clutch is being released and engaged. This adjustment cannot be made by setting the levers parallel to the face of the release bearing after the clutch has been assembled to the flywheel because of variations in thickness of the driven plate. The most accurate method is to adjust the levers by using a special clutch compressing and adjusting fixture.

Instructions in this manual covering clutch disassembling, adjusting and assembling procedure are based on the use of the C-585 fixture obtainable from the Miller Tool and Manufacturing Company, Detroit, Michigan. This fixture accurately checks the parallel alignment of the clutch pressure plate while the clutch release levers are under load. The use of the fixture eliminates possibility of error in clutch release lever adjustment due to clutch leverage ratios and housing strains.

Disassembly

(a) Remove the clutch cover assembly from the truck as explained in Subject 86.

(b) Mark the cover and pressure plate with a prick punch (4, Fig. 91) so that they may be assembled in their original position to maintain balance.

(c) Mount the clutch assembly on the clutch compressing and adjusting fixture.

(d) Install the three-legged spider (part of tool set No. C-585) over the center screw

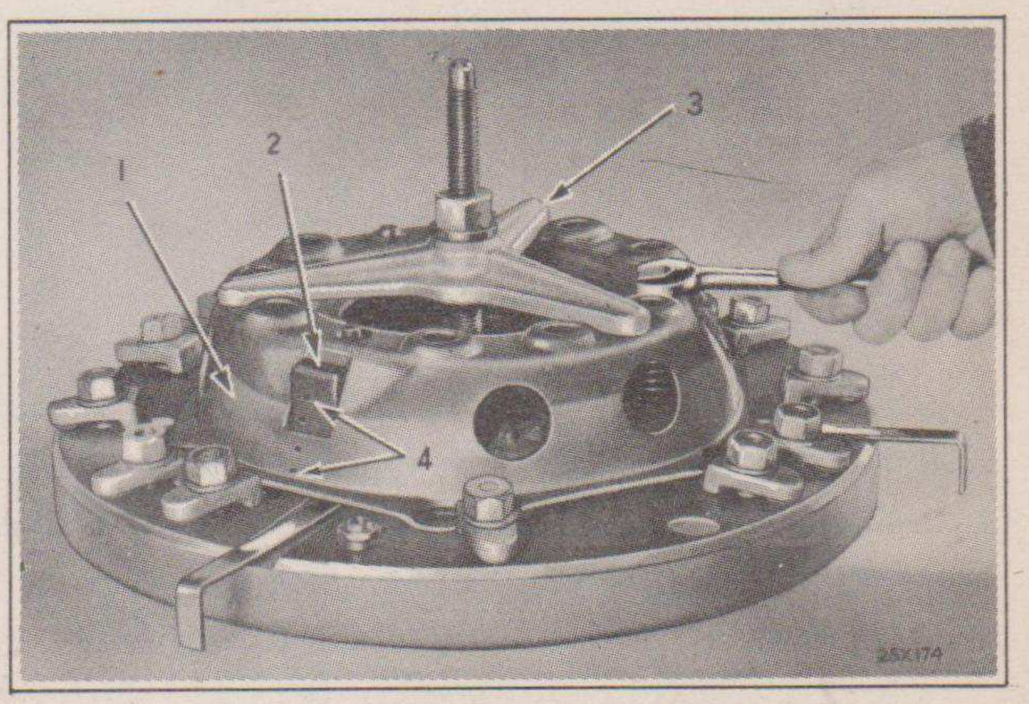


Fig. 91—Clutch Cover and Pressure Plate Assembly in Fixture

1—Clutch cover
2—Clutch pressure plate
3—Fixture (Tool C-585)
4—Punch marks on pressure plate and cover

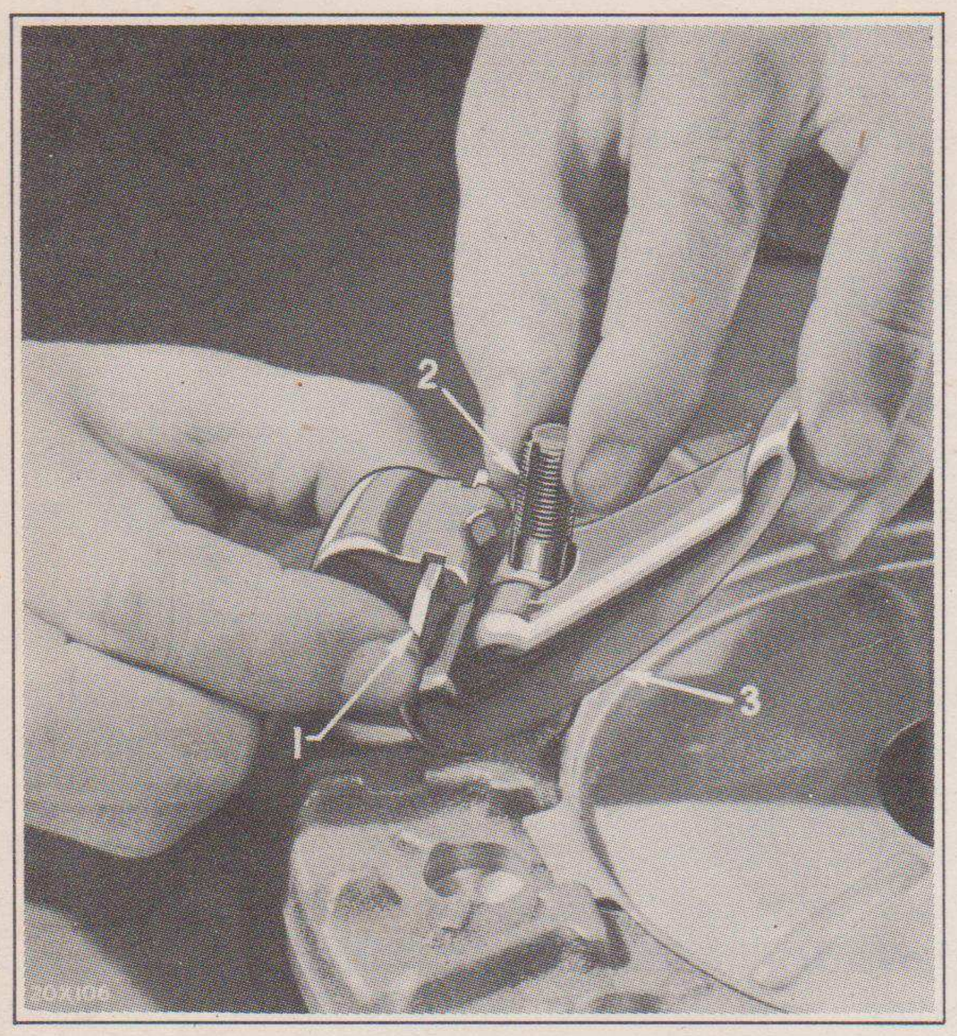


Fig. 92—Removing or Installing Release Lever
1—Release lever strut 2—Eye bolt
3—Release lever

so that it rests directly against the top of the clutch cover.

(e) Install the plain thrust washer and the hexagonal compression nut and compress the springs by turning down the compression nut. See Fig. 91.

(f) With the springs under compression, remove the clutch release lever eye bolt nuts (Fig. 91) and slowly relieve the spring pressure by unscrewing the compression nut.

(g) The cover may then be lifted off and all parts will be available for inspection (Fig. 89).

(h) To remove the release levers, grasp the lever and eye bolt between the thumb and fingers, as shown in Fig. 92, so that the flat side of the lever and upper end of the eye bolt are as close together as possible, keeping the eye bolt pin seated in its socket in the lever. The strut (1, Fig. 92) can then be lifted over the ridge on the end of the lever, making it possible to lift the lever and eye bolt off the pressure plate. It is advisable to replace any parts which show wear.

Assembly

(a) Place the pressure plate on the base of the clutch fixture.

(b) If the release levers have been removed, install them as follows:

Hold the threaded end of the eye bolt between the thumb and index finger, with the lever end resting on the second finger (Fig. 92). Hold the lever and eye bolt close together. With the other hand, insert the strut in the slot of the pressure plate lug. By lifting the strut upward and tilting it at the same time, it will pass the ridge on the lower end of the lever and drop into its groove in the lever.

(c) Place the pressure springs in position so that they rest on the small bosses of the pressure plate and engage the embossed seats on the cover.

(d) Make sure the release lever springs are in position in the cover and place it over the pressure springs. At the same time match up the marks made on the cover and pressure plate (4, Fig. 91) to maintain balance of the assembly. The tops of the pressure springs should index with the embossed seats in the cover.

(e) Install the three-legged spider over the center screw of the fixture so that it rests directly against the top of clutch cover.

(f) Install the plain thrust washer and hexagonal compression nut and compress the springs by turning down the compression nut. Make sure the pressure springs remain in their seats.

(g) With the pressure springs compressed, install the release lever eye bolt nuts about flush with the end of the eye bolt. Then slowly relieve spring pressure by unscrewing the clutch fixture compression nut.

Before installing the clutch cover and pressure plate assembly in the truck, adjust the release levers as explained in Subject 88.

88—Adjustment of Release Levers

(a) Mount the clutch cover and pressure plate assembly on the fixture (C-585) with the release levers over the feeler gauges in the base of the fixture. See Fig. 93.

(b) Place the proper spacer (number 17) on the center screw of the fixture.

(c) Install the compression plate (2, Fig. 93) on the center screw. Make sure that it rests directly against the fingers of the clutch release levers. This plate can be reversed for proper clearance depending on the size of the clutch.

(d) Install the self-aligning washer, the plain thrust washer and the compression nut.

(e) Tighten the compression nut until the clutch is fully compressed.

(f) Install the clutch housing clamps over the bolt holes and tighten them securely.

(g) Adjust the clutch release levers until each of the three feeler gauges (1, Fig. 93) have the same slight "drag" or "feel" while being pushed in and out. Tighten the release lever nuts to decrease "drag" and loosen to increase "drag."

(h) Recheck the release lever adjustment to make sure each one is adjusted properly, then stake the release lever nuts (6, Fig. 93).

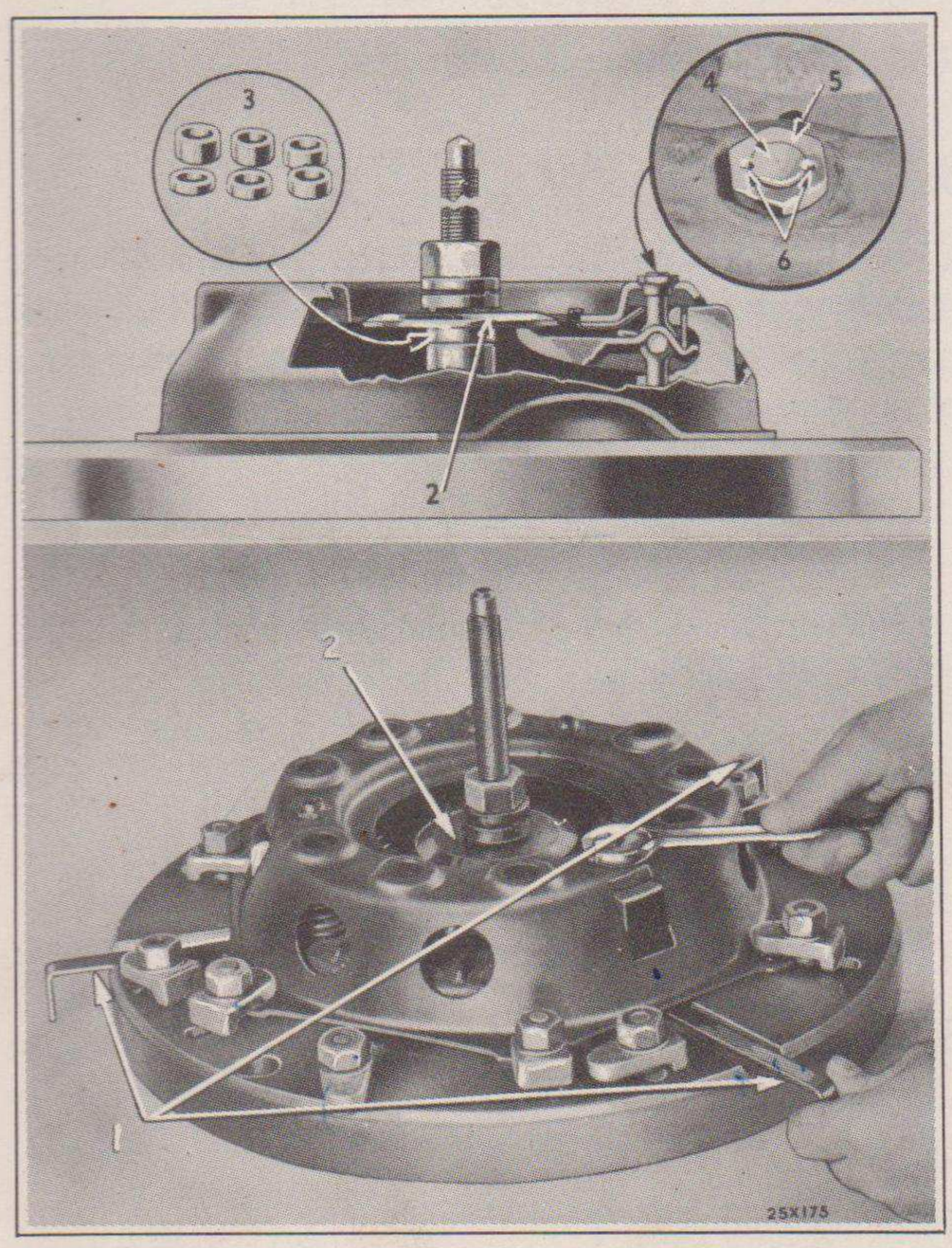


Fig. 93—Adjusting Clutch Release Levers

1—Feeler gauges (part of Tool C-585)
2—Compression plate (part of Tool C-585)
3—Spacers (part of Tool C-585)
4—Clutch release lever eye bolt
5—Clutch release lever eye bolt nut
6—Stake here to lock

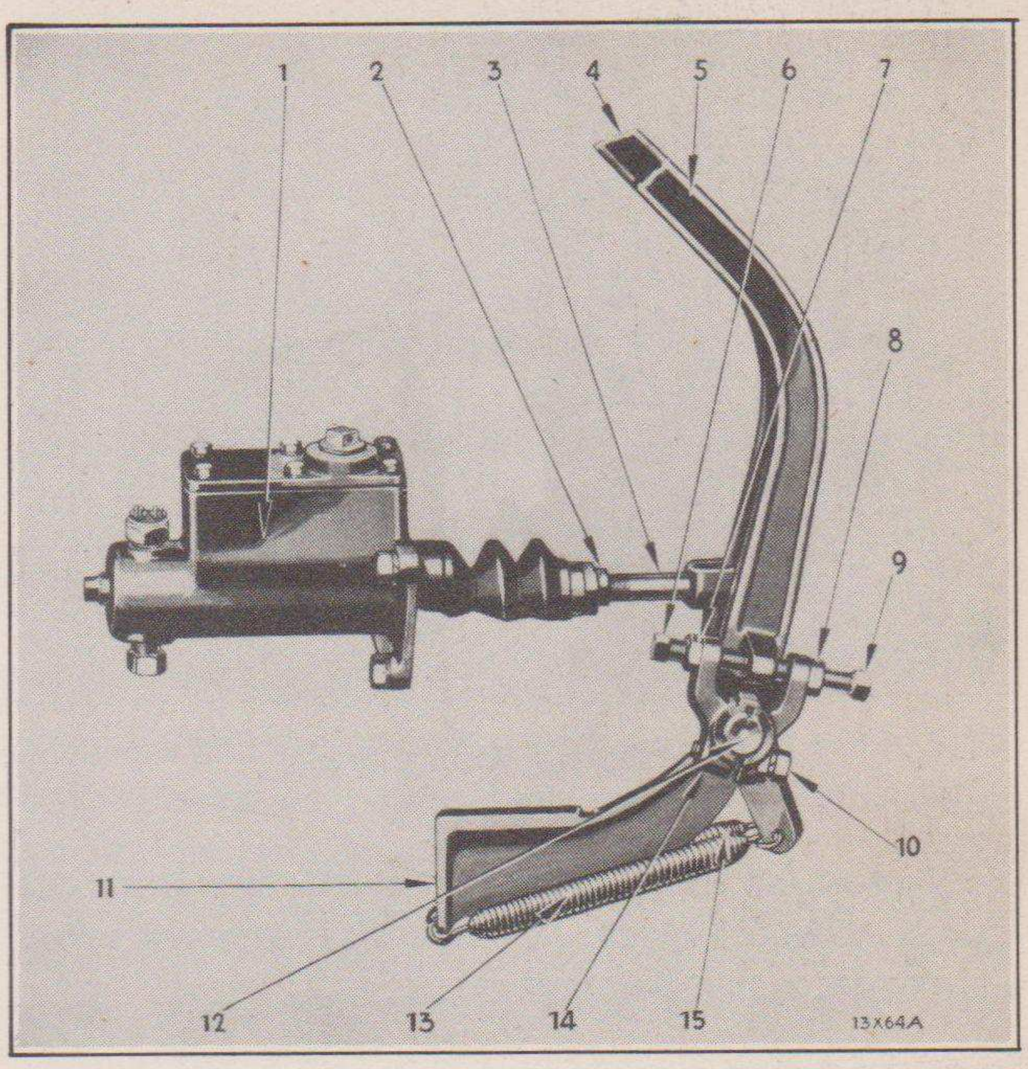


Fig. 94—Pedal Adjustments

1—Master cylinder assembly—complete
2—Master cylinder push rod end nut
3—Master cylinder push rod assembly
4—Brake pedal assembly
5—Clutch pedal assembly
6—Clutch pedal adjusting collar set screw
7—Clutch pedal adjusting collar set screw nut
8—Clutch pedal adjusting collar set screw nut
9—Clutch pedal adjusting collar set screw
10—Clutch pedal adjusting collar clamp screw
11—Clutch and brake pedal reinforcement bracket
12—Clutch release fork
13—Clutch pedal pull-back spring
14—Clutch pedal adjusting collar
15—Brake pedal pull-back spring

IMPORTANT: When removing the clutch cover assembly from the fixture, loosen the housing clamps first, then remove the compression nut. This will avoid throwing unequal strain on the release levers.

Before installing the clutch cover and pressure plate assembly in the truck, read the instructions in Subject 86.

89—Clutch Pedal Free Play

(a) Loosen the clutch pedal adjusting collar set screw lock nuts (7 and 8, Fig. 94).

(b) Turn the clutch pedal adjusting collar set screws (6 and 9, Fig. 94) until the pedal has 1⅛" free play. See Fig. 95.

Free movement of the clutch pedal is necessary to compensate for wear of clutch facing and to avoid clutch slippage. It insures proper

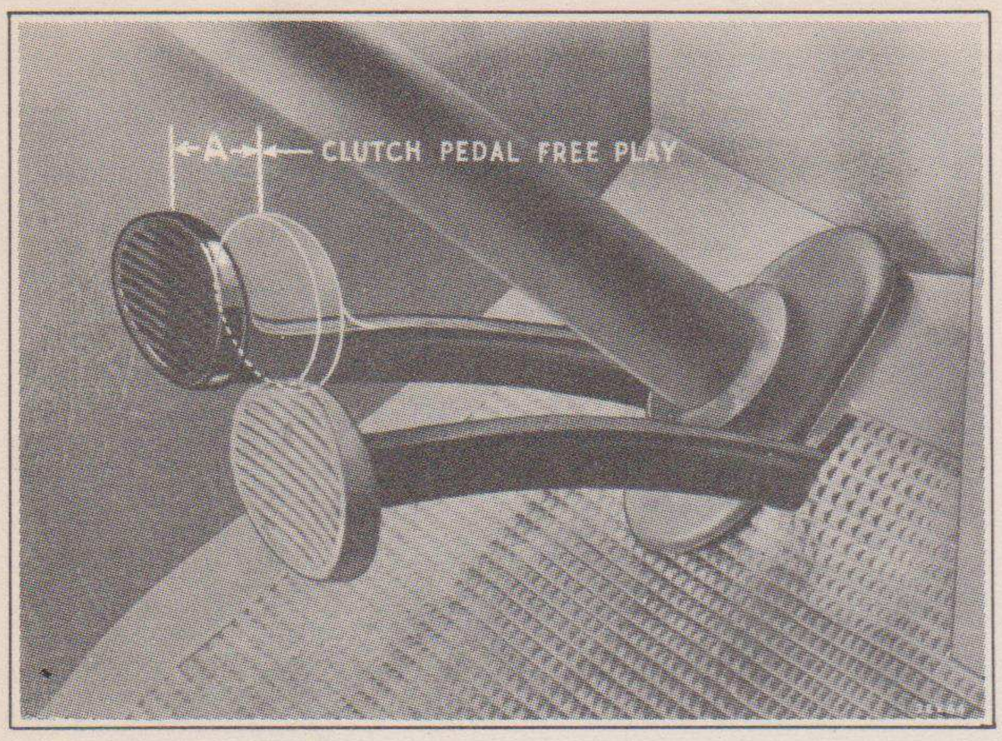


Fig. 95—Clutch Pedal Free Play

clearance between clutch release bearing and clutch release levers. (For clutch release lever adjustment, see Subject 88.)

Pedal Location

Backward travel of the clutch pedal is limited by the floor board. No adjustment is provided.

SERVICE DIAGNOSIS

90—Chatter

Chatter may be due to:

(a) Grease or oil on the disc, flywheel or pressure plate.

(b) Binding of clutch release linkage.

(c) Disc facings loose.

(d) Broken disc facings or pressure plate.

(e) Loose engine mountings.

(f) Incorrect adjustment of release levers.

91—Grabbing

Grabbing is usually caused by:

(a) Oil or grease on the disc, pressure plate or flywheel.

(b) Broken disc facings or pressure plate.

(c) Hub of disc not sliding freely on splined shaft, or binding of release mechanism.

92—Slippage

Slippage may be caused by:

(a) Lack of pedal free movement.

(b) Binding of clutch release mechanism.

(c) Broken clutch pressure springs.

(d) Worn disc facings, pressure plate or flywheel.

(e) Weak pressure plate springs.

93—Dragging

Dragging or incomplete release may be caused by:

(a) Excessive free movement of the pedal.

(b) Incorrect adjustment of release levers.

(c) Loose or broken disc facings.

(d) Bent or dished driven disc.

94—Spinning

Clutch spinning is frequently confused with clutch dragging. A clutch disc which releases perfectly will naturally spin under its own weight and momentum immediately after being released if the transmission gears are in the neutral position.

Gear clash, when shifting from neutral to first speed, or to reverse, is usually caused by the clutch spinning and can be overcome only by the "double clutch" method of shifting. (See Subjects 21 and 24.)

COOLING SYSTEM

An internal combustion engine operates most efficiently at uniform engineered temperature. This proper temperature is automatically maintained in the cooling system under all normal operating conditions.

The process of combustion creates high temperatures which are dissipated through the cooling solution circulated by the water pump. A water distributor tube located between the cylinders and the valve ports directs the flow of the cooling solution against the exhaust valve ports which are the hottest spots in the engine. Then the cooling solution is circulated through full-length water jackets around the cylinder walls, and through the radiator where the heat in the water is dissipated.

When a cold engine is started, the thermostat prevents the circulation of the cooling solution through the radiator. A simple by-pass allows the solution to circulate only in the water jackets of the engine until normal operating temperature has been reached. When the temperature as shown by the heat indicator on the instrument panel reaches approximately 157°, the thermostat starts to open allowing some of the cooling solution to circulate through the radiator. At approximately 183° the thermostat is fully open, allowing unrestricted circulation of the cooling solution. Thus the thermostat and by-pass automatically maintain the most efficient engine temperature.

The cooling system is a very important factor in the economical and satisfactory performance of the truck. Only a minimum amount of attention is necessary for its satisfactory operation.

95—Draining Cooling System

To drain the cooling system completely, open the radiator drain cock as well as the drain cock at the lower edge of the water jacket on the left side of the engine to drain all water from the cylinder block. See Fig. 96. If the truck is to be stored or left idle for a long period, it is advisable to leave these drains open.

CAUTION: When removing the filler cap from a hot radiator, rotate it towards the left until the stop is reached. This is the vented position which allows the pressure to escape. Keep it in this position until the pressure in the cooling system has been relieved. Then turn more forcibly to the left to remove. Turn the cap all the way to the right when installing.

96—Filling Cooling System

Whenever adding water to the system be sure it is clean and does not contain alkali which would form scale inside the system and eventually clog the passages causing poor or no circulation. A good way to keep the cooling system clear is to flush it by the forced reversed flow method (see Subject 97) before filling the system with anti-freeze solution in the fall and after draining it out in the spring.

The level of the liquid in the radiator should be 1½ to 2 inches above the top of the radiator core. If the radiator is filled to a higher level, the cooling solution will expand when it becomes warm and run out the overflow pipe. This is especially important when using anti-freeze solution to prevent loss of the solution.

CAUTION: Never pour cold water or cold anti-freeze solution in the radiator of an engine that is overheated. Allow the engine to cool and avoid the danger of cracking the cylinder head or block.

Radiator Rust Resistor

Rust resistor when added to the water in the

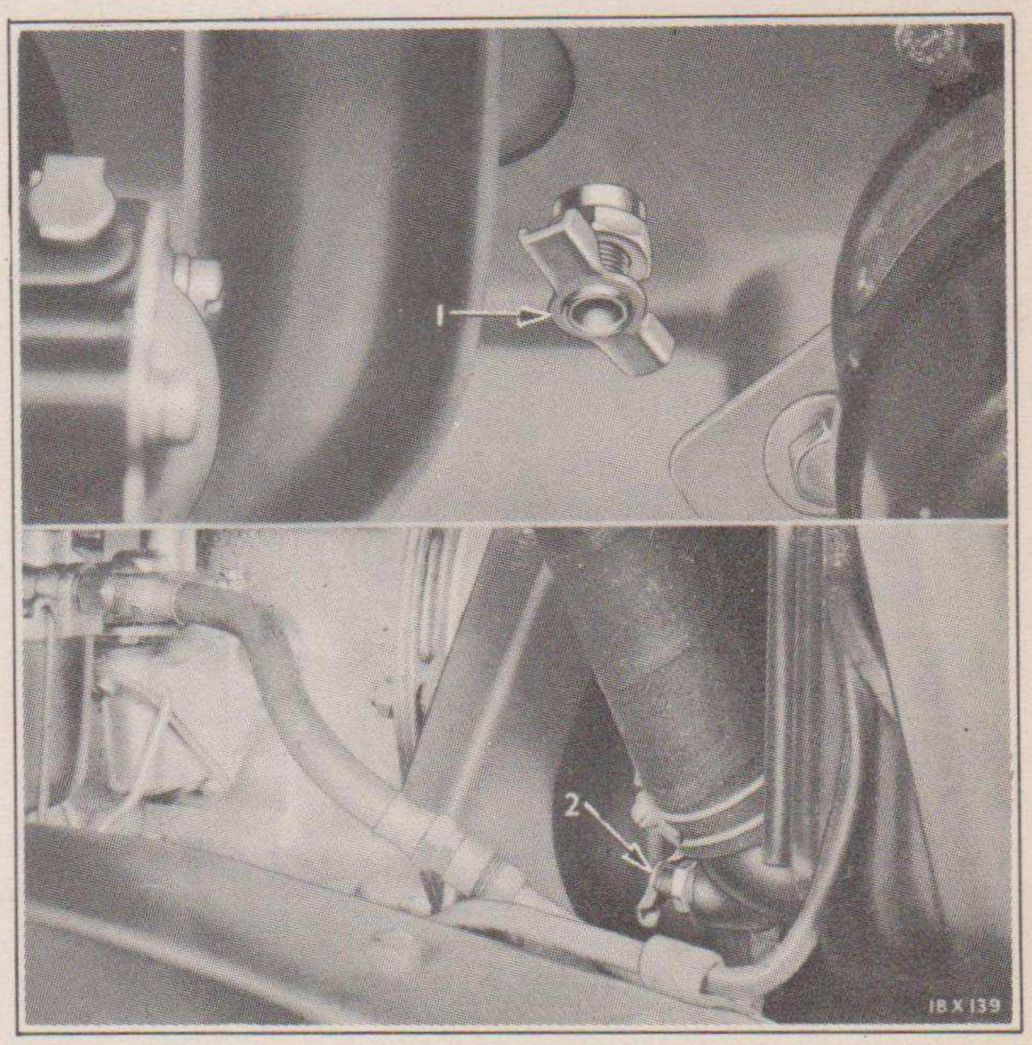


Fig. 96—Cooling System Drain Cocks
1—Cylinder block water jacket drain cock
2—Radiator core drain cock

cooling system retards the formation of scale and rust, and also is a safeguard against electrolytic corrosion which could take place where dissimilar metals are used, such as the radiator core. Scale or rust tends to obstruct flow through the passages of both the cylinder block and the radiator, and when such formation is excessive, can cause overheating. This, in turn, causes loss in lubricating efficiency and the accumulation of carbon, varnish and gums. Rust resistor does not remove rust—it is a preventative only and not a cleaner.

One pint of rust resistor is sufficient for the cooling system and once put in, no further additions are necessary except when the system is drained or flushed. If an anti-freeze solution containing a rust resistor is used it is not necessary to add additional rust resistor.

97—Flushing Cooling System by Reverse Flow Method

(a) Open the radiator drain cock.

(b) Remove the water hose from the radiator inlet (top).

(c) Remove the cylinder head water outlet elbow from the cylinder head and take out the thermostat. Plug the by-pass elbow with a cork and install the elbow.

(d) Remove the water hose from the radiator outlet (bottom).

(e) Attach a flushing gun to the hose on the engine water outlet elbow at the top of the cylinder as shown in Fig. 97.

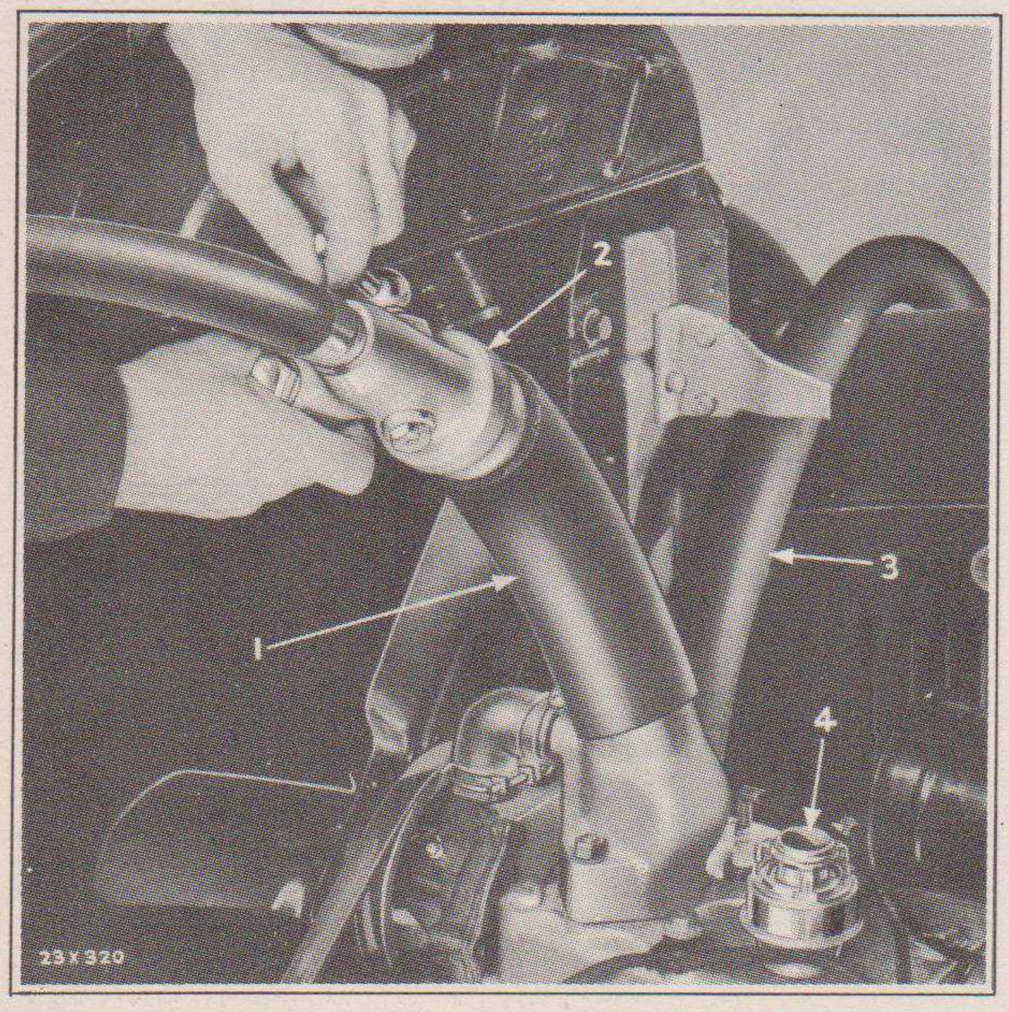


Fig. 97—Flushing Engine with Flushing Gun
1—Radiator inlet hose
2—Flushing gun—Tool C-811
3—Water outlet hose
4—Thermostat removed

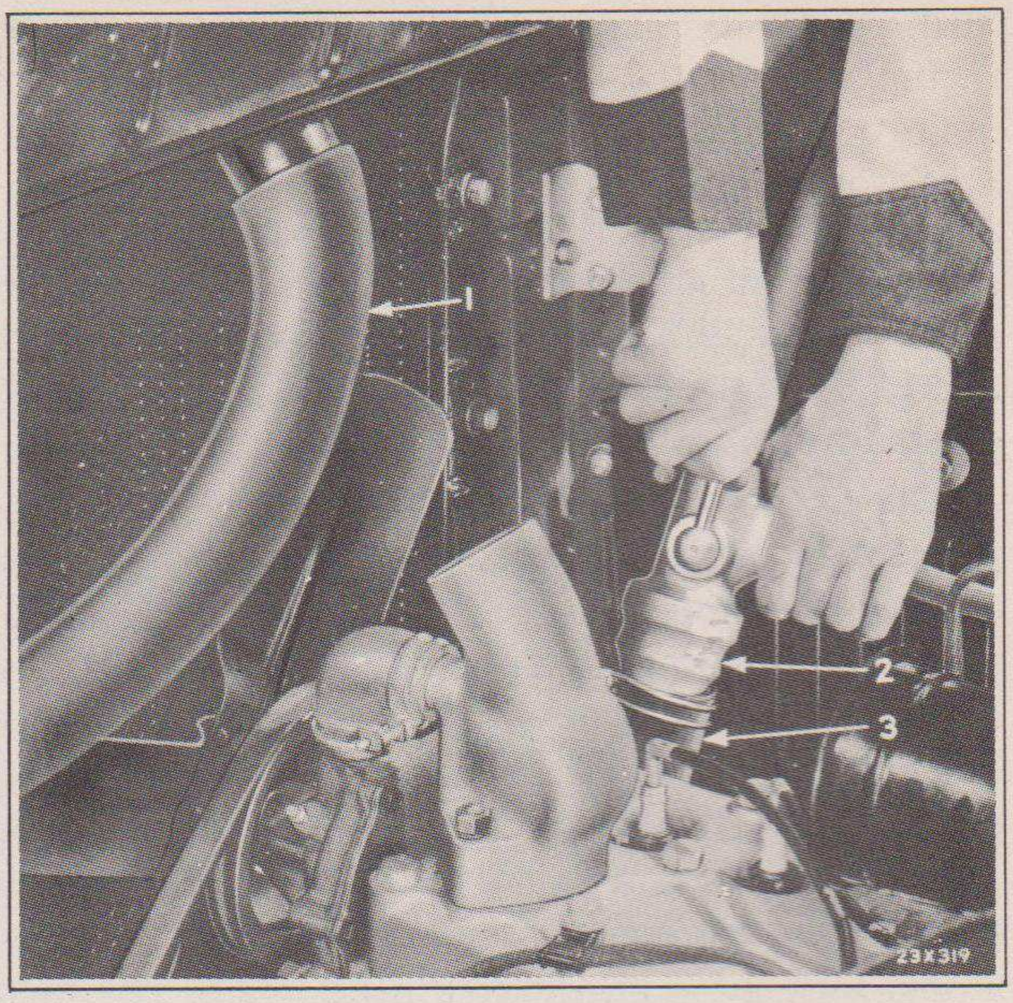


Fig. 98—Flushing Radiator with Flushing Gun
1—Water outlet hose
2—Flushing gun—Tool C-811
3—Radiator outlet hose—lower

(f) Turn on the water and compressed air supply and force the water downward through the cylinder head and block until the water jackets are clean. A pulsating flow of the water will loosen sediment quicker than a steady flow.

(g) Attach the flushing gun to radiator outlet elbow (bottom of radiator) and force the water upward through the radiator until cleaned. See Fig. 98.

CAUTION: When pressure flushing the radiator do not apply excessive water pressure which might damage the radiator. Make sure there is a clear open outlet for the incoming water before applying any pressure. Never flush a radiator while it is connected to the engine block as rust scales may be forced from the block into the radiator, and permanently clog it.

(h) Assemble the thermostat as explained in Subject 104. Then install the hose from the engine to the radiator, *removing the cork or plug from by-pass elbow.*

(i) Inspect for water leaks at the connections after filling with water or anti-freeze solution.

98—Anti-Freeze Solutions

At the approach of freezing weather an anti-freeze cooling solution should be used. Always flush the system clean before making the initial

filling with anti-freeze. The solution should be tested frequently during freezing weather, to make certain that the engine is protected against a "freeze-up."

There are three commercial liquids available which may be used to prepare anti-freeze solutions that are satisfactory for automotive cooling systems. These liquids are denatured alcohol, methanol (synthetic wood alcohol) and ethylene glycol. It is recommended that the cooling system be cool before adding anti-freeze solution. To facilitate accurate testing of the freezing point, it is not advisable to mix different basic types of anti-freeze.

Denatured alcohol and methanol are subject to evaporation, especially on heavy runs. If these liquids are used as anti-freeze solution, the solution 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. These liquids, if spilled on the vehicle, should be washed off immediately with a generous quantity of water, to prevent damage to the finish.

When using ethylene glycol, thoroughly clean and flush the entire cooling system before putting in the solution. If there are leaks in the system, they should be located and stopped. It is advisable to tighten all hose connections and if necessary, replace these parts to obtain tight joints. Keep the cylinder head tight to prevent leakage past the cylinder head gasket. Regular lubrication of the water pump is further precaution against leaks at the water pump shaft. If evaporation occurs with the use of ethylene glycol, it is only necessary to add water to the solution; however, the cooling system must be watched closely for leaks.

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 will either clog the water passages or damage the hose connections and other parts.

Testing Anti-Freeze Solution

The freezing point of an anti-freeze solution may be determined by using a hydrometer made for this purpose. 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. Universal hydrometers are available which will test any anti-freeze solution at various temperatures.

99—Water Pump

Removal and Installation

(a) Drain the cooling system. See Subject 95.

(b) Loosen the generator mounting bracket pivot bolts and the adjusting strap locking screw to loosen the fan belt.

(c) Remove the fan belt.

(d) Remove the fan blade assembly, (pulley and fan blades).

(e) Loosen the hose clamps on the hose which connects the pump to the by-pass elbow.

(f) Loosen the hose clamps on the hose at the right side of the pump and pull the hose off the pump.

(g) Remove the water pump retaining nuts and lockwashers. Move the pump forward toward the radiator core. Using stud pliers between the pump and block, unscrew the studs and remove the water pump assembly.

When installing the water pump remove all traces of torn gaskets, and dirt. Use new gaskets. Then holding pump in place, screw the studs into the block tightly and continue to install the parts taken off during the removal procedure. Be sure to tighten all hose connections securely as well as the cooling system drain cocks. Then fill the radiator (using rust resistor if required, Subject 96) and check for leakage of the cooling solution. The pump should be lubricated according to instruction in the "Lubrication" section of this manual, and the fan belt should be adjusted as explained in Subject 102.

Disassembling Water Pump

(a) Drive out the fan pulley hub pin.

(b) Pull the hub off the shaft with puller, C-412, as shown in Fig. 101.

(c) Remove the cap screws holding the cover to the pump body and take off the cover.

(d) Pull the impeller and shaft assembly out of the pump body.

(e) Drive out the pin which holds the impeller to the shaft. (This operation is not necessary if a new shaft, impeller and seal assembly is to be installed.)

(f) Drive the front bushing locking pin into the shaft hole of the bushing to permit removal of the bushings.

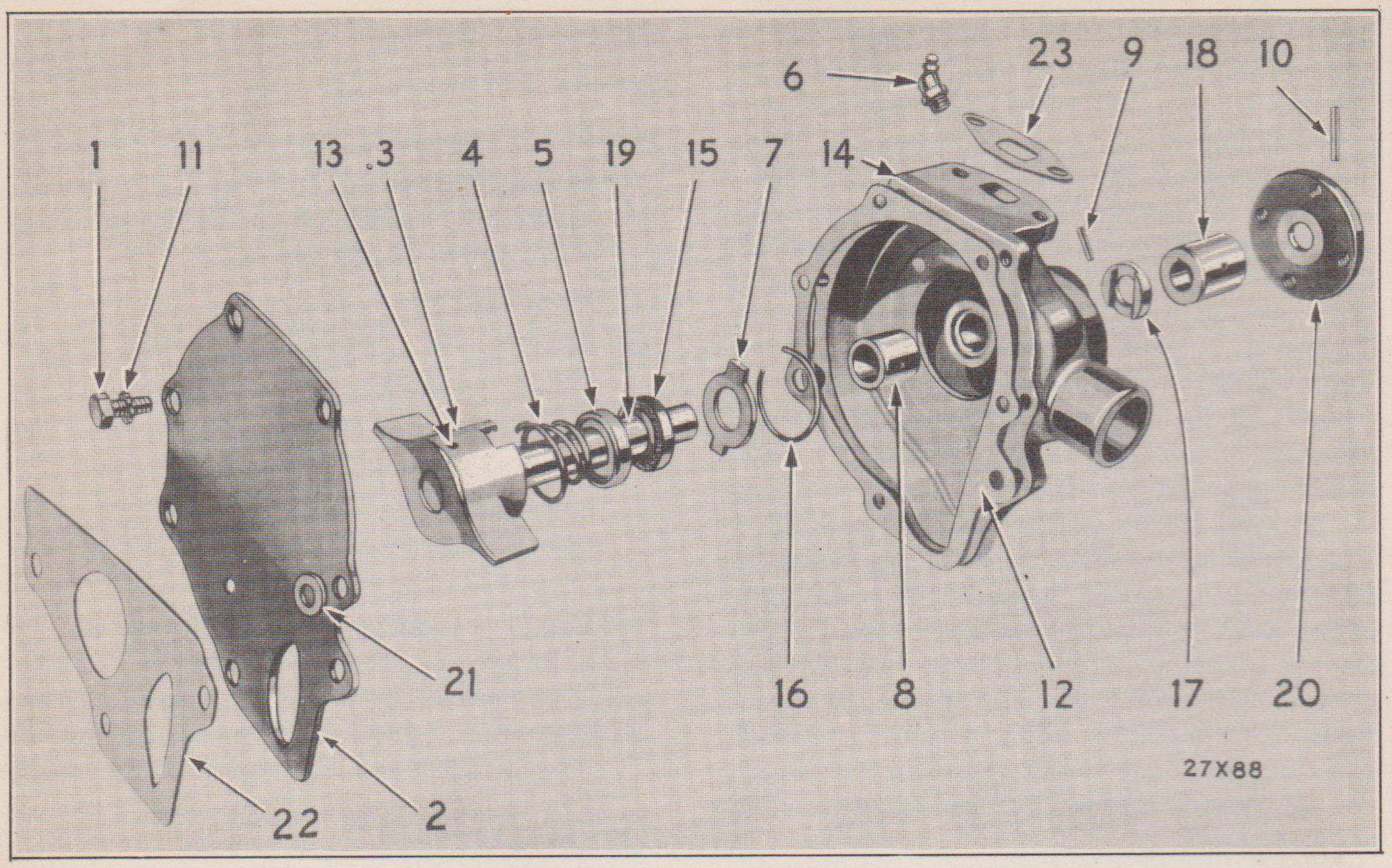


Fig. 99—Water Pump (disassembled view)

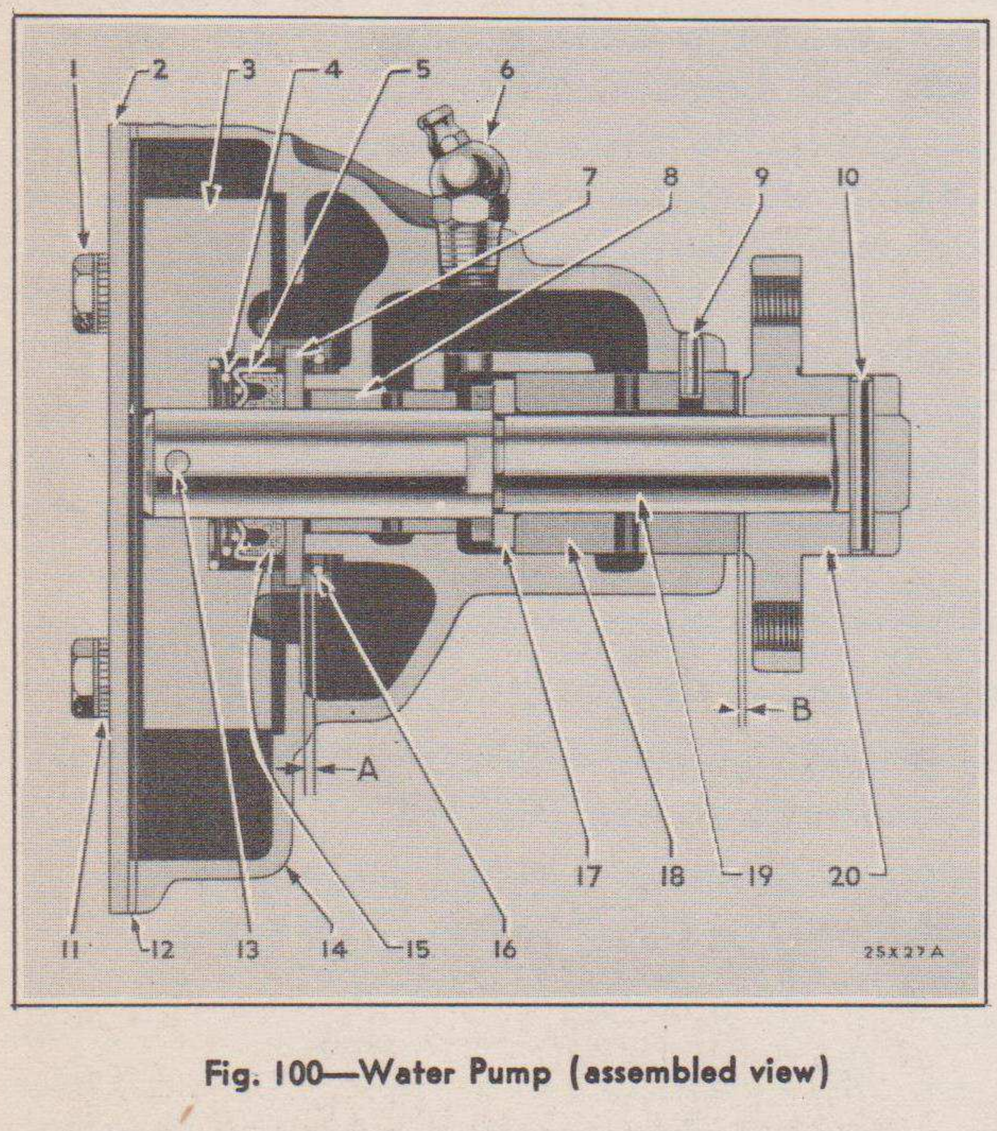


Fig. 100—Water Pump (assembled view)

(g) Use puller, C-373 (Fig. 102), to remove the front and rear bushings from the pump body—pulling them out toward the front. Fig. 99 shows the water pump disassembled and Fig. 100 shows an assembled view of the pump.

Figs. 99 and 100—Water Pump

1—Body cover plate screw
2—Body cover plate
3—Impeller
4—Seal thrust spring
5—Seal retainer
6—Lubricant nipple
7—Seal retainer washer
8—Shaft rear bushing
9—Shaft front bushing pin
10—Fan pulley hub pin
11—Body cover plate screw lockwasher
12—Body cover plate gasket
13—Impeller pin
14—Body
15—Seal
16—Seal retainer washer lock ring
17—Shaft thrust washer
18—Shaft front bushing
19—Shaft
20—Fan pulley hub
21—Body cover plate screw washer
22—Cover plate to cylinder block gasket
23—By-pass elbow gasket
A—Minimum dimension (3/32")
B—End play (.003")

100—Assembling Water Pump

(Using Special Tools C373-C384)

Proper installation of the water pump shaft bushings is important in order to provide the necessary clearance (A, Fig. 100) for water pump impeller. When using special tool C-373, the shaft front bushing (18, Fig. 100) will be properly located and correct clearance maintained for the water pump impeller.

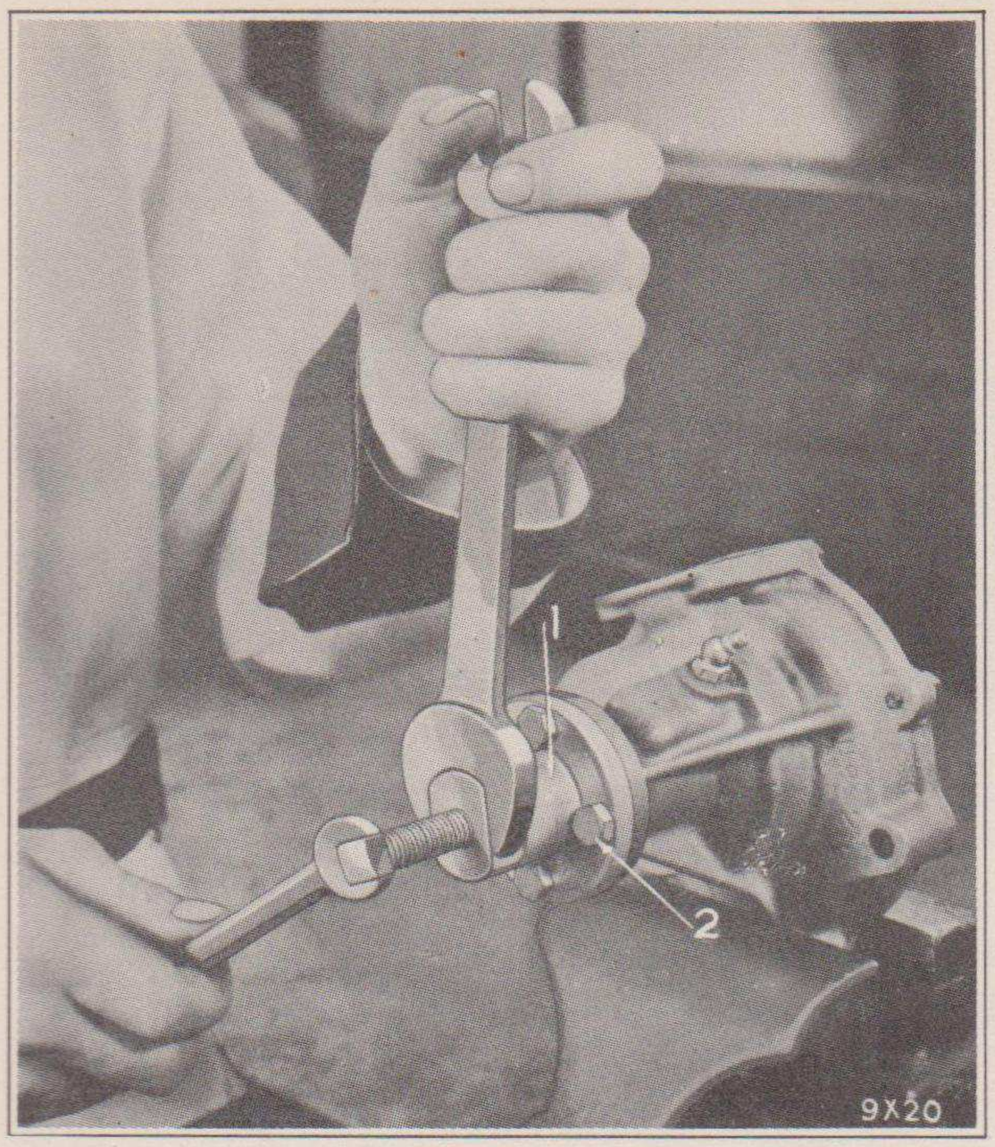


Fig. 101—Pulling Hub from Water Pump Shaft
1—Tool C-412
2—Screw holding tool to water pump hub

a) Clamp the C-373 puller screw upright in a vise.

(b) Install special tool bushing No. 3 with the large diameter against the small hex nut on the screw. Be sure the hex nut is tight against the shoulder on the screw.

(c) Start the shaft rear bushing (8, Fig. 100) slightly in the pump body and assemble the complete body over C-373 screw.

(d) Install the thrust washer (17, Fig. 99) over C-373 screw with the *flat side up*

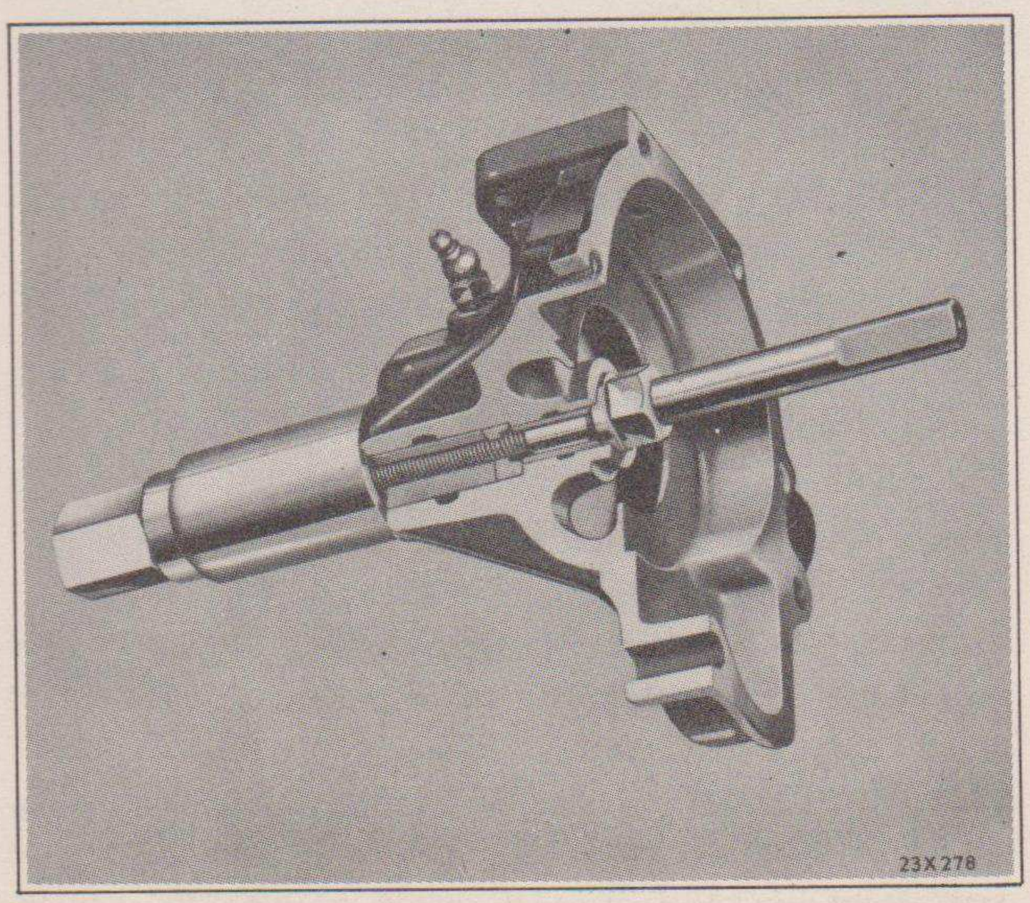


Fig. 102—Removing Water Pump Shaft Bushings
Tool C-878

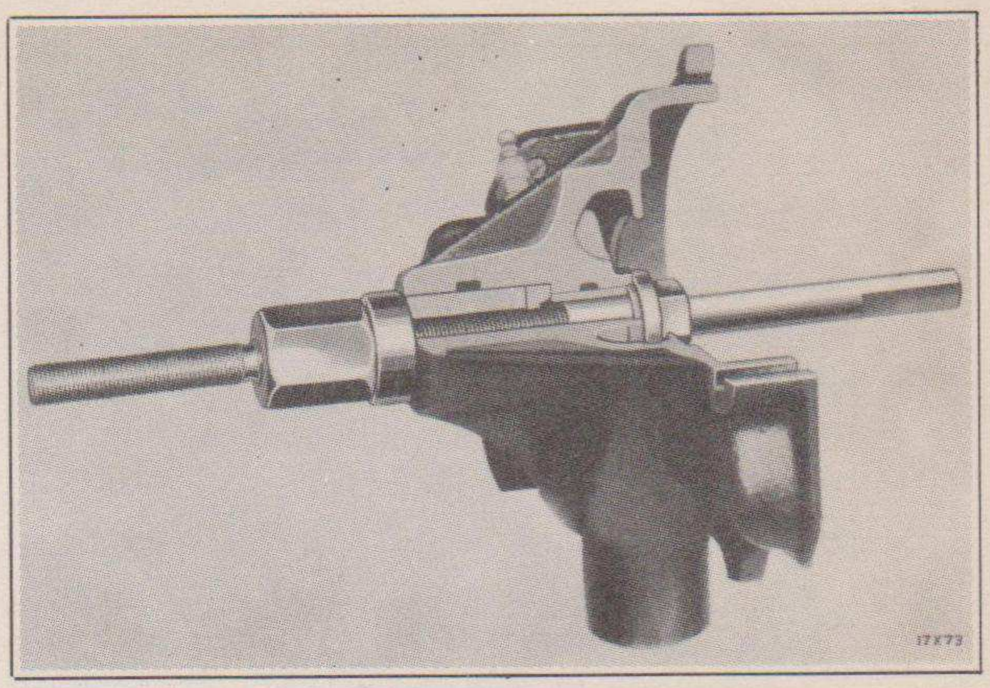


Fig. 103—Installing Water Pump Shaft Bushings
Tool C-373

(toward front of pump). Then assemble the shaft front bushing, tool thrust bearing and large hex nut on C-373 puller screw.

(e) Tighten the hex nut, drawing the bushings in position until the top face of the hex nut lines up with the lower edge of the groove in the C-373 puller screw. See Fig. 103. This will give the required clearance of $\frac{3}{32}$" shown at "A" in Fig. 100.

(f) Remove tool and drill the shaft front bushing for the pin using the hole in the pump body as a guide. Use drill size No. 13 (.185"). Remove drill burr from inside of bushing and install the front bushing pin flush with the body.

(g) Line burnish the bushings and reface the body using special tool C-384 (Fig. 104). Turn the burnisher in an *even* clockwise

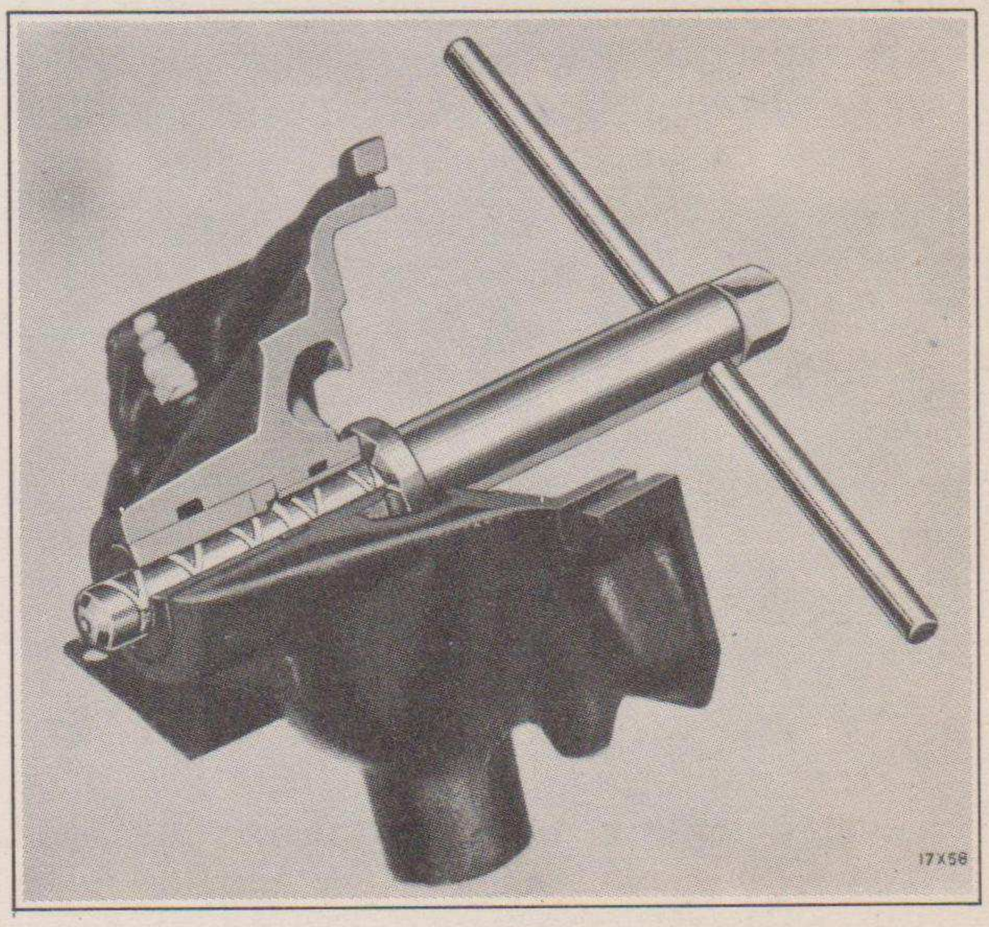


Fig. 104—Line Burnishing Bushings and Facing the Housing
Tool C-884

direction until a full cut has been taken on the body, then continue turning the burnisher clockwise as it is being removed, to prevent leaving a ridge on the body.

(h) If a new shaft, impeller and seal assembly is to be installed in the pump, slide the assembly through the rear bushing, thrust washer and front bushing, aligning the shaft and washer so they will fit together.

Note: If the component parts of the shaft assembly are being replaced, first install the impeller on the shaft, making back of impeller flush with end of shaft and then drill shaft and install the impeller pin. Install the seal thrust spring and seal retainer. Using special tool C-528, assemble seal as shown in Fig. 105. This special sleeve prevents danger of scuffing inside diameter of seal which might cause leakage of water between shaft and seal. Then install seal retainer washer and lock ring.

(i) Mark the end of the shaft, showing the direction of the fan pulley hub pin hole. (This operation is not necessary when a new shaft is installed.) Then press a new (unused) fan pulley hub onto the pump shaft, leaving a clearance between the bushing and hub of .003" for shaft end play measured with a feeler gauge. See Fig. 106.

IMPORTANT: The fan pulley hub MUST fit the shaft tightly and due to the nature of the hub, it will not fit tight enough after having been pressed "on," "off" and then "on," therefore, a new hub should always be used.

(j) Drill through the hub and shaft with a number 22 (.157") drill so that the new hole is at right angles to the old hole in the shaft.

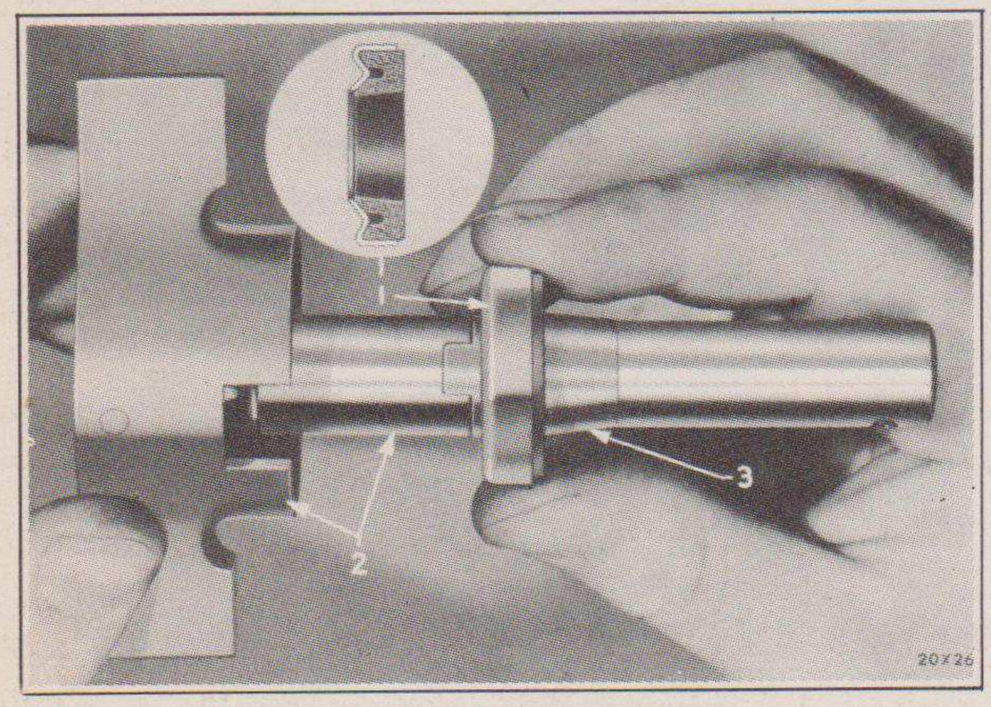


Fig. 105—Installing Water Pump Seal
1—Seal
2—Water pump shaft and impeller
3—Tool C-528

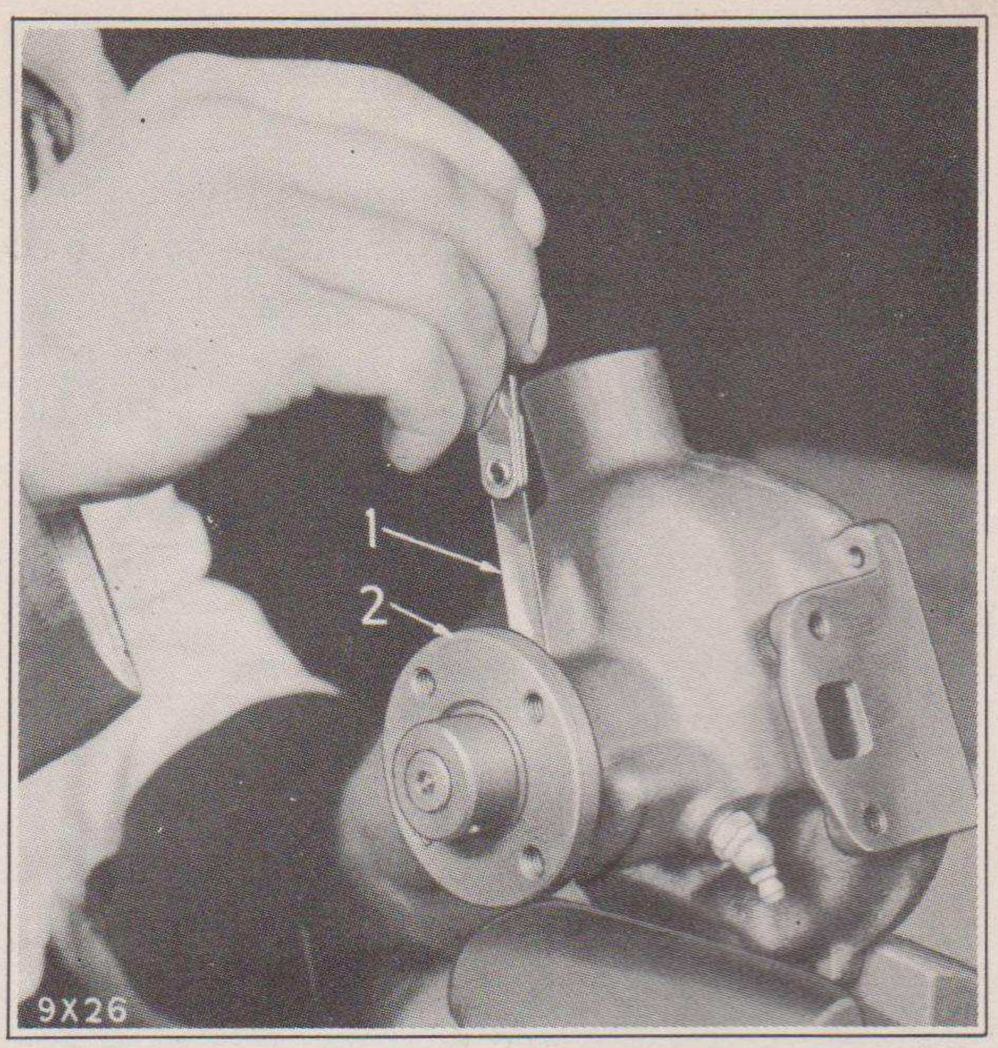


Fig. 106—Checking End-Play of Water Pump Shaft
1—Feeler gauge 2—Fan pulley hub

This will be shown by the mark made on the end of the shaft prior to pressing on the new hub.

(k) Install the pump on the engine as explained in Subject 99.

101—Fan Belt Replacement

To replace the fan belt, loosen the generator mounting bracket pivot bolts and adjusting strap lock screw at the generator. Then push the generator toward the engine. This will remove the tension on the belt and it can be removed or installed by threading it through the fan blades. When a new belt is installed, adjust it as explained in Subject 102.

102—Fan Belt Adjustment

(a) Loosen the generator mounting bracket pivot bolts.

(b) Loosen the adjusting strap lock screw.

(c) Pull outward on the generator until the belt is just snug. While holding the generator in this position, tighten the adjusting strap lock screw and the bracket pivot bolts. Do not over-tighten the belt.

CAUTION: Never adjust the fan belt by moving the generator with a pry bar.

103—Radiator Core

Removal and Installation

(a) Remove the hood and drain the cooling system.

(b) Remove the radiator tie rods.
(c) Disconnect the water inlet and outlet hose at the radiator.
(d) Remove the fan blade assembly.
(e) Remove the screws that hold the core to the support.
(f) Lift out the radiator core assembly, being careful not to let it strike any of the surrounding parts and damage the radiator core cells.

The clearance between the fan pulley hub and the fins of the radiator is very slight when the radiator core is being removed or installed. Place a piece of cardboard between the fan pulley hub and the core to prevent damaging the radiator core fins.

To install the radiator core, first place it in position and install the screws which hold it to the support. After installing the other parts taken off during the removal procedure be sure that both drain cocks (at the radiator core and cylinder block) are securely tightened as well as all hose connections. Then fill the radiator, and check for possible leakage of cooling solution. If the cooling solution does not contain a rust resistor, add a pint. See Subject 96.

104—By-Pass Thermostat

The thermostat is located in the cylinder water outlet elbow and is for the purpose of preventing water circulation through the radiator until the engine reaches its normal operating temperature.

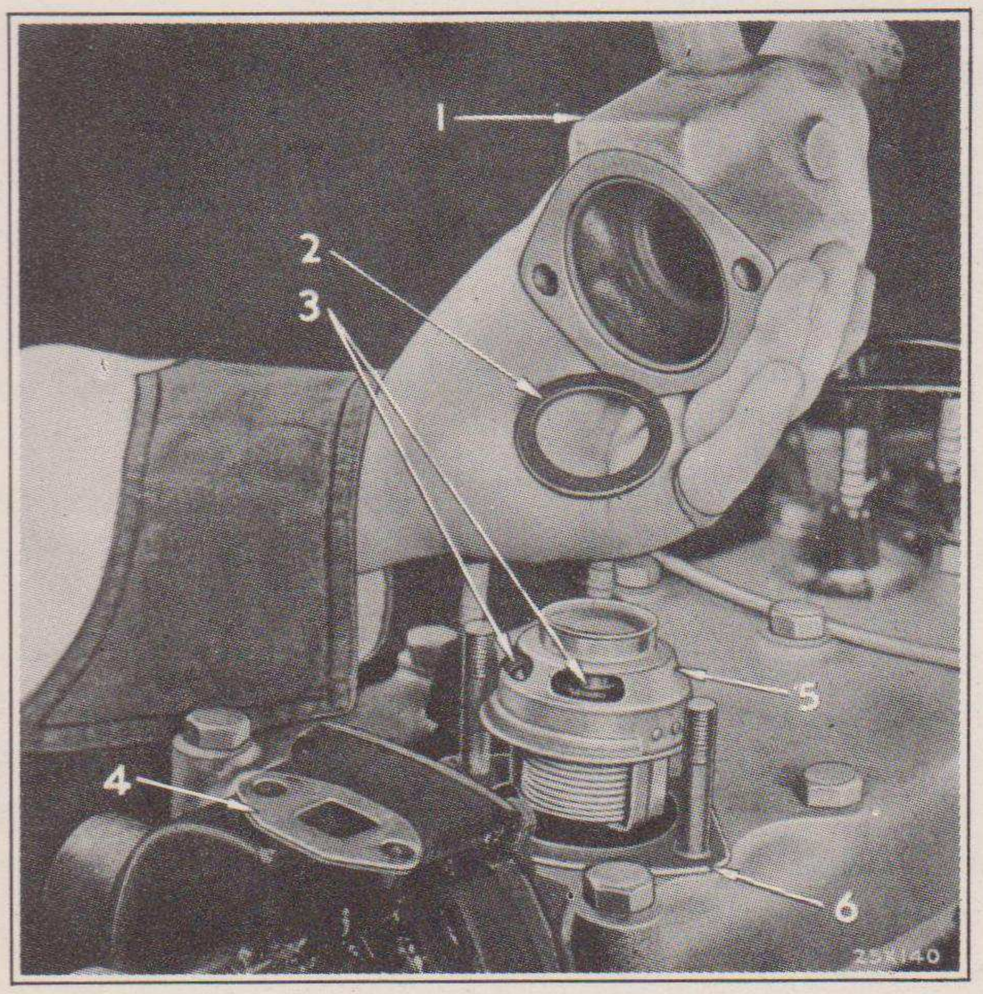


Fig. 107—Removing Thermostat

1—Cylinder water outlet elbow, water pump by-pass elbow and hose
2—Thermostat gasket
3—Thermostat openings
4—Water pump by-pass elbow gasket
5—Thermostat
6—Cylinder water outlet elbow gasket

The thermostat may be removed by disconnecting the engine outlet hose and the by-pass hose connection at the water pump. Then remove the two nuts and lock washers which hold the cylinder head water outlet elbow to the cylinder head and lift the unit upward to expose the thermostat. See Fig. 107.

When installing the thermostat be sure to install the upper and lower gaskets (2 and 6, Fig. 107). The thermostat by-pass openings (3, Fig. 107) should face in the proper direction; toward the radiator and to the rear of the truck, leaving the two wide faces to right and left.

During the warming up period, water circulates through the cylinder block. The thermostat is designed to start opening at a pre-determined temperature of 157° to 162° F. The thermostat will be fully opened at a temperature of 183° to 187° F.

There are no repairs or adjustments to be made on the thermostat and failure to operate should be corrected by replacement of the unit.

Failure of the thermostat to close will be indicated by slow warming up of the water and slow rise of the heat indicator.

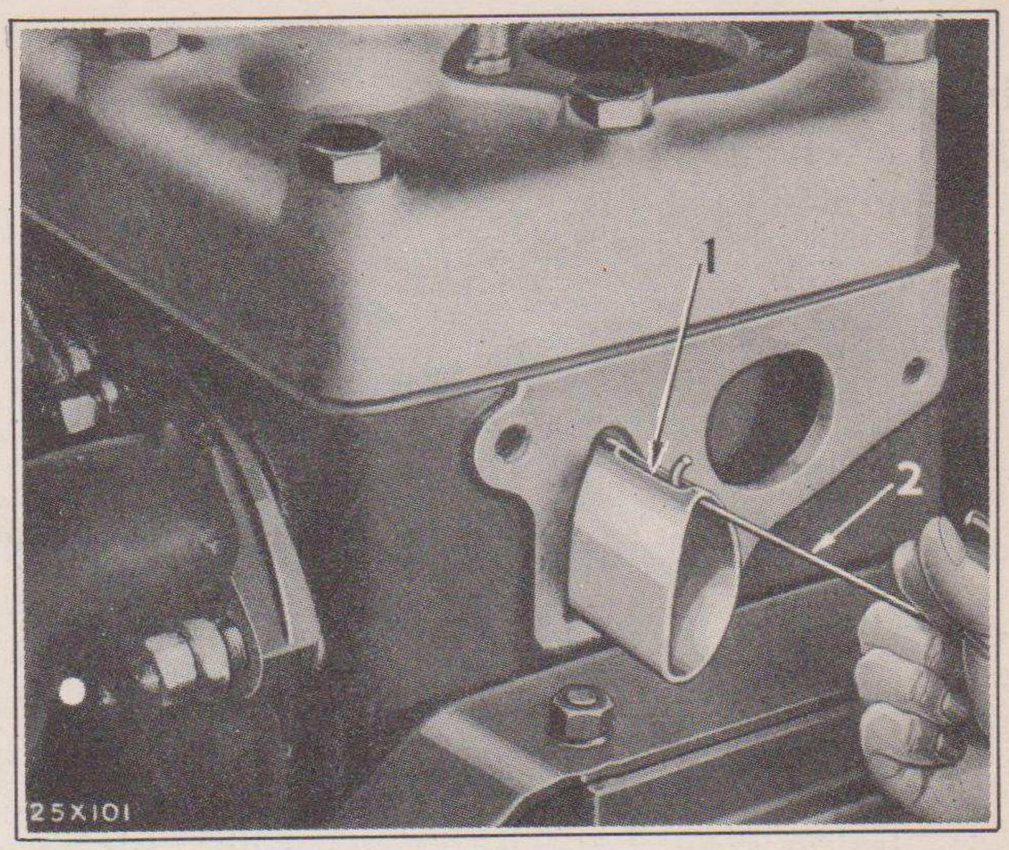


Fig. 108—Removing Cylinder Block Water Distributor Tube

1—Tube 2—Hook

105—Water Distributor Tube

The water distributor tube (Fig. 108) directs the flow of water from the water pump against the exhaust valve ports which are the hottest spots in the engine. The tube is located between the cylinders and the valve ports near the top of the cylinder block.

It can be removed and installed after removing the radiator core and water pump. See Subjects 99 and 103. A rod with a hook formed on one end will facilitate its removal. See Fig. 108.

The tube should be replaced whenever the engine is completely overhauled. If the tube becomes rusted or corroded, overheating of the engine will occur due to failure of the water to circulate properly through the cylinder block.

106—Engine Temperature

Correct engine operating temperature has much to do with fuel economy and engine performance. Trucks used in a service which requires frequent stops often do not develop an economical engine operating temperature, especially in cold weather. Water vapor forms in the crankcase from natural causes of combustion and cannot be avoided. An engine operated below normal engine temperature may develop an excessive accumulation of water in the crankcase oil.

Gas fumes and water vapor are circulated in the crankcase by the motion of the crankshaft and drawn out of the crankcase by vacuum caused by the forward travel of the vehicle. Fresh air is drawn in through the breather pipe (oil filler pipe) and exhausted through the ventilator outlet pipe on the right side of the crankcase at the rear.

In instances where the service of the truck requires frequent stops, it is recommended that the engine be operated at a higher temperature. This may be accomplished by using a thermostat which opens at a higher temperature (180° to 185° F.). This thermostat should not be used with anti-freeze solutions having a boiling point less than 200° F. As an alternative, a partial cover over the radiator grille may be used. In some instances it may be necessary to use both, in order to sufficiently reduce condensation in the crankcase.

107—Heat Indicator

The temperature of the water in the cylinder block is indicated by a heat indicator on the instrument panel.

The gauge assembly is operated by means of an expansive gas enclosed in a metal bulb and connected to the gauge by a thin (capillary) tube. The bulb is screwed into the water jacket of the cylinder head. In the event of failure to indicate or operate properly, the complete assembly (gauge, tube and bulb) should be replaced.

The bulb is sometimes firmly seated in place, due to rust and corrosion and is difficult to remove. In such cases, after the retaining nut is removed, it may be necessary to jar the bulb loose by lightly tapping or prying against it with a small screw driver or some other similar instrument. Solvent such as kerosene freely applied to the bulb, may also facilitate its removal.

Care should be used when working on the engine or when removing the cylinder head, not to damage the tube or bulb. Sharp kinks in the tube must be avoided.

The heat indicator will not withstand temperatures in excess of 250° F. If the gauge (unit on the instrument panel) is found to have a permanent set so that it does not return to 100° F. when cold, it is a strong indication of extreme temperature having been produced by low water level, a frozen radiator or cylinder block.

If the inaccuracy of the heat indicator is not over 30° F., it is frequently possible to correct the instrument reading by bending the link which connects the instrument operating tube to the pointer. The metal bulb should be immersed in water and tested at approximately 140° and 212° F. after this adjustment.

SERVICE DIAGNOSIS

108—Overheating

Possible Causes:

(a) Loose fan belt.
(b) Obstructed radiator core, cylinder block or head.
(c) Collapsed or obstructed hose connections.
(d) Dirt, or other foreign particles lodged between radiator fins.
(e) Inoperative water pump due to sheared impeller pin.
(f) Insufficient cooling solution.

109—Engine Runs Too Cold

Possible Causes:

(a) Thermostat remains open.
(b) Thermostat should open at a higher temperature. See Subject 106.

110—Loss of Cooling Solution

Possible Causes:

(a) Leakage at hose connections, drain cocks, radiator core or water pump.
(b) Loose cylinder head allowing combustion pressures to pass cylinder head gasket, forcing cooling solution out through radiator overflow pipe.

ELECTRICAL SYSTEM

(Type—6 Volt, Negative Ground)

The units comprising the single wire electrical system of U. S. Army Dodge 4 x 4 Trucks as covered by this manual have been divided into seven parts as follows:

Starting System
Generating System
Ignition System
Radio Interference Suppression
Lighting System
Horn
Service Diagnosis

Description of various units of the electrical system together with information regarding tests and repairs will be found under these subgroup headings.

STARTING SYSTEM

The starting motor illustrated in Fig. 109 is the positive shift type with a sliding gear and overrunning clutch. As the starting motor pedal is depressed, the starting motor pinion and clutch are moved toward the flywheel ring gear. If the pinion and flywheel teeth are not in alignment for perfect mesh, the pinion butts up against the ring gear teeth. Further movement of the starting motor pedal compresses a spring behind the clutch. This spring exerts approximately 45 pounds pressure against the starting motor pinion when the starting motor pedal is depressed far enough to close the starting motor switch. When the switch is closed, the starter is energized, turning the pinion until the teeth of the pinion enter into engagement with the teeth on the ring gear thus cranking the engine. When the engine starts under its own power the overrunning clutch allows the armature to turn slower than the pinion, thus preventing damage to the armature and windings of the starting motor.

STARTING MOTOR

111—Testing Starting Motor on Truck

Test Connections

To test the starting motor before it is removed from the truck, first make sure the battery is fully charged and in good condition. Then attach the leads of an accurate ammeter with 0 to 600 ampere scale in series with the starting motor. An accurate voltmeter with 0 to 10 volt scale with .10 volt divisions should be connected with one voltmeter lead at the starting motor terminal and the other voltmeter lead on the positive battery post.

Lock Torque Test

To make a lock torque test, shift the transmission to high gear and lock the hand brake. Depress the starting motor pedal and *quickly* take the ammeter and voltmeter readings. For every 100 amperes current draw, the voltmeter should read .12 volt, i.e., with 550 amperes recorded on the ammeter, the voltmeter should read 5.5 x .12 or .66 volt.

If the drop is found to exceed .12 volt per 100 amperes, examine all connections and check voltage drop starting at the battery posts. See Subject 118.

CAUTION: Depressing the starting motor pedal for too long a period of time or too often will damage the starting motor and battery.

Motorizing Test

Before disconnecting the voltmeter and ammeter, connect the voltmeter leads across the starting motor (one lead to ground and the other to the starting motor terminal) and make a free-running test of the starting motor. Depress the starting motor button without engaging the starting motor pinion. The following test meter readings should be obtained:

Ammeter.....60 Voltmeter.....5.5

If the foregoing readings cannot be obtained, remove the starting motor for further checking.

112—Starting Motor

Removal and Disassembly

To remove the starting motor, disconnect the terminals from the binding post and tape the battery terminal, or disconnect it at the battery. Remove the oil filter and tubes. Then disconnect the starting motor linkage, remove the bolts

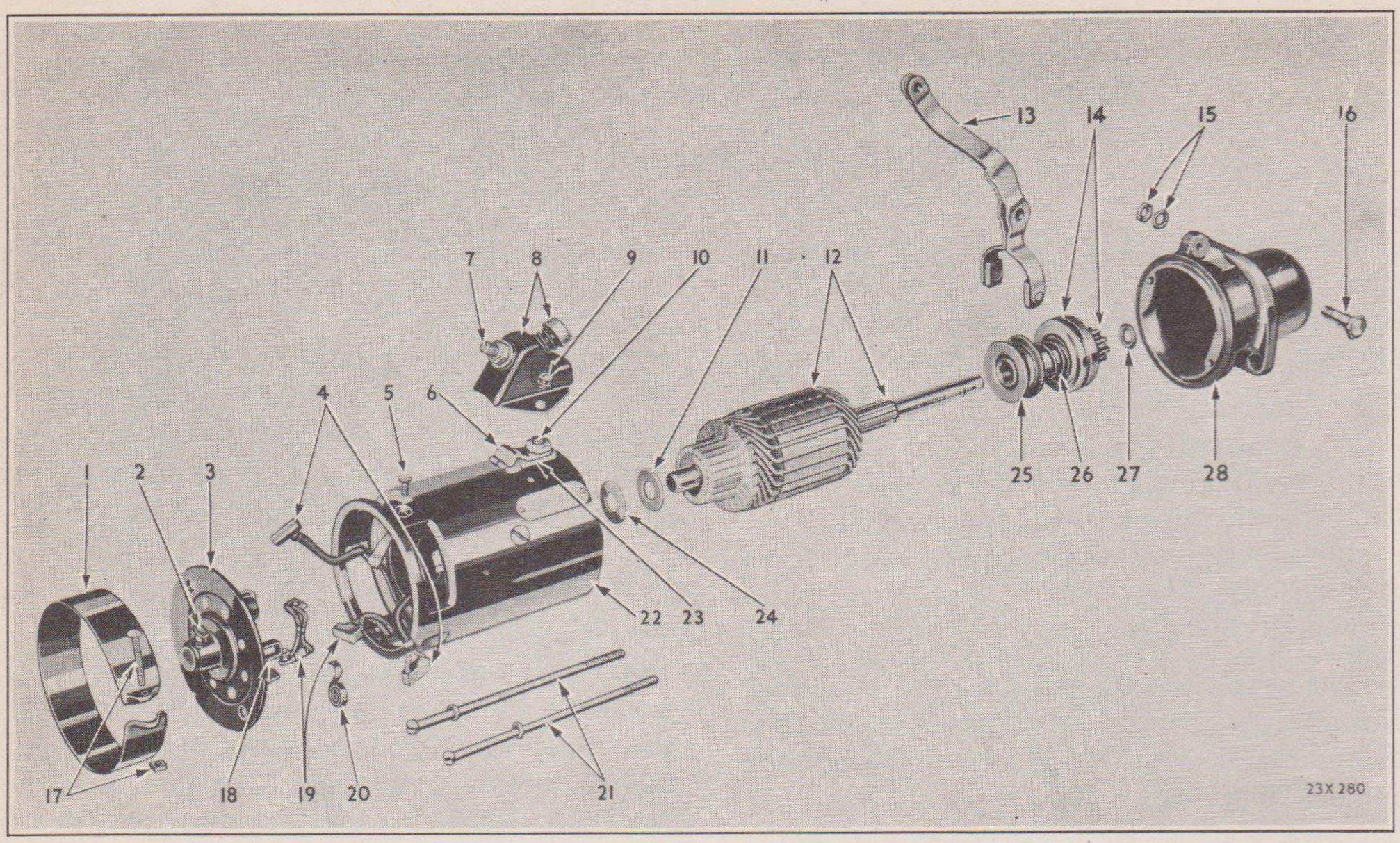


Fig. 109—Starting Motor

1—Head or inspection cover band
2—Oil cup
3—Commutator end plate assembly
4—Main brushes
5—Ground brush fastening screw
6—Starting switch contact—lower
7—Starting switch cable terminal post
8—Starting switch assembly
9—Starting switch fastening screw
10—Terminal post
11—Thrust washer—front
12—Armature and shaft assembly
13—Shift yoke assembly
14—Starting clutch assembly
15—Shift yoke pivot screw nut and lockwasher
16—Shift yoke pivot screw
17—Cover band clamp screw and nut
18—Brush holder
19—Ground brushes
20—Brush spring
21—Frame screws
22—Frame and field assembly
23—Starting switch insulating block
24—End play thrust washers
25—Shift collar
26—Shift spring
27—Thrust washer—rear
28—Pinion housing assembly

from starting motor to flywheel housing and draw out the starting motor assembly.

The armature and shaft assembly may be removed after removing inspection cover band and commutator end plate assembly. To remove the pinion housing assembly, remove the four screws which hold it to the frame and field assembly. See Fig. 109.

Assembly and Installation

When assembling the starting motor, keep the round side of the shoe plates on the yoke assembly toward the starting motor pinion.

The armature shaft end-play should be within .005″ to .030″. This end-play is controlled by spacers on the shaft between the end housing and the shoulder on the armature shaft.

Before installing the starting motor, make a free-running test and check the starting motor pinion adjustment as explained in Subject 113. Tighten the starting motor mounting cap screws securely to the flywheel housing when the starting motor is installed on the truck.

113—Starting Motor Pinion

When the starting motor pinion is fully engaged, there should be $\frac{1}{16}$″ to $\frac{3}{32}$″ clearance between the pinion and the pinion housing.

To adjust or check the pinion for proper clearance, remove the starting motor from the engine. Then push the shift yoke assembly (Fig. 110) to its extreme limit of travel, or until the starting motor switch has made contact. Then measure the clearance between the end of the pinion and the rear thrust washer.

The starting motor switch button may be screwed into or out of the switch assembly as required for proper pinion adjustment.

CAUTION: The starter switch button adjustment should not be changed without removing the starter to verify proper setting as explained in the foregoing instructions.

114—Starting Motor Armature

The armature should be tested in a "growler." If it is shorted at an accessible point, it may be repaired; otherwise, a new armature should be installed.

Test for a "grounded" armature by using a 110-volt test light between the armature shaft and the commutator. A "grounded" armature will cause illumination of the light.

The armature commutator should be turned down in a lathe if the mica is high or the commutator out of round, or cleaned if covered with an oil film or dirt. Only sufficient material should be removed to correct the difficulty. Use 00 sandpaper to finish the commutator smoothly. Do not undercut the mica. Undercutting allows dirt to collect in the grooves which is undesirable.

115—Starting Motor Fields

Shorted Fields

A shorted field can be detected after removing the field wires from the brushes and connecting a 110-volt test light between the case and the field wire. If the field coil is grounded, the test light will become illuminated. If the short is accessible, insulate the field coil, otherwise replace it.

Open Fields

An open field can be detected by connecting a test light between the starting motor terminal post (10, Fig. 109), and the field to brush wire with the switch assembly removed. An open field will show no test light illumination. If the broken connection is accessible, solder it; otherwise, replace the field.

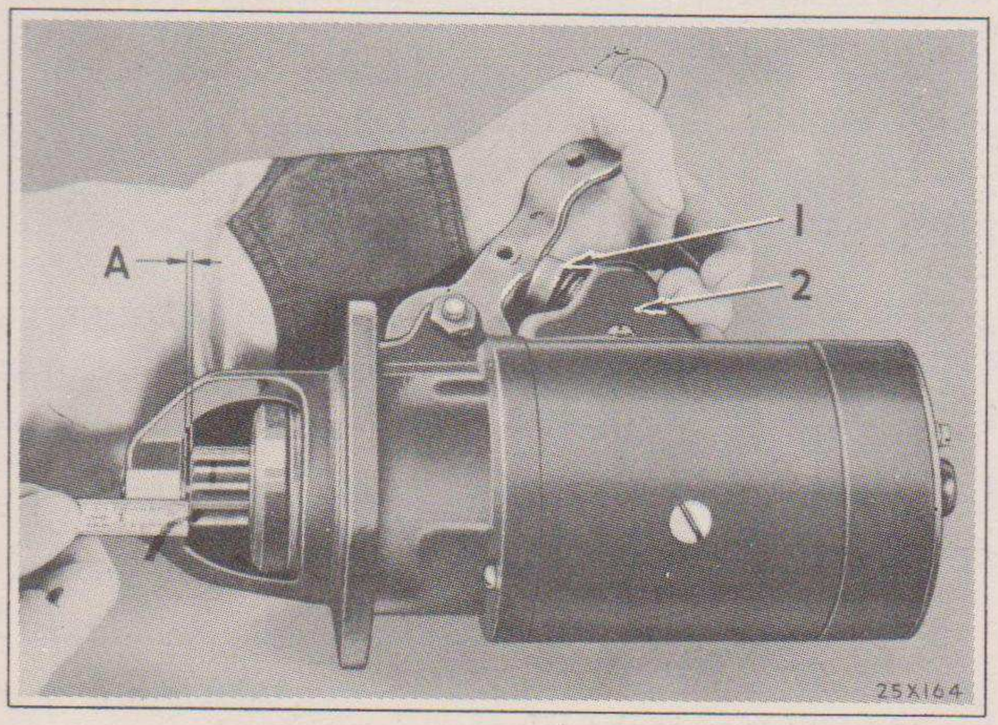


Fig. 110—Checking Starting Motor Pinion
1—Contact button 2—Starting motor switch
A—Clearance between pinion and thrust washer

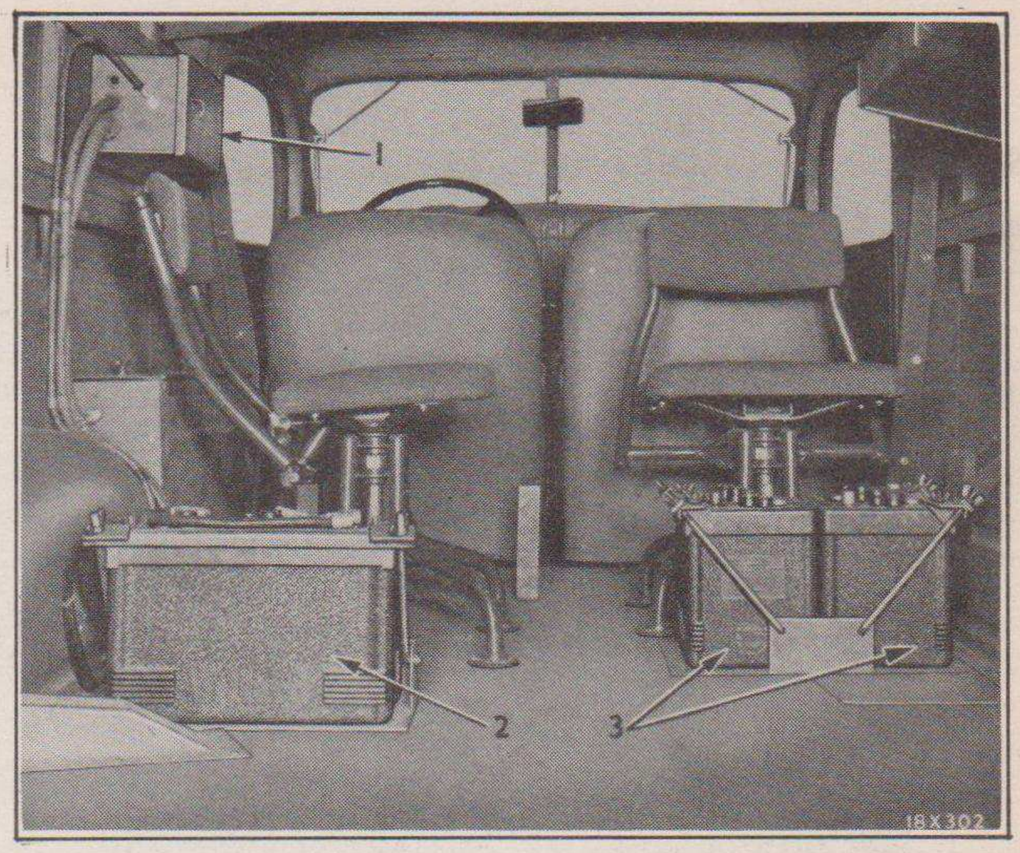


Fig. 111—Auxiliary and Spare Batteries
1—Switch box 2—Auxiliary battery
3—Spare batteries

BATTERIES

Four batteries are supplied with each Radio Panel type 4 x 4 truck. A heavy duty vehicle battery is located on the left hand side of the truck under the floor boards. A removable plate in the lower floor board gives access to the battery for adding water or for checking its specific gravity.

Mounted in the rear of the vehicle on the floor is a second (auxiliary) heavy duty battery for radio operation (Fig. 111) which is connected to a switch box mounted on the left side panel of the body. In this box is a single pole double throw switch. Power for radio operation may be taken either from the vehicle battery or the auxiliary battery by operation of this switch.

Two additional light duty batteries are located in the rear of the body on the floor. These units are not connected to any circuits but are carried as spares.

116—Battery Maintenance

The electrolyte in the batteries should be maintained 3/8" above the top of the plates by adding pure distilled water, or any water which is odorless, tasteless, colorless and suitable for drinking, to each cell. Water should be added once a month in winter and every two weeks in summer or every 1,000 miles of travel. Do not overfill or fill too frequently.

Batteries with special vent plugs should be filled after removing the filler caps and attach-

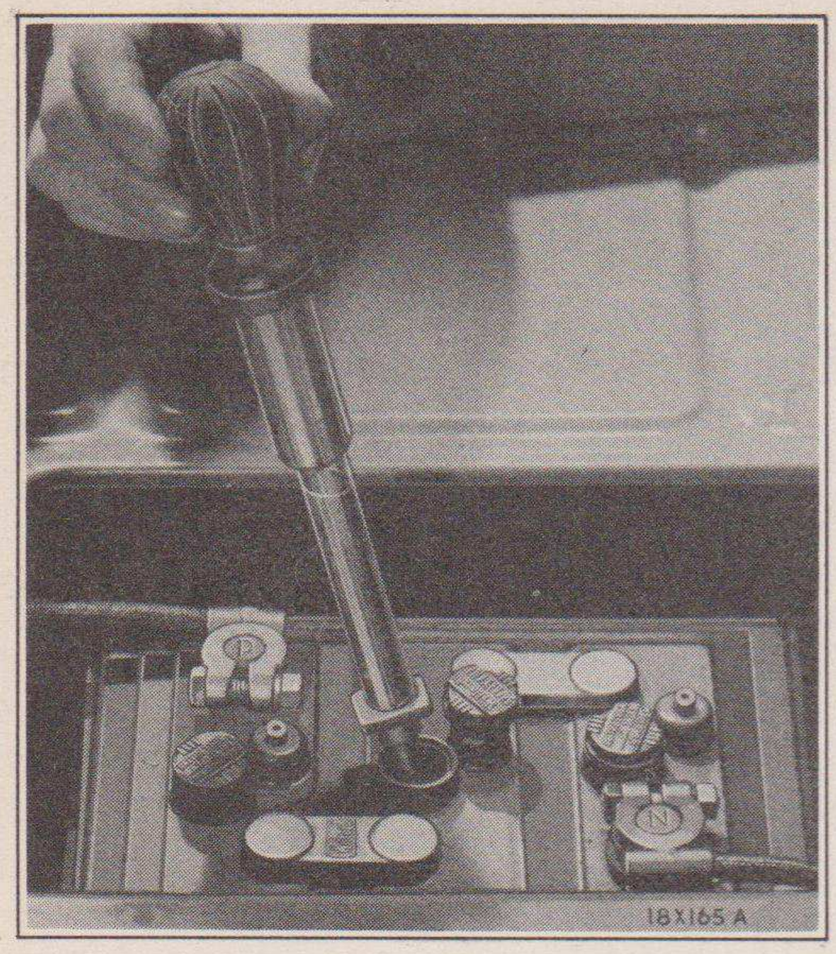


Fig. 112—Testing the Battery with Hydrometer

ing them to the vents (See Fig. 112). Fill each cell to the top of the filler opening, then remove the caps from the vents and the electrolyte solution will drop to the proper level 3/8" above the top of the plates.

Batteries should always be kept securely fastened in their carriers and kept clean and dry.

The terminals at each end of the ground cable should be removed and thoroughly cleaned and inspected at regular intervals. When installing the cables, the connections at each end of the terminal must be securely tightened.

A loose battery connection will cause excessively high generator voltage, which is likely to burn out light bulbs, pit and burn ignition breaker points and cause damage to the generator and other electrical equipment.

Note: The negative (—) cable is grounded on the "Radio Panel" type 4 x 4 trucks covered in this manual.

Battery Specific Gravity

The state of charge of the battery should be checked periodically with a hydrometer. The following hydrometer readings show the charge condition:

Fully Charged	1.275 to 1.300
Half Charged	1.225
Dangerously Low	1.150

A fully charged battery will not freeze in temperatures ordinarily encountered, but a battery with 1.150 specific gravity will freeze at 5° F., above zero, while a battery with 1.100 specific gravity will freeze at 18° F., above zero.

GENERATING SYSTEM

The units comprising the generating system are the generator, the current and voltage regulator, the battery, the ammeter, and the wiring connections for the starting and generating circuits. These two circuits are closely related and both must be considered when making electrical tests or repairs.

A large capacity, air-cooled, shunt-type generator with automatic cut out, current and voltage regulation is used. The output of the generator is controlled in relation to the voltage requirements, keeping the battery fully charged and maintaining proper voltage under normal driving conditions. This means that the ammeter hand may gradually approach zero, indicating that the battery requires less current at the time. Thus the voltage control feature of the generator prevents over-charging of the battery and because there is no excessive voltage, long life is assured for the electrical system.

The servicing of an electrical generating circuit can be easily understood by considering each phase or step separately.

(a) Checking the battery.

(b) Checking for resistance in the starting and generating circuits.

(c) Checking for improper operation of the generator and regulator.

(d) Repairs to the regulator itself.

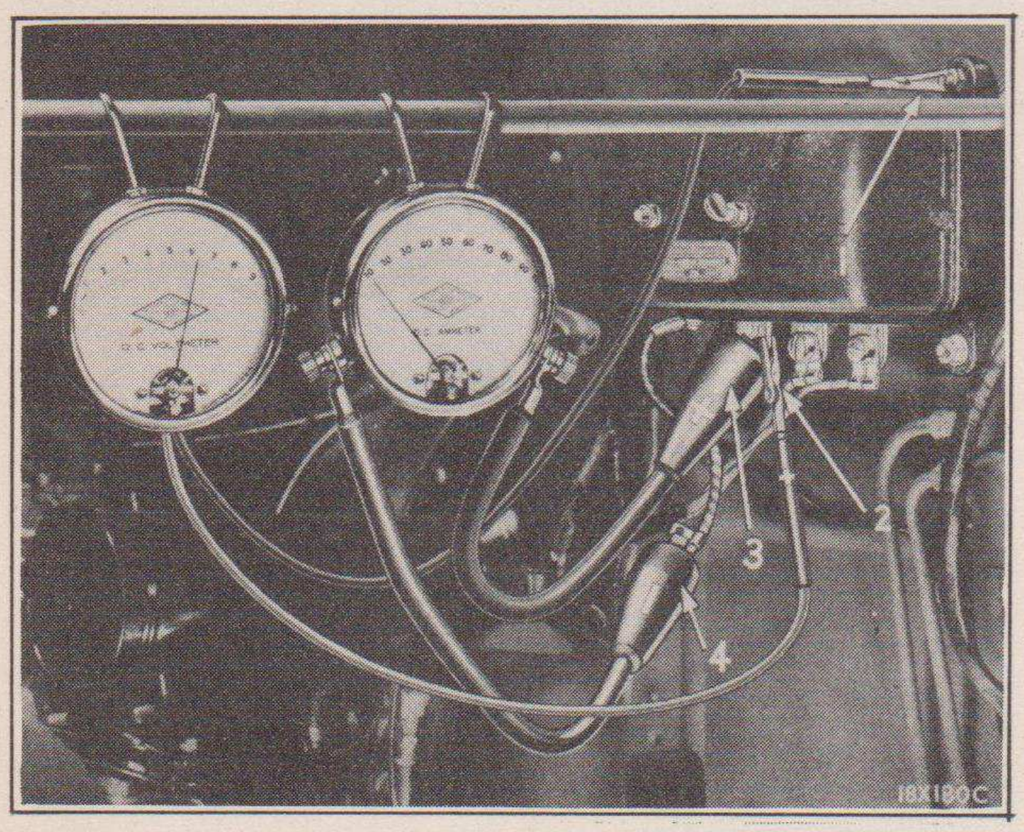


Fig. 113—Generator Regulator Test Connections
(6 volt—Negative Ground)

1—Voltmeter negative lead
2—Voltmeter positive lead
3—Ammeter positive lead
4—Ammeter negative lead

117—Test Equipment

In order to test the performance of the generator and regulator, and check the electrical generating circuit the following equipment is required:

(a) An accurate indicating *ammeter* with a 0 to 100 ampere scale graduated in 1 ampere divisions and heavy short leads is necessary in order to check all types of voltage regulators with which Dodge Army Trucks are equipped. If only a 50-ampere scale ammeter is available, the instrument should be returned to the manufacturer to be equipped with an accurately calibrated 100-ampere shunt. When a 100-ampere shunt is used with a 50-ampere scale meter, the readings should be multiplied by 2.

(b) An accurately calibrated *voltmeter* with a 15-volt scale graduated in .1 volt divisions.

(c) A reliable *thermometer* with a 20° to 140° F. scale.

(d) A battery *hydrometer*.

There are several reliable combination voltmeter and ammeter units on the market that are satisfactory for checking the electrical generating circuit.

The modern ammeter for checking purposes, has two heavy leads with clip type connectors. One lead is known as the positive cable and the other as the negative cable. The positive cable is usually red in color although in some cases the clip boot is red in color and the cable may be identified with a (+) sign. The negative cable is usually black and may be identified with a (—) sign. Moreover, the positive lead is usually on the right hand side of the instrument.

The modern voltmeter for checking purposes, also has two leads with clip type connectors, one known as the positive cable and one as the negative cable. In all combination voltmeter and ammeter units the positive and negative cables are identified in the same manner as the ammeter leads, the positive (+) red in color and the negative (—) black in color.

A thermometer is necessary to check the under-hood temperatures at the time any voltage checks are made as the voltage of the charging circuit varies with the temperature.

A hydrometer is necessary as all checks must be made with a fully charged battery.

118—Checking for Resistance in Starting and Generating Circuits

Whenever the starting motor, generator or voltage regulator requires servicing, the wiring circuit should also be checked for loose or defective connections and frayed or damaged wires. High resistance is frequently the underlying cause of many electrical difficulties that cannot be permanently repaired until the cause is located and corrected.

As some resistance exists, even in a generating circuit that is normal in every respect, a total resistance or voltage drop, not to exceed 0.35 volt from the generator "A" terminal (7, Fig. 115) to the battery positive post (1, Fig. 115) can be considered normal, with 10 amperes flowing in this circuit.

Connect the ammeter negative lead to the wire removed from regulator "B" terminal and the ammeter positive lead to regulator "B" terminal, (see Fig. 113), in order to establish a 10 ampere charge rate. *All resistance checks described in this manual should be made with the engine running and generator charging 10 amperes.*

Inasmuch as a fully charged battery is recommended, it is possible that a 10-ampere charging rate can not be established unless an electrical load is induced across the battery terminals.

It is not recommended that the "resistance unit" built into test meters be used to secure a

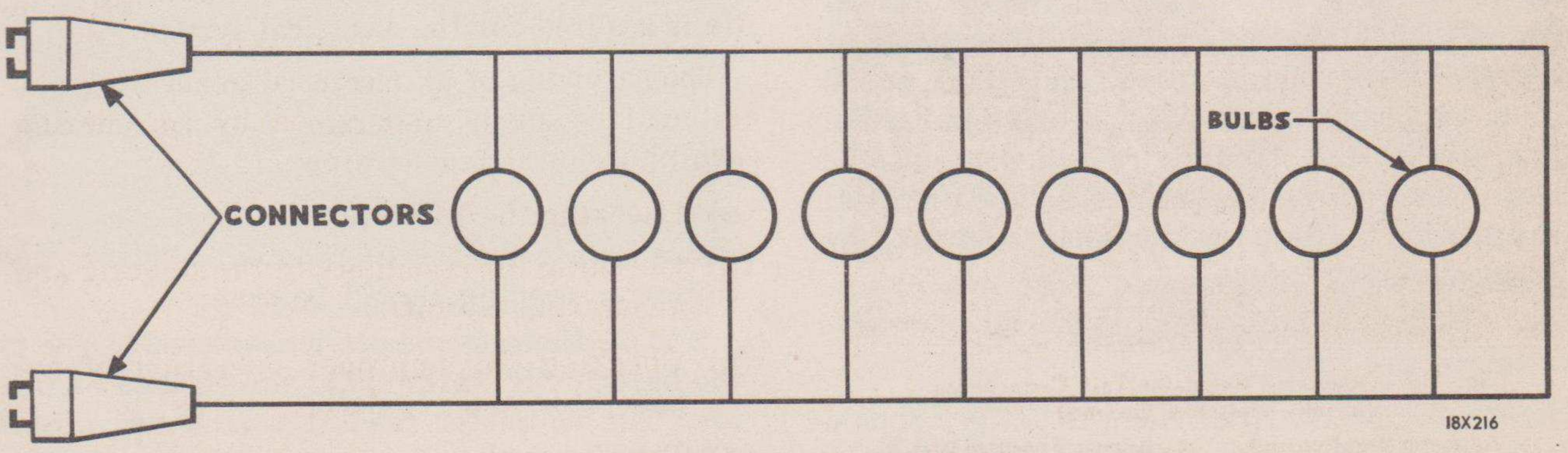


Fig. 114—Diagram for a Parallel Lamp Bank

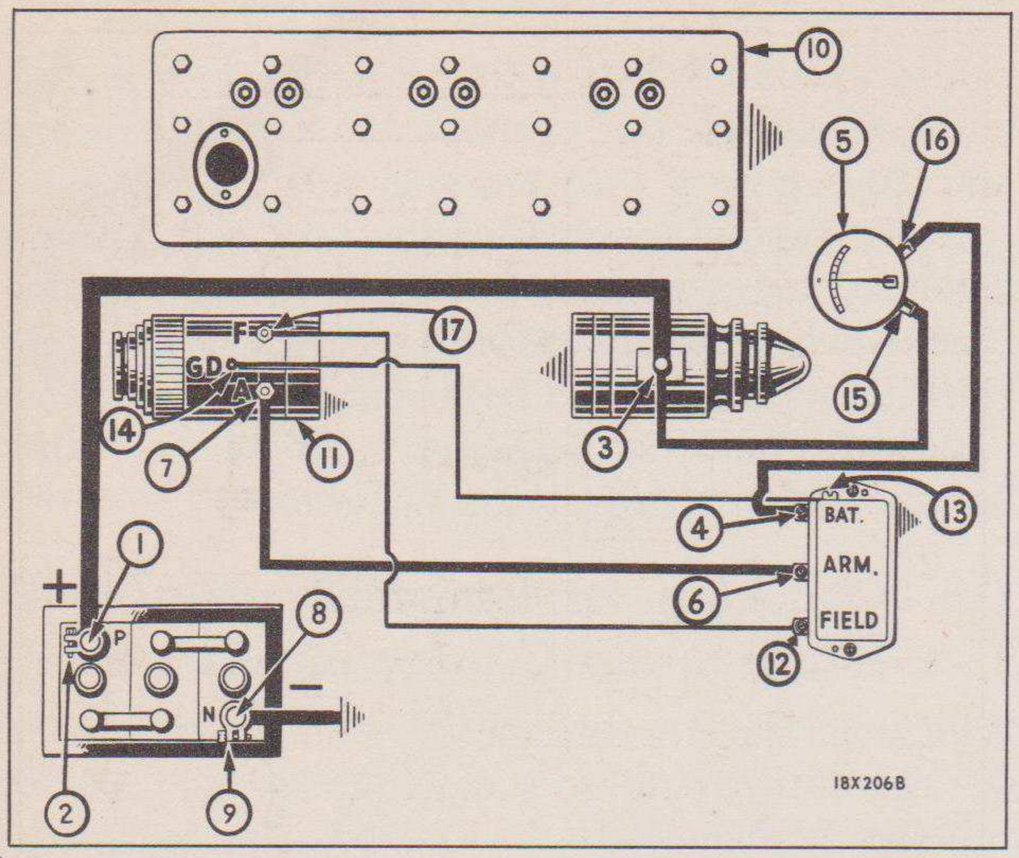


Fig. 115—Checking Diagram for Starting and Generator Circuits (6 volt—Negative Ground)

1—Positive battery post
2—Positive battery terminal
3—Starting motor terminal
4—Voltage regulator "B" terminal
5—Ammeter
6—Voltage regulator "A" terminal
7—Generator armature terminal
8—Negative battery post
9—Negative battery terminal
10—Engine
11—Generator frame
12—Voltage regulator field terminal
13—Voltage regulator ground connection or ground
14—Generator ground connection
15—Ammeter connection on generator side
16—Ammeter connection on battery side
17—Generator field connection

charging rate of 10 amperes with a fully charged battery, as the current value may change as the resistance heats up.

It has been found more practical to use a parallel lamp load across the battery terminals, as the current draw will then remain constant. A parallel lamp bank can be built at relatively little expense by mounting a sufficient number of headlight or high candlepower bulbs in suitable sockets on a piece of fiber board. They should be wired in parallel, (see diagram, Fig. 114) with two connectors, one for the negative post of the battery and one for the positive post.

The lamp load should be great enough to assure a draw of 40 amperes on 6-volt systems.

The amount of load can be varied by adding or removing bulbs to obtain any desired charging rate within the maximum limits. As an example, if a charging rate of 10 amperes is desired at an engine speed equivalent to 30 miles an hour, install enough bulbs to obtain that result. A carbon pile resistor may also be used instead of a lamp bank to induce electrical load across the battery terminals and may be obtained at small cost.

Checking the Battery

Before *any* checks are made the battery should be checked with a hydrometer to determine the specific gravity of the electrolyte in each cell. The reading should be from 1.275 to 1.300, and the electrolyte should be above the plates in each cell. If the battery needs water or is not fully charged, it should be replaced temporarily with a battery that is fully charged.

Never attempt to make any tests with a battery that is not fully charged.

Polarity of Electrical System

IMPORTANT—A majority of vehicles have the positive post of the battery grounded and the negative post connected to the wiring circuit. All of the recommended tests outlined in the following paragraphs, however, are based on a negative ground system. The same tests may be applied to a vehicle with a positive ground system by reversing the meter leads from that recommended for the negative ground system. The illustrations, Figs. 113 and 115, apply to a system with a negative ground polarity.

Voltmeter Checks

The following resistance checking procedure is divided into two steps:

(a) Wiring and connections.

(b) Ground connections.

Wiring and Connections

To check the wiring and connections, first make an overall quick check of the circuit by connecting the negative voltmeter lead to the positive battery post and the positive lead of the voltmeter to the armature terminal on the generator. See 1 and 7, Fig. 115.

If the voltmeter reading is below .35 volt with 10 amperes flowing in the circuit, the drop in voltage is normal.

If the reading is above .35 volt, leave the negative voltmeter lead connected to the positive battery post or terminal and proceed as follows:

Refer to Fig. 115

1 to 2—Connect the positive voltmeter lead to the positive battery terminal. The voltmeter reading should be zero. If not, clean and tighten the battery terminals.

2 to 3—Connect negative voltmeter lead to battery terminal (retain this connection for succeeding checks) and connect the positive voltmeter lead to the starting motor terminal. The voltmeter reading should be zero.

2 to 4—Connect the positive voltmeter lead to the battery "B" terminal at the voltage regulator. The voltmeter reading should not exceed .15 volt.

If the voltmeter reading exceeds .15 volt, clean and tighten the connections on the back of the ammeter and examine the soldered connections on the ends of the wires for poor connections or corrosion. In some instances excessive voltage drop may be traced to the ammeter itself. To check, place a jumper across the ammeter (15 and 16, Fig. 115) to eliminate the internal resistance of the meter.

2 to 6—Connect the positive voltmeter lead to the armature "A" terminal at the voltage regulator. The voltmeter reading should not exceed .28 volt.

4 to 6—Connect the negative voltmeter lead to regulator "B" terminal and the positive voltmeter lead to regulator "A" terminal. The voltmeter reading should not exceed .12 volt. A higher reading indicates burned contact points in the circuit breaker.

Ground Connections

The next step in checking the starting and generating circuits is to check for resistance in the ground side of the circuit. Connect the positive voltmeter lead to the negative battery post and retain this connection while the following checks are being made:

Make a quick, overall check of the ground side of the circuit by connecting the negative voltmeter lead to the generator frame. See 8 and 11, Fig. 115. The voltmeter reading should be practically zero. If any reading can be obtained, make the following checks leaving the positive lead of voltmeter connected to negative battery post or terminal:

Refer to Fig. 115

8 to 9—Connect the negative voltmeter lead to the negative battery terminal. The voltmeter reading should be zero.

9 to 10—Connect the positive voltmeter lead to battery terminal and the negative voltmeter lead to the engine. The voltmeter reading should be zero.

9 to 11—Connect the negative voltmeter lead to the generator frame. The voltmeter reading should be practically zero.

If any reading can be obtained on the voltmeter, clean and tighten all ground connections, especially the generator frame bracket where it is bolted to engine and the battery ground strap.

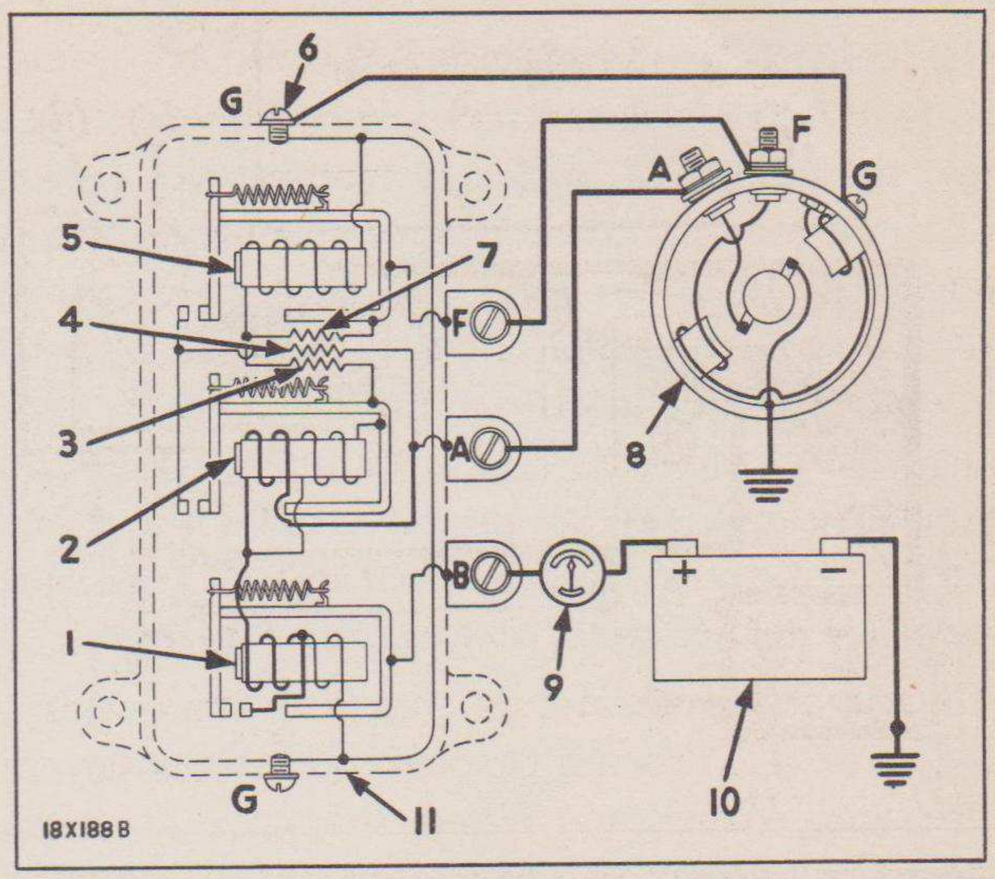


Fig. 116—Generator Regulator (VRY-4203A) Wiring Diagram—6 Volt System—Negative Ground

1—Circuit breaker
2—Current regulator
3—Resistor No. 2
4—Resistor No. 3
5—Voltage regulator
6—Ground terminal screw
7—Resistor No. 1
8—Generator
9—Ammeter
10—Battery
11—Regulator base
A—Armature terminals
B—Battery terminals
F—Field terminals
G—Ground terminals

CURRENT AND VOLTAGE REGULATOR

The voltage regulator furnished with Dodge 4 x 4 Radio Panel-type Trucks is designed for operation with a 6-volt negative ground electrical system. The 6-volt voltage regulator is known as type "VRY-4203A."

If for any reason the regulator is replaced extreme care must be taken to install the same type. A positive ground type regulator will not operate with a negative ground system and serious damage to the electrical system will result if the wrong type regulator is used.

119—Description of Operation

The regulator assembly contains three units, each with its own function to perform. These include the circuit breaker, the current regulator and the voltage regulator.

Circuit Breaker Operation

The circuit breaker (1, Fig. 116) is an automatic switch between the generator and the battery which closes the charging circuit when the generator is charging and opens the circuit when it is not charging, thus preventing the battery discharging back through the generator.

It consists of an electromagnet and a set of contacts. The electromagnet has two windings: one, the shunt coil connected across the generator like a voltmeter, and the other a series coil connected in series with the generator output like an ammeter. These two windings are both wound in the same direction. The contacts consist of two movable contacts mounted on an armature operated by the electromagnet, while the others are stationary contacts. These contacts are held open by an armature spring.

When the generator is charging the battery, the current is flowing through both windings in the same direction. When the current flows from the battery to the generator, the current is flowing through the shunt coil in one direction and through the series coil in the opposite direction.

The sequence of operation of the circuit breaker unit is as follows:

When the generator is not running, the contacts are open. When the generator is started, the voltage builds up at the generator terminal and in the shunt coil, and as soon as it reaches the value for which the circuit breaker is calibrated, there is sufficient magnetism created by the shunt coil to pull down the armature, closing the contacts, which automatically connects the generator to the battery. With the contact points thus closed, the current in the series coil is flowing from the generator to the battery in the same direction as the current in the shunt coil, so that the pull on the armature is increased by magnetism of the series coil.

When the engine is stopped and the generator loses speed, the voltage falls, and as soon as the generator voltage drops below the battery terminal voltage, the current flows from the battery to the generator, reversing the direction of current in the series coil so that the magnetism created by the series coil opposes and reduces the magnetism created by the shunt coil. This results in a reduction of pull on the armature to the point where the spring opens the contact, disconnecting the generator from the battery.

Current Limiting Regulator Operation

The current limiting regulator (2, Fig. 114), limits the maximum current output in amperes. When the generator output reaches its predetermined maximum the regulator points are opened, cutting in a resistance in the generator field circuit and reducing the output. Immediately upon the dropping of the output, the points close, cutting out the resistance and the output rises.

A second winding is connected in series with the generator field circuit and is connected so that the rise and fall of the field circuit accelerates the action of the current regulator armature. This causes the above cycles to occur at sufficiently high frequencies to limit the output to a minimum fluctuation.

Voltage Regulator Operation

The voltage regulator (5, Fig. 116), holds the voltage of the electrical system constant within close limits. When the voltage rises to a predetermined value the regulator contact points vibrate, thus cutting in and out a resistance in the generator field circuit.

The electromagnet of the voltage regulator unit has a single winding which is shunt connected across the battery charging circuit. When the voltage rises to a predetermined value, this winding is energized sufficiently to cause the voltage regulator contact points to open, thus cutting in a resistance in the generator field circuit reducing the generator output. This reduction in output lowers the voltage of the charging circuit and the points close shorting out the resistance, and the voltage rises again thus completing one cycle of operation. These cycles occur at frequencies high enough to maintain the system voltage constant within close limits and will continue as long as the voltage of the circuit is high enough to keep the voltage regulator unit in operation. With the addition of a current load great enough to lower the battery voltage below the operating voltage of the unit the points will remain closed and the generator will maintain its maximum charging rate. The voltage regulator is compensated for temperature variations through the use of a nickel-iron magnetic by-pass whereby a higher voltage is required to vibrate the contact points under cold operating conditions than is required under hot operating conditions. This is neces-

sary as a higher voltage is required to charge a cold battery than a hot battery.

TESTING REGULATOR ON TRUCK

The test equipment needed for testing the regulator on the truck is the same as that listed in Subject 117 under items (a), (b), (c), and (d).

120—Test Connections

Disconnect the wire from the regulator "B" terminal. Connect the test ammeter positive lead to the regulator "B" terminal and the test ammeter negative lead to the wire removed from the "B" terminal. The voltmeter positive lead should be connected to the regulator "B" terminal and the negative lead to the regulator base ground screw. *If the connections are not made in this manner, false readings will be obtained due to drop in the current connections.* See Fig. 113.

121—Testing Regulator On Truck

In the foregoing "Description and Operation" of the voltage regulator (Subject 119) it can be readily learned that the regulator is only a part of the generating circuit. While this is the controlling unit of the circuit, the generator, battery and wiring must also be taken into consideration whenever difficulty is experienced with the generating circuit. Before attempting to correct troubles which appear to be in the charging system by adjusting or replacing the voltage regulator or other units of the system, analyze the difficulty carefully. The following testing procedure will help the mechanic to trace any type of circuit failure to its source so that permanent repairs can be made. A systematic testing procedure will avoid unnecessary work, time and expense.

Two types of conditions may be encountered in the generating circuit.

These are:

(a) An overcharged battery, one with high specific gravity reading requiring frequent addition of water; or a high charging rate, either intermittent or steady. This is usually due to high voltage.

(b) An undercharged battery or no charge rate.

If the battery is fully charged and the charging rate is 5 to 8 amperes the voltage and current operation is normal and the following tests are unnecessary. However, if either one of the foregoing conditions, (a) or (b), is being experienced, the following tests should be made:

Testing for an Overcharged Battery

(a) Check for poor ground at regulator.

Make sure that the ground lead on the regulator base is secure to the base and that the mounting screws are tightly pulled down.

(b) Check for high voltage regulator setting.

It must be remembered in analyzing this type of difficulty that the charging rate at any given voltage depends as much on battery temperature as on battery specific gravity. The charging rate to a fully charged "hot" battery will be greater than that obtained with a "cool" battery fully charged and may be greater than that obtained with a "cool" battery which has a fairly low specific gravity. For this reason compensation has been built into the voltage regulator to limit the control voltage to the following:

VRY (Type 4203A)

Temp. (F)	50°	60°	70°	80°	90°	100°	110°	120°
Volts	7.41	7.38	7.35	7.32	7.29	7.26	7.23	7.20

(Allowable variation plus or minus 0.15 volt)

To check the regulator setting with the test meter connections outlined in Subject 120, first start the engine and set the throttle for a speed equivalent to 30 M.P.H. Then apply a parallel lamp load or a carbon pile resistor across the battery terminals. In using a parallel lamp bank, enough bulbs should be placed in the circuit to allow a charging rate of 10 amperes when the engine is operated at this speed.

The thermometer should be located approximately 2 inches from the regulator case to record air temperature. It must not touch the regulator. Be sure the engine has run for no less than 15 minutes with the hood up before taking voltmeter readings.

At the end of the 15 minute run, stop the engine as this allows the cut-out points to open which removes the residual magnetism in the

regulator assembly. Again bring the engine speed up to 30 M.P.H. and adjust load to 10 amperes.

Record the voltage and thermometer readings. If the voltmeter readings check within the limits given in the foregoing chart, the voltage regulator unit can be passed as operating correctly.

However, if the voltmeter readings do not check within these limits, adjustment of the voltage regulator is necessary. See "Bench Test" on this page.

Testing for an Undercharged Battery or No Charge Rate

(a) Check for loose connections.

Check the entire circuit from generator to battery for loose connections, frayed or damaged wires and defective soldered terminal connections. See "Checking for Resistance in Starting and Generating Circuits," Subject 118.

High resistance resulting from poor connections will prevent normal charge reaching the battery. Make sure the ground lead on the regulator base is secure at the base and the regulator mounting screws are tight.

(b) Check for circuit breaker not operating.

Connect a jumper test lead between "A" and "F" terminal at regulator. Connect the positive lead of the voltmeter to the generator "A" terminal and the negative lead of the voltmeter to the generator frame or ground. Operate the engine at a medium speed. Under this condition the generator may produce a dangerously high output if the speed is carried too high.

If the voltmeter indicates a voltage sufficient to close the circuit breaker (see "Test Data" Subject 130), the generator is functioning properly, but is unable to produce current due to an open circuit in the regulator.

If the test with the voltmeter reveals low voltage, the generator should be removed and repaired. If the voltage is normal, it is an indication that the generator can build up, but the circuit breaker relay is inoperative. This may be due to burned points, points not closing or open shunt winding.

If the generator shows an output only when the jumper connector is used, the circuit breaker "cut-in" setting is too high, the voltage regulator setting is too low, or the regulator contacts are in need of cleaning.

(c) Check for generator being inoperative.

On radio equipped vehicles remove the condenser at the generator "A" terminal and test on 110 volt circuit for ground. If the condenser is fautly, replace it. After replacing condenser repeat test under circuit breaker above and if the generator output remains at a few amperes with the test lead across the "A" and "F" regulator terminals, the generator is at fault.

(d) Check for low current regulator setting.

With the test meters connected as outlined under Subject 120, turn on the lights and other electrical accessories and crank engine over several times without starting. This reduces the voltage of the battery. Then start the engine and increase speed rapidly, noting the reading of the test ammeter. This reading will be the value for which the current regulator is set, and should not be lower than that shown on the name plate of the regulator. If the reading is below these limits, the current limiting regulator is in need of adjustment.

(e) Check for low voltage regulator setting.

If the voltage regulator setting is below that specified in the foregoing chart, the generator will be prevented from furnishing sufficient current to the battery to keep it in a healthy state of charge, and adjustment is necessary. (See Subject 127.)

BENCH TEST

If it is necessary to remove the regulator from the truck for testing and adjusting, after making tests outlined under "Testing Regulator on Truck," on page 87, proceed as follows:

122—Visual Inspection

Before making any tests or adjustments it is recommended that a close visual inspection be given the regulator, with special emphasis being paid to the following points:

(a) Broken regulator seal.

(b) Evidence of burning or abnormal high temperature at the coils, contacts, insulation, external terminals or any other point. (It is suggested that this test be made with a magnifying glass.)

(c) Loose connections which result from poor soldering.

(d) Loose nuts on the bottom of the magnet

cores, loose rivets or screws. All nuts and screws must have lock washers.

(e) Loose contact points.

(f) Misalignment of contact points.

(g) Bent armature either at the contact or hinge end. (The armature should be perfectly straight from one end to the other.)

(h) Field yoke bent.

(i) Bent armature hinges.

(j) Reversed bimetal hinges on the circuit breaker unit. (When correctly installed the brass side must be up.)

(k) Stripped or crossed threads on any screw or nut.

(l) Corrosion due to salt or acids.

(m) Evidence of water having been inside of cover.

(n) Incorrect, bent or distorted armature spring. In case of doubt it is recommended that the spring be replaced.

(o) Broken or altered carbon resistors.

(p) Broken gaskets.

(q) Incorrect wiring connections between units.

(r) Shunt leads and terminal on circuit breaker armature must be free and not interfere with armature movement or touch tension spring.

(s) Metal transfer or built up on regulator contact points.

123—Tool Equipment

The following tools are required to test or adjust voltage regulators. These may be obtained from any authorized Electric Auto-Lite Service Station.

Name	*Tool Number*
Ohmmeter	ST-284
Armature Core Gap Gauge (pin gauge)	ST-281-1
Armature Core Gap Gauge (pin gauge)	ST-281-2
Armature Core Gap Gauge (pin gauge)	ST-281-5
Regulator Point Adjusting Tool	ST-282
Spring Tension Scale	ST-283
Contact Point File	ST-290

124—Regulator Tests and Adjustments

CAUTION: The cover must be on the regulator when taking readings or when the unit is being heated by operation prior to taking readings. This is necessary due to the fact that the cover helps retain the heat.

When testing or adjusting the regulator, it must be mounted firmly and in a place where there is no vibration. It must also be tested in the same position as it is mounted on the truck.

Care must be taken in making the various test connections as these connections should be firmly made so that the resistance of all connections does not exceed .01 ohm with a 10 ampere charge. It is for this reason that spring clip connections are not recommended. Flexible cables which have flat spade type terminals are recommended, as experience shows that these prevent high resistance connections from entering into the test circuit.

It is suggested that a single earphone (2000 ohms or higher) be procured and attached to the "F" terminal and "A" terminal, thus picking up the click of the regulator armature vibrations and so obtain an accurate reading as to the operation of the current limiting and voltage regulator units.

Heat the regulator by operating it for 15 minutes with the generator charging 10 amperes for all units rated up to 30 ampere output and 20 amperes for all units rated above 30 ampere output. While heating the regulator have the cover on the unit.

(a) Check Circuit Breaker Operation

To test, connect the ammeter in series between the battery and the "B" terminal. The voltmeter is to be connected to the "A" terminal of the regulator and to ground. (See Fig. 117.)

To adjust the cut-in voltage, remove the cover and adjust the armature spring tension by adjusting the screw which holds the lower end of the spring. A very accurate method of checking this cut-in voltage is by connecting a headphone (2000 ohms or higher) between the "A" and "B" terminals of the regulator and observe the voltage at which the click, caused by the closing points, is heard.

To adjust the cut-out amperage, adjust the contact point gap by raising or lowering the stationary points. In making this adjustment, be sure that the armature and the yoke do not make contact.

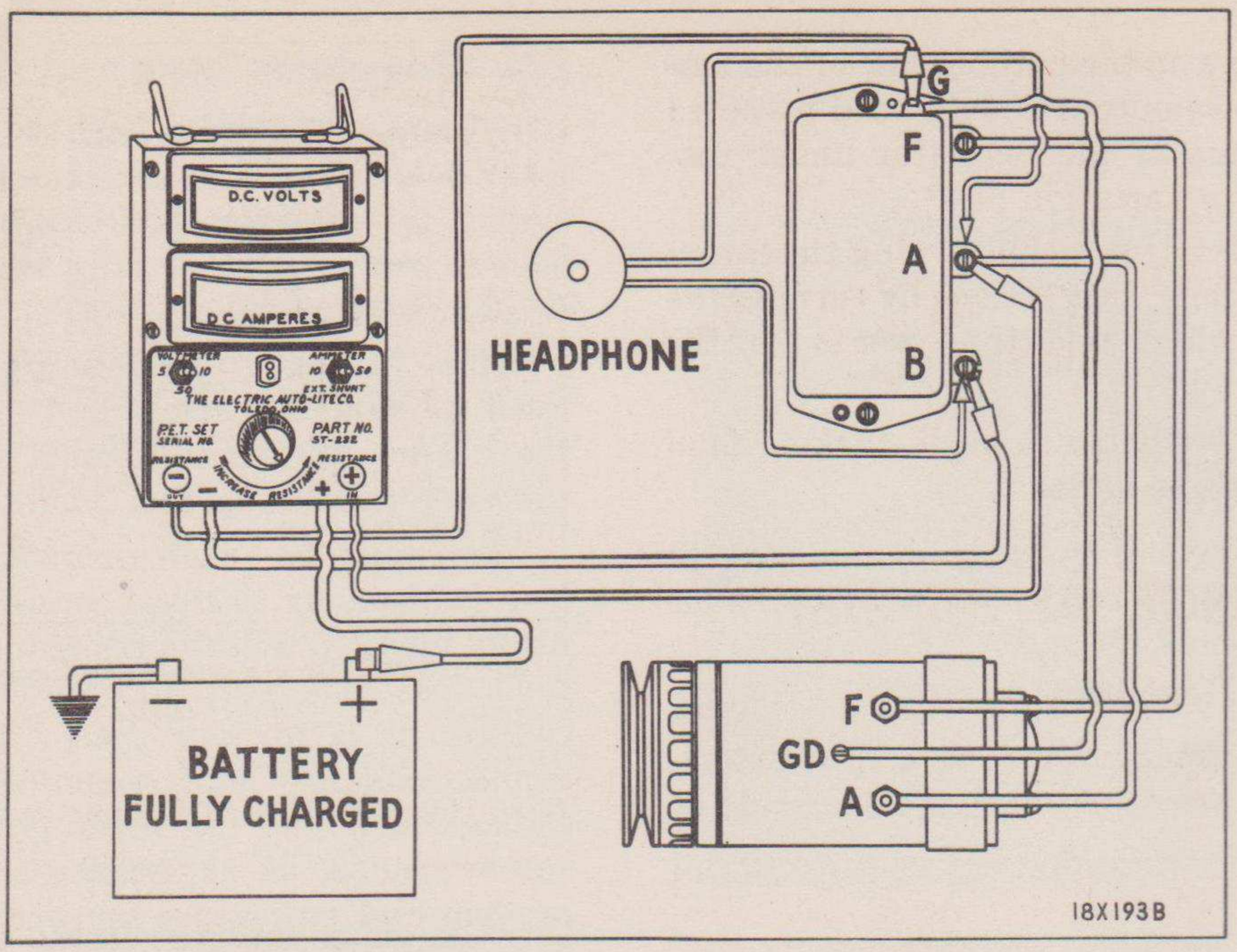


Fig. 117—Testing Circuit Breaker Operation

After adjusting, install the regulator cover and again test the circuit breaker operation.

There should always be .5 volts less voltage at which the circuit breaker closes than the voltage at which the voltage regulator operates.

At the conclusion of this check make a final flash test. See Subject 130 for "Test Data."

(b) Check Voltage Regulator Operation

In making this test, an accurate voltmeter must be used. See Fig. 117 for test connections. (The voltmeter must be connected to the regulator "B" terminal and to ground, instead of to the "A" terminal as shown in illustration.)

The voltage regulator unit must operate within the limits shown under "Test Data," Subject 130.

To adjust its operation, increase or decrease the armature spring tension. Increasing the spring tension increases the voltage at which the unit will operate, while decreasing the tension decreases its operating voltage. This is done by adjusting the nut which holds the lower end of the spring.

Replace the cover after making any necessary adjustments and take a flash voltage reading by stopping the generator and noting the maximum voltage reading when the generator is immediately restarted.

(c) Check Current Limiting Regulator Operation

Connect the test ammeter in series between the regulator "B" terminal and the battery.

By increasing the generator output with a lamp bank or other suitable resistance connected

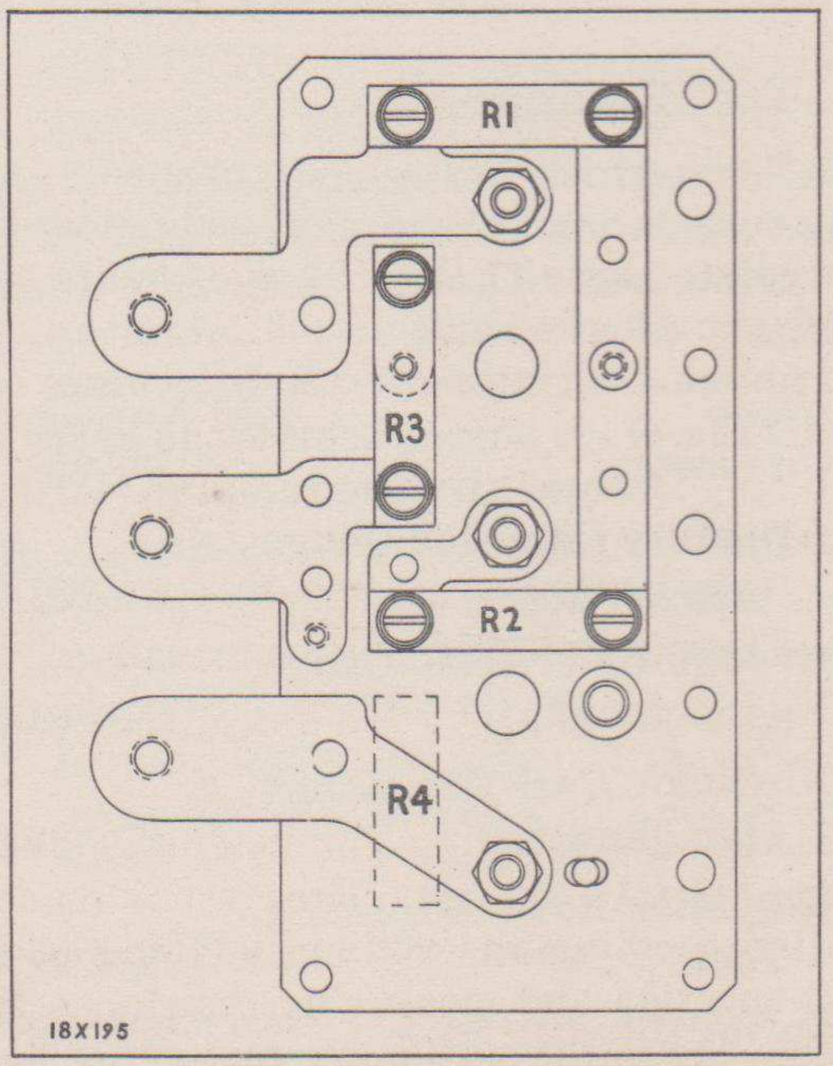


Fig. 118—Carbon Resistors

across the battery on the battery side of the ammeter, the ampere output should read as noted on the name plate of the regulator under test with an allowable variation of 5%.

Its operation is adjusted by varying the armature spring tension. This is done by turning the adjustment nut which holds the lower end of the spring.

After all adjustments are made, make a final flash test on all three units.

SEQUENCE OF REPAIRS

125—Carbon Resistors

Check the resistance of the carbon resistors. These resistors are found on the under side of

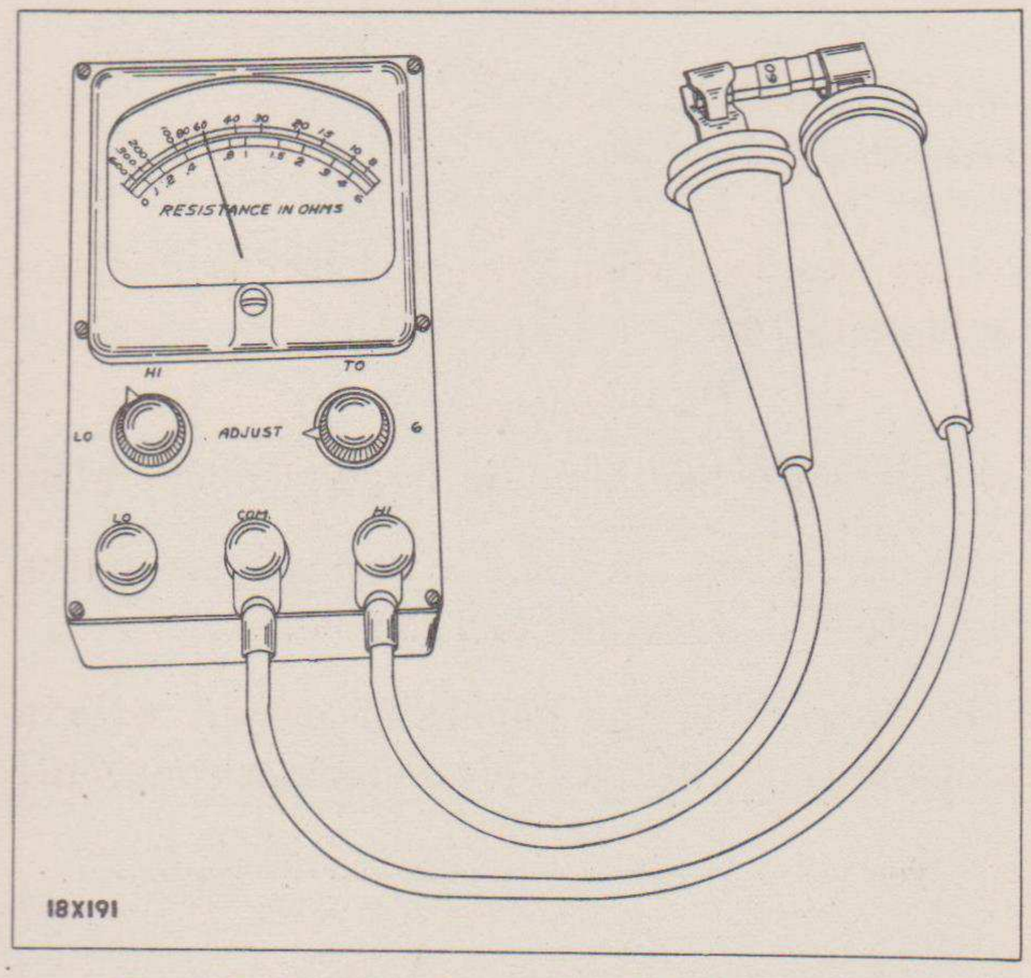


Fig. 119—Checking Resistance of Carbon Resistors

the regulator base (Fig. 118) and should be removed and checked one at a time in order to avoid any interchanging. Use an accurate ohmmeter (Fig. 119) for checking the resistance which should be within the limits given under "Test Data," in Subject 130.

126—Circuit Breaker Adjustments

(a) Check resistance of circuit breaker voltage winding.

An accurate reading ohmmeter (ST-284) is needed for this test. This test is made by disconnecting the voltage winding ground connection and measuring resistance from the lead to the stationary contact as shown in Fig. 120.

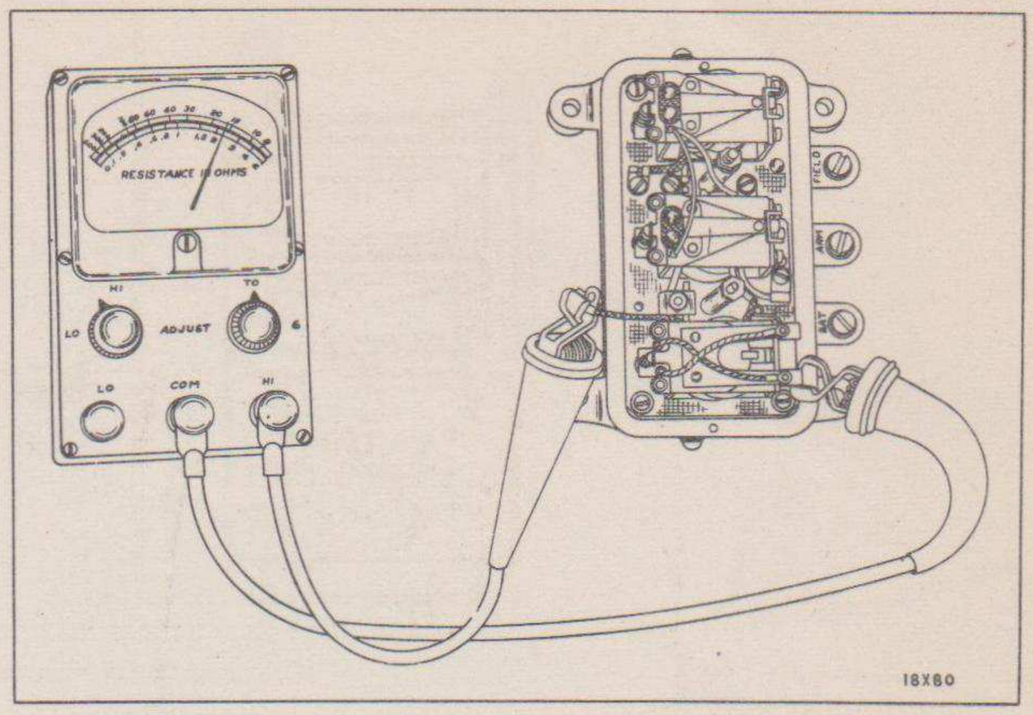


Fig. 120—Checking Resistance of Circuit Breaker Voltage Winding

(b) Check the armature air gap with the points open.

Use gauge inserted on the point side of the brass pin in the core as shown in Fig. 121. See "Test Data" in Subject 130. Adjust by raising or lowering the stop at the point end of the armature.

(c) Check gap of the contact points. (See Fig. 122). This gap should be .015" minimum, but will possibly be more than this in actual adjustment.

Adjust by bending the supporting arms of the stationary contact point with special tool ST-282, being sure that both points are in perfect alignment and that contact is

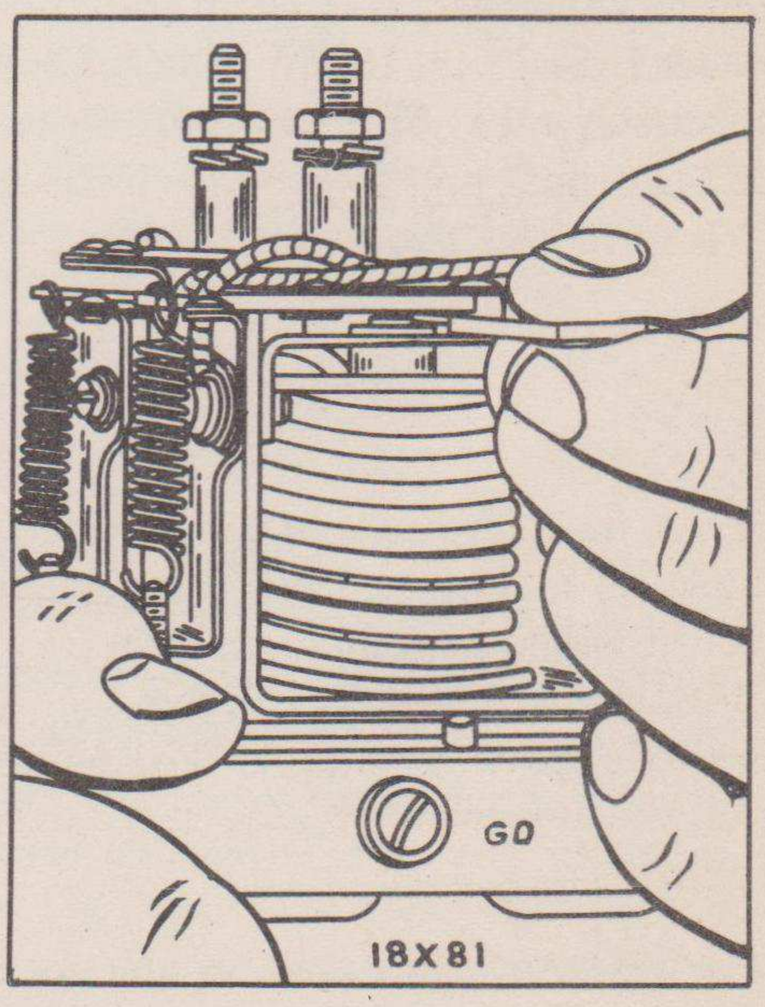


Fig. 121—Checking Circuit Breaker Armature Air Gap with Points Open

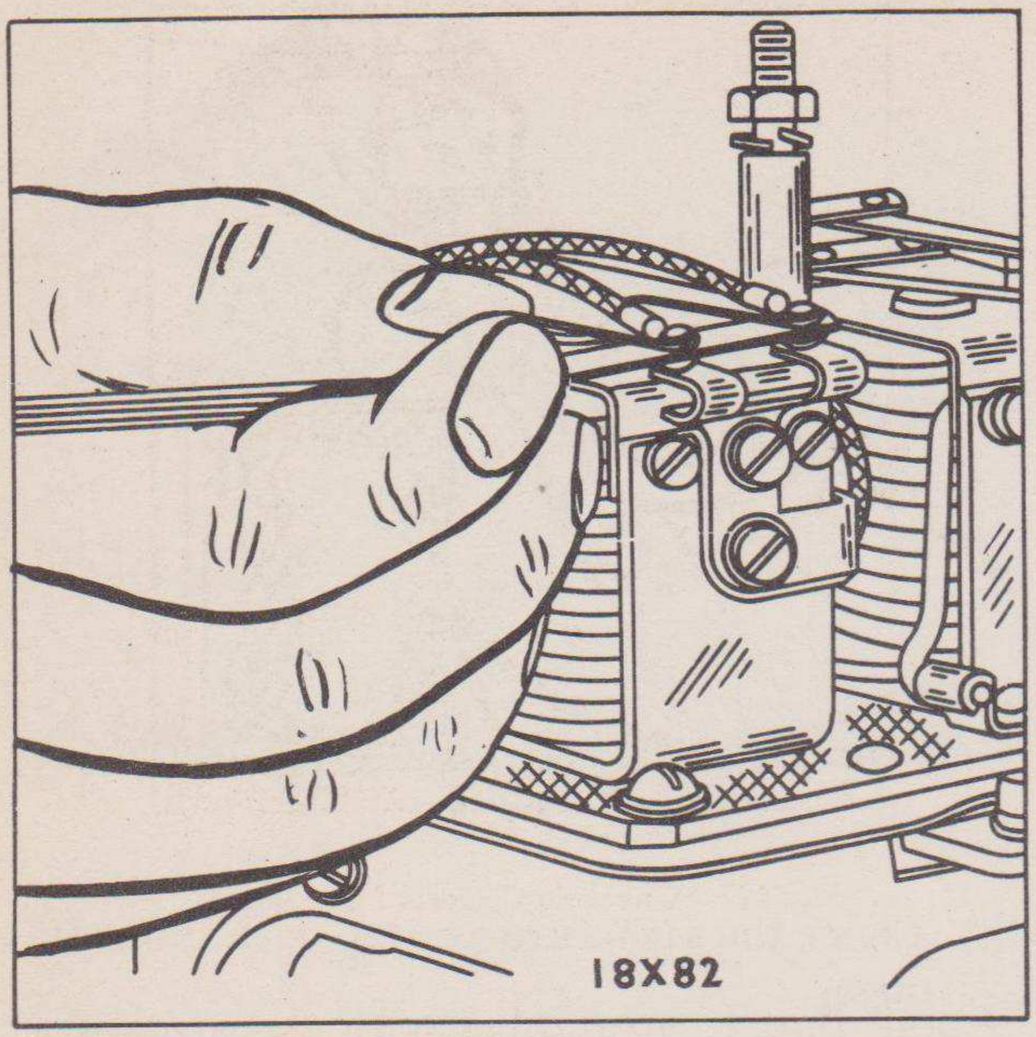


Fig. 122—Checking Gap of Circuit Breaker Contact Points

made on both points at the same time. Use a straight edge across the top of the point brackets to check their alignment.

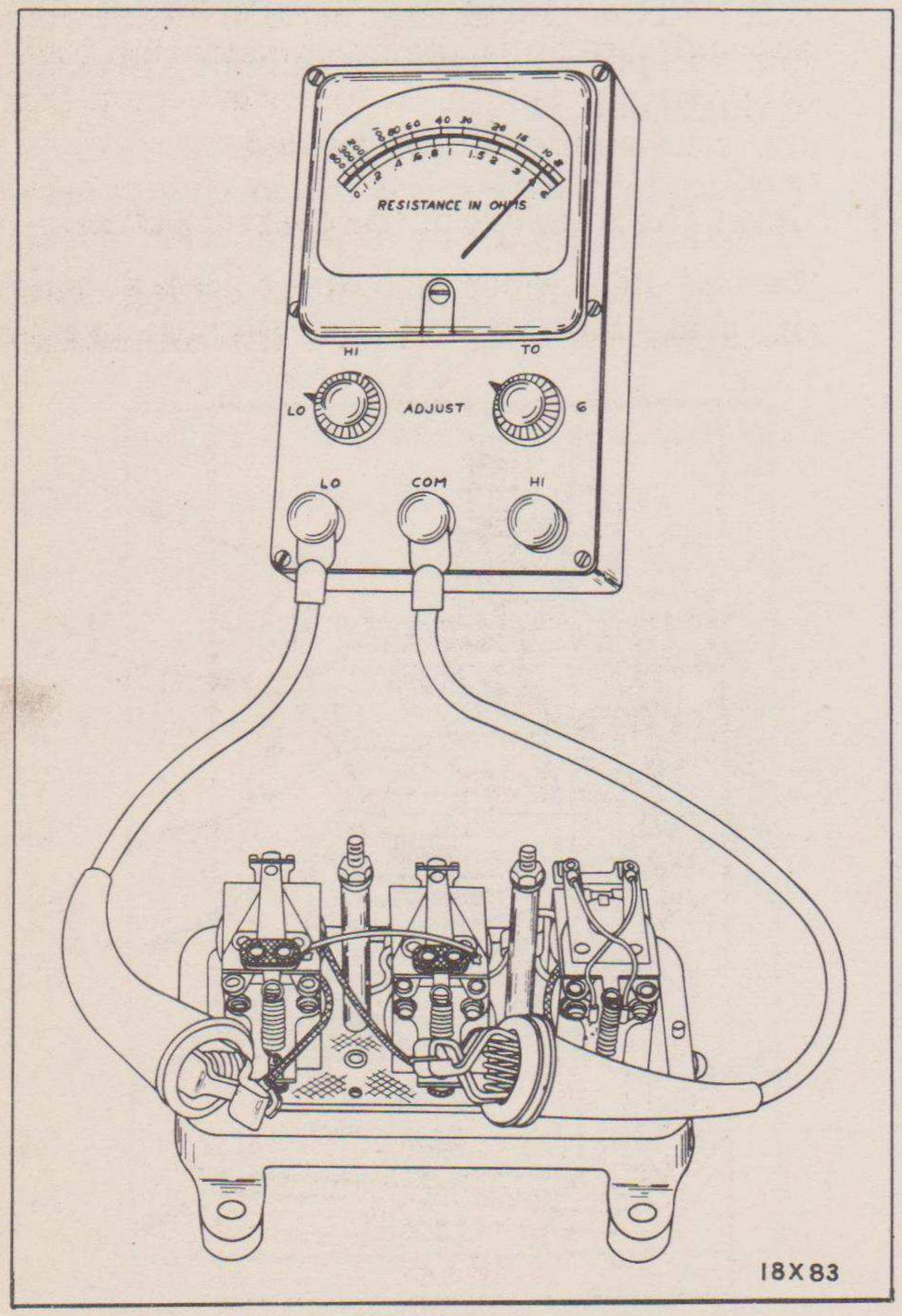


Fig. 123—Checking Resistance of Voltage Regulator Winding

127—Voltage Regulator Adjustments

(a) Clean contact points.

Regulator contacts can be cleaned by filing them parallel with the length of the armature with a No. 6 American Swiss Cut File (ST-290). After filing, clean with carbon tetrachloride and then draw a piece of clean dry linen tape between the contacts to remove any residue that may be on the contact surfaces.

(b) Check the resistance of the winding.

An accurate reading ohmmeter (ST-284) is needed for this test. To test, disconnect both leads from the base and measure resistance between the leads as shown in Fig. 123.

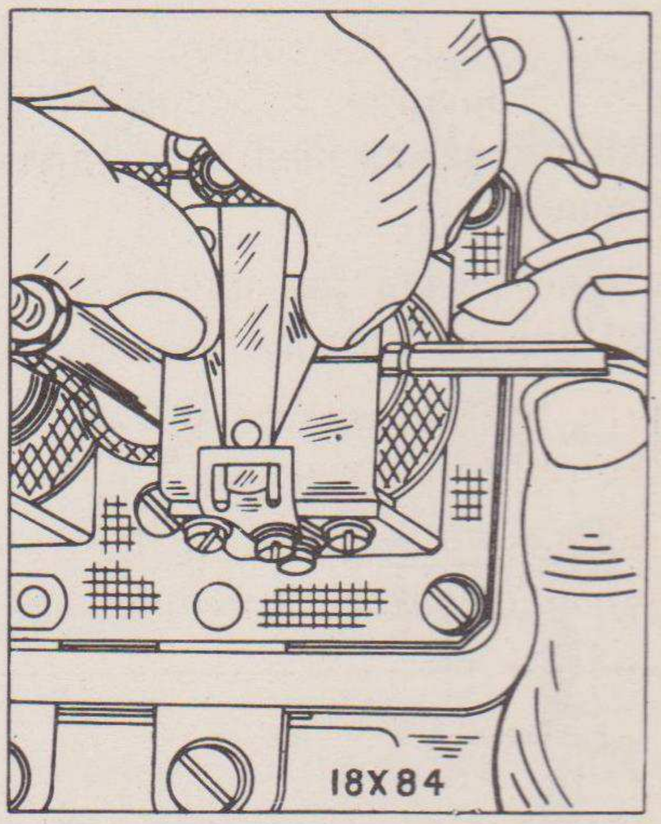


Fig. 124—Checking Armature Air Gap with Pin Gauge (View Showing the Point Side)

(c) Check armature air gap with points just breaking.

Test with pin gauge. See "Test Data" in Subject 130. This measurement is to be taken on the point side (Fig. 124) and next to the brass armature stop pin as shown in Fig. 125.

To test, connect a test light as shown in Fig. 126 in series with the "A" and "F" terminals and a battery. With the low limit pin gauge in place, depress the armature and the light should go out. With the high limit pin gauge in place, depress the armature and the light should stay lighted. Use two fingers in depressing the armature, one

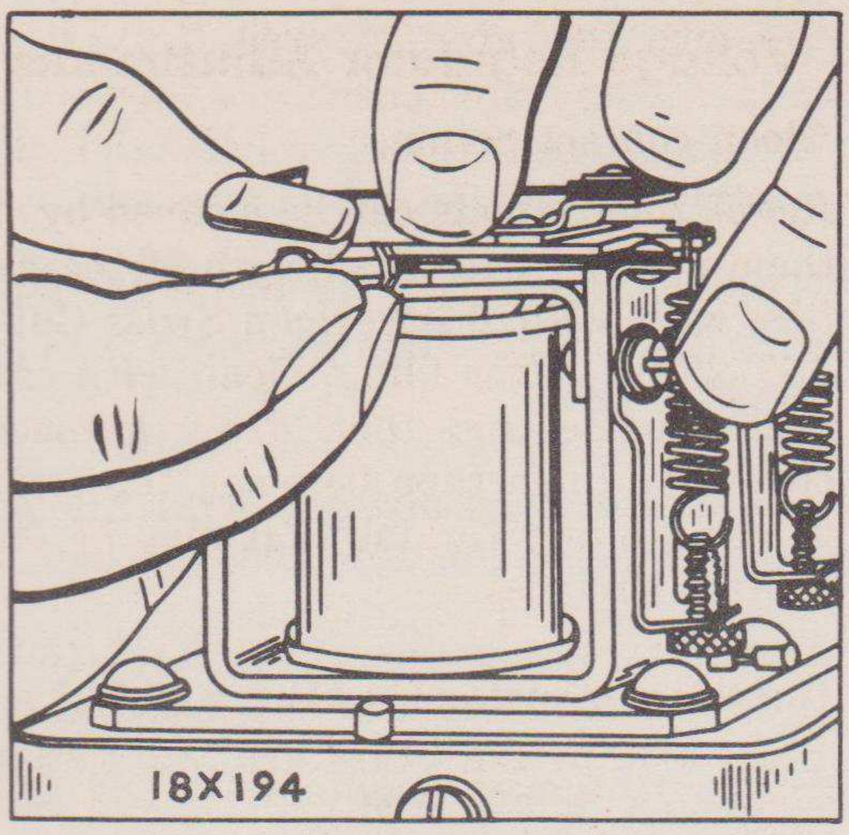


Fig. 125—Checking Armature Air Gap with Pin Gauge (View Showing the Brass Armature Stop Pin)

on either side of the contact spring, so that the contact spring is not touched. The pressure should be applied near the center of the armature.

To adjust, loosen the screws and raise or lower the armature point stop.

Be sure that these screws are tightened with suitable lock washers.

Check and see that the spring upon which the movable contact is mounted is straight

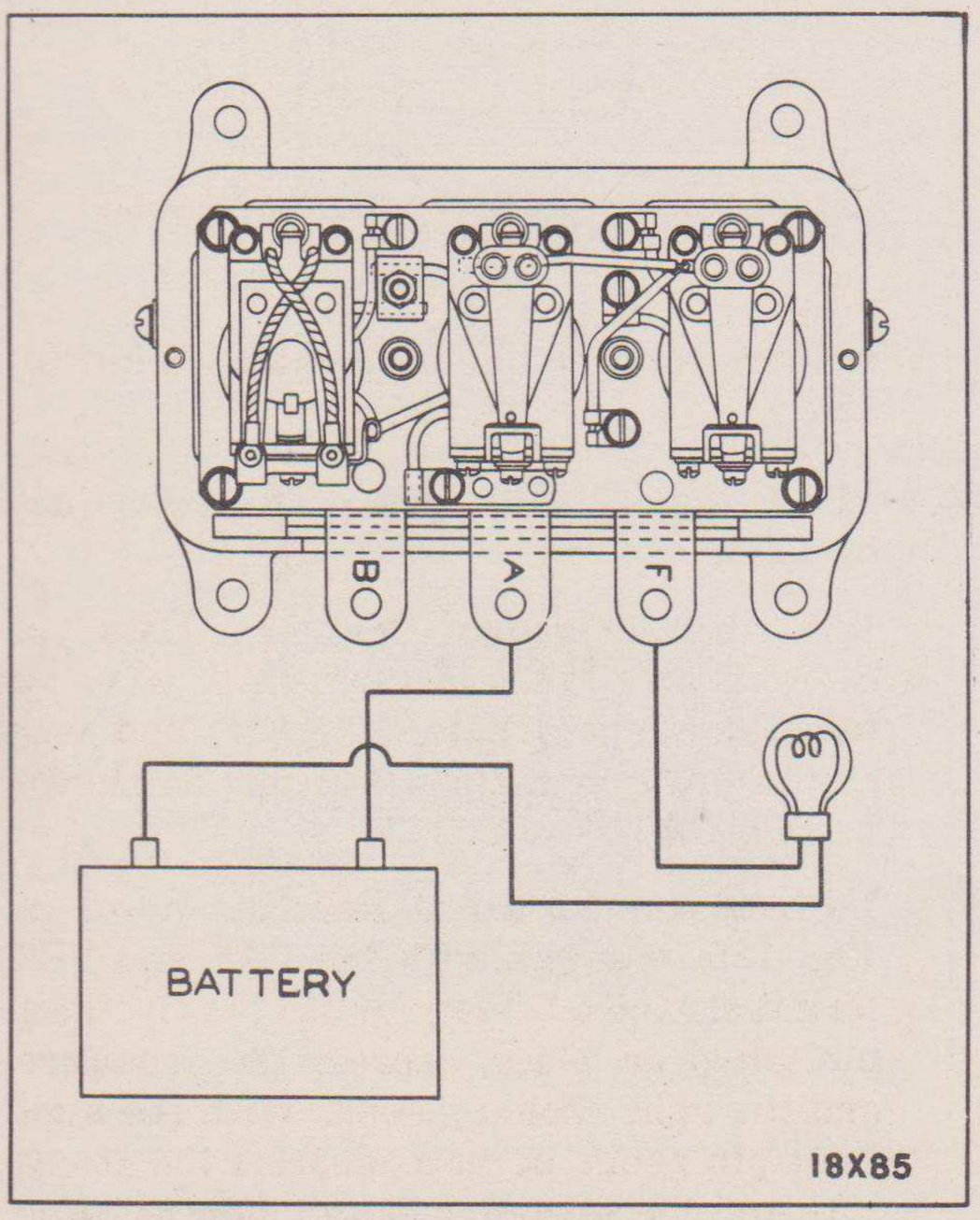


Fig. 126—Test Light Connections for Testing Armature Air Gap

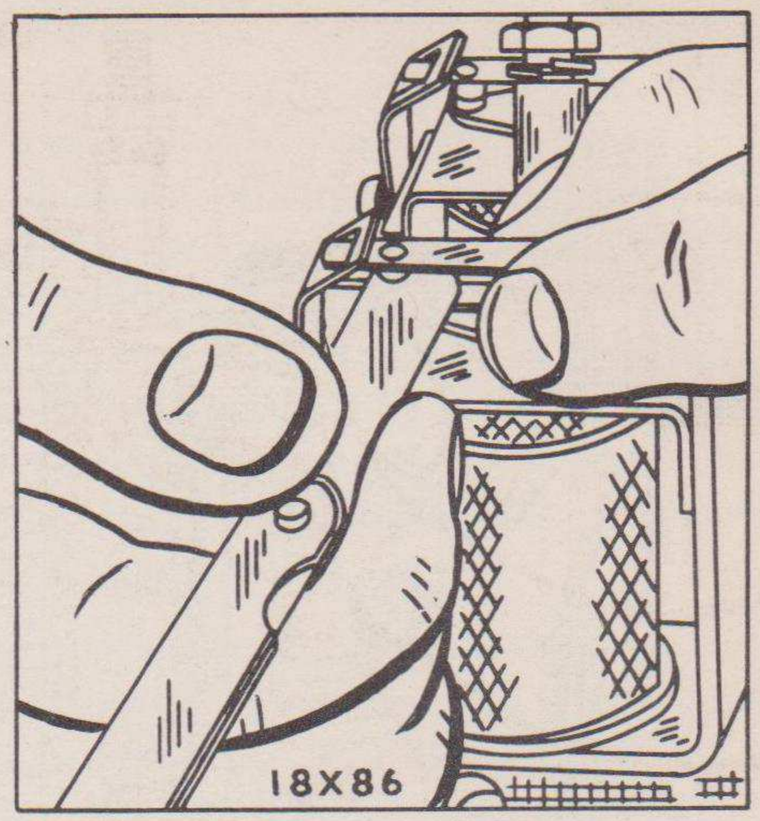


Fig. 127—Checking Contact Point Gap

and that it is parallel with the armature.

(d) Check point gap with the armature against the stop pin. See Fig. 127.

Hold the armature down with two fingers as shown in Fig. 124, taking care that the contact spring is not touched.

The test figures shown in Subject 130 are approximate only; too much variation indicates wrong length to armature stop pin and a new unit will be needed.

(e) Check the pressure of the contact points.

To test, disconnect the spiral spring from the armature and remove the adjustable

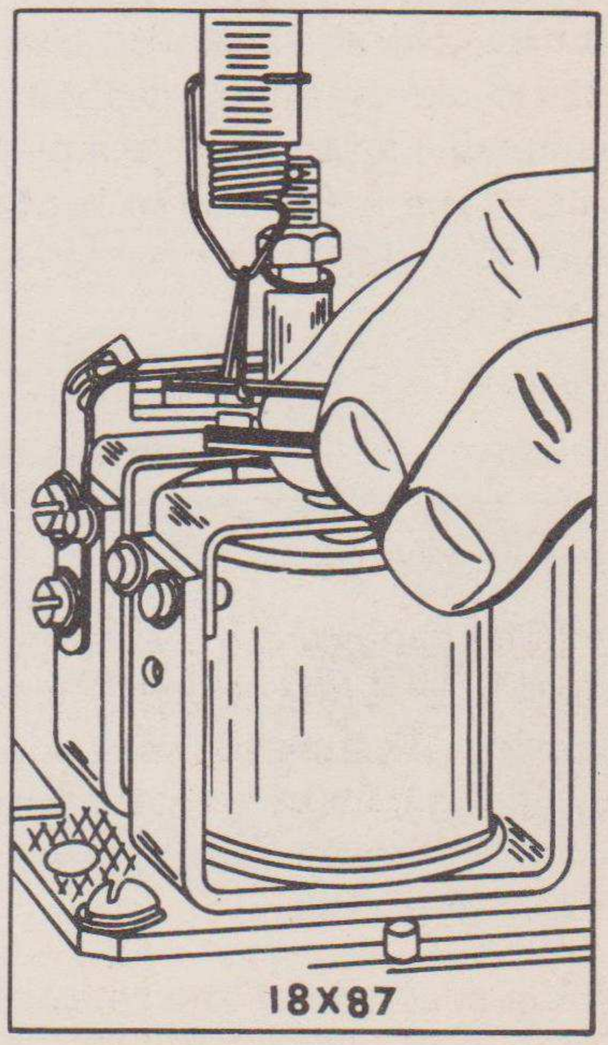


Fig. 128—Checking Pressure of Contact Points with Spring Scale

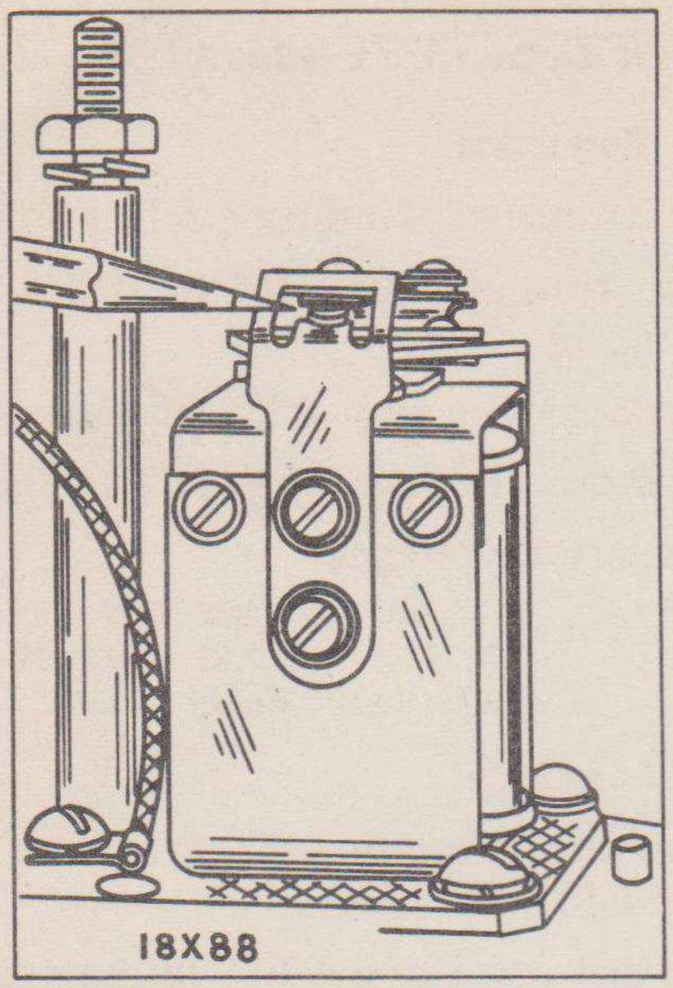


Fig. 129—Armature Stop Fibre Bumper Block

armature stop. Using a spring scale as shown in Fig. 128, and holding the armature firm, take a reading just as the points separate.

When re-assembling the armature stop, be sure that the fibre bumper block is in place. See Fig. 129.

128—Current Limiting Regulator Adjustments

(a) Clean contact points.

Regulator contacts can be cleaned by filing them parallel with the length of the armature with a No. 6 American Swiss cut file (ST-290). After filing, clean with carbon tetrachloride and then draw a piece of clean dry linen tape between the contacts to remove any residue that may be on the contact surfaces.

(b) On the VRY (6 volt) regulator, check the resistance of the frequency winding. An accurate reading ohmmeter (ST-284) is needed for this test.

To test, disconnect the lead from the current regulator unit where it is connected to the resistor through the sub base between the current and voltage regulator and measure from this lead to the current regulator yoke. See Fig. 130.

(c) Check the pressure of the contact points.

To test, disconnect the spiral spring from the armature and remove the armature stop. Using a spring scale as shown in Fig. 128, hold the armature firm and take a reading just as the points separate.

When re-assembling the armature stop be sure that the fibre bumper block is in place. See Fig. 129.

(d) Check armature air gap with the points just breaking. See Fig. 125.

Test with pin gauge. See "Test Data"—Subject 130. This is to be measured on the point side of the brass armature stop pin as shown in Fig. 124.

To test, connect a test light in series with the "A" and "F" terminals and a battery as shown in Fig. 126. With the low limit pin gauge in place depress the armature and the light should go out. With the high limit pin in place the light should stay lighted. Use two fingers in depressing the armature, one on either side of the contact spring, so

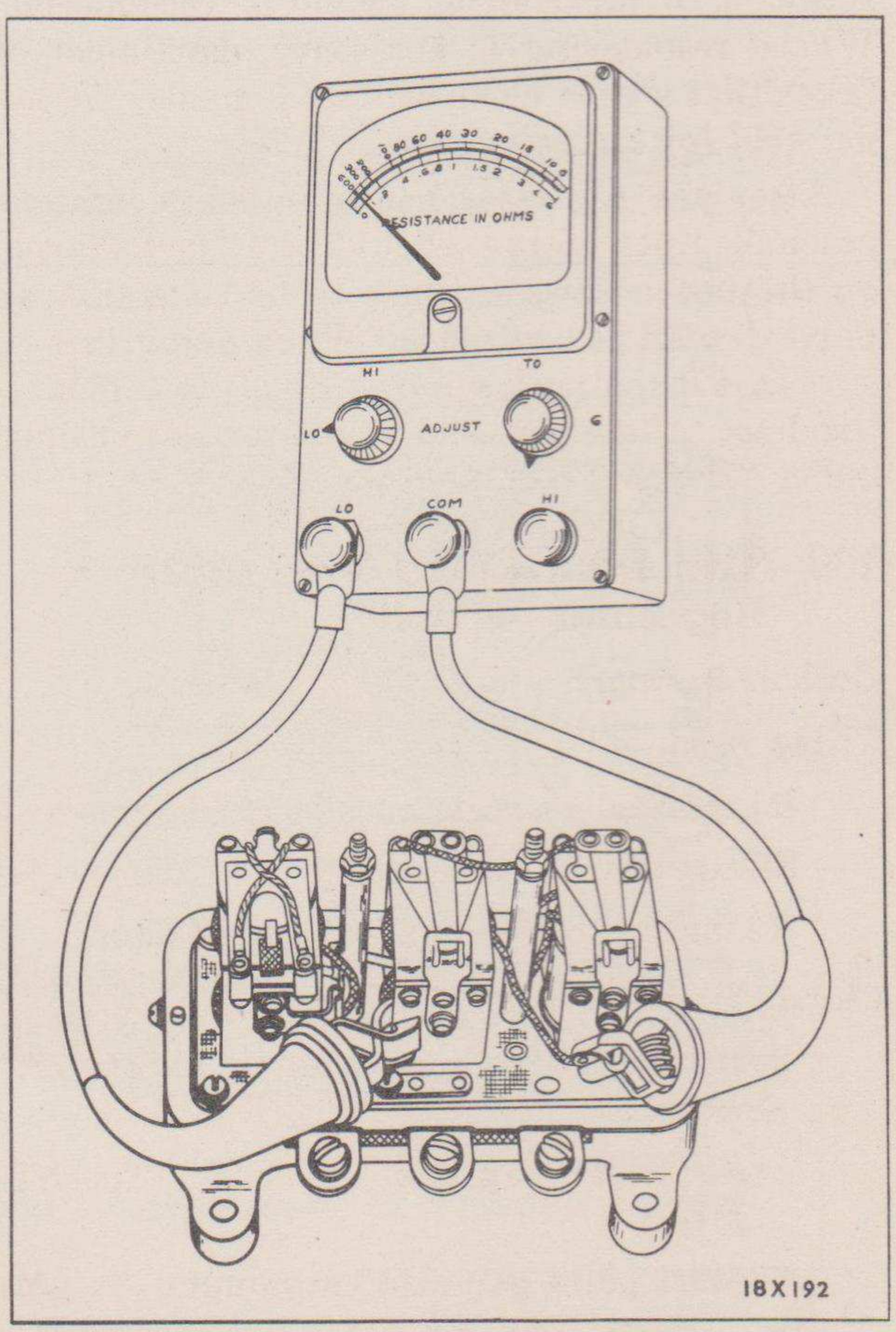


Fig. 130—Checking Resistance of Current Limiting Regulator Frequency Winding

that the contact spring is not touched. The pressure should be applied near the center of the armature.

To adjust, loosen the screws and raise or lower the armature stop.

Be sure these screws are tightened with suitable lock washers.

Check to see that the spring upon which the movable contact is mounted is straight and that it is parallel with the armature.

(e) Check point gap with the armature against the stop pin. See Fig. 127.

Hold the armature down with two fingers as illustrated in Fig. 124. Test figures shown in Subject 130 for this gap are approximate only. Too much variation indicates wrong length to armature stop pin and a new unit will be needed.

129—Reassembling Regulator

When all the preceding checks and adjustments have been completed, all the leads which have been disconnected either by the removal of a screw or by unsoldering should be reconnected. Where resoldering is necessary, care must be taken that a good clean contact is made. *Do not use acid for soldering flux.*

After the regulator has been completely reassembled, its bottom should be struck sharply on the bench several times to be sure that all parts are settled in place. When doing this be sure that it is struck squarely on all four mounting lugs. Then test the regulator as outlined under "Bench Test" on page 88.

130—Test Data (Type VRY 4203A Regulator—6 Volts)

Carbon Resistors

Three used—

R1 marked 80, resistance 76 to 84 ohms

R2 marked 7, resistance 6.5 to 7.5 ohms

R3 marked 80, resistance 76 to 84 ohms

Circuit Breaker

Resistance of voltage winding 15.8 to 17.4 ohms.

Armature air gap .0595″ to .0625″ (Tool ST-281-2)

Contact point gap .015″ minimum

Points close 6.5 volts

Points open 0.5 to 4.0 amperes discharge.

130—*Test Data (VRY-4203A)—Continued*

Voltage Regulator

Resistance of winding 4.3 to 4.7 ohms.

Armature air gap .040″ to .042″ (Tool ST-281-1)

Contact point gap .010″ minimum

Pressure of contact points 7 to 8 ounces

Operating voltages:

Temp. (F):	50°	60°	70°	80°	90°	100°	110°	120°
Volts:	7.41	7.38	7.35	7.32	7.29	7.26	7.23	7.20

Allowable variation ± .15 volt

Current Regulator

Armature air gap .047″ to .049″ (Tool ST-281-5)

Contact point gap .010 ″ minimum

Pressure of contact points 7 to 8 ounces

Operating amperage 40 amperes—plus or minus one ampere.

Resistance of frequency winding .033 to .037 ohms.

Ground Polarity

Negative

Internal wiring (See Fig. 116).

GENERATOR

The generator becomes warm by the nature of its work. The harder the work, the warmer it will become. To reduce this natural heat, an inbuilt fan draws fresh, cool air into the rear end of the generator and forces the hot air out the front end. The fresh air passes over the brushes and commutator. The faster the generator runs—the faster the air moves through it forcing out the natural heat developed in the generator.

131—Generator

Removal and Disassembly

To remove the generator, disconnect the lead wires, remove the adjusting strap screw and the support bracket bolts.

To disassemble generator, remove the inspection band, lift brush tension arms and remove brushes. Remove frame screws and lift off drive end head with armature and commutator end plate assembly. To remove pulley, use a utility puller. Fig. 131 shows a disassembled view of the generator.

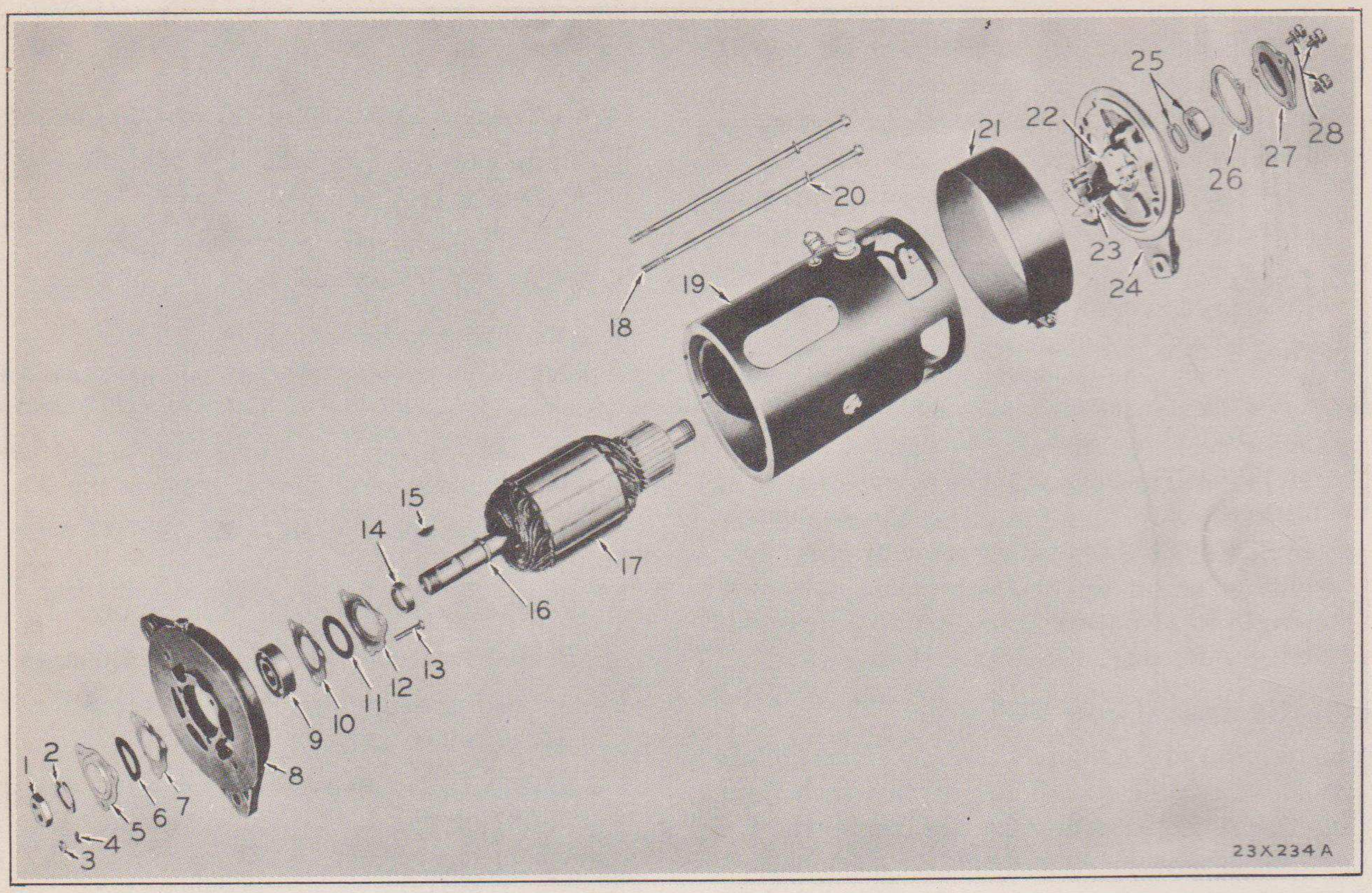


Fig. 131—Generator

1—Armature shaft nut—front
2—Armature shaft nut lockwasher
3—Bearing retainer screw nut
4—Bearing retainer screw nut lockwasher
5—Bearing retainer
6—Felt washer
7—Felt guard
8—Drive end head
9—Front bearing
10—Felt guard
11—Felt washer
12—Bearing retainer
13—Bearing retainer screw
14—Felt washer retainer
15—Pulley key
16—Snap ring
17—Armature assembly
18—Frame screw
19—Frame and field assembly
20—Frame screw lockwasher
21—Head or inspection band
22—Main brush set
23—Main brush set
24—Commutator end plate assembly
25—Armature shaft nut and lockwasher—rear
26—Commutator end plate cover gasket
27—Commutator end plate cover
28—Commutator end plate cover screws and lockwashers

Assembly and Installation

After assembling the generator, make sure the brushes are properly seated, (See Subject 133) and that the tension springs apply pressure on the brushes, not the brush holders.

After installing the generator on the truck, adjust the fan belt so that it is just snug. If the belt is too tight, damage to the generator or water pump bearings will result. Make sure the generator lead wires are connected to the proper terminals on the generator before starting the engine. See Wiring Diagram, Fig. 149.

132—Testing Generator on Test Bench

To check the output of the generator without the regulator, it is necessary to remove the unit from the truck and operate it on a "Test Bench" where speeds as well as current and voltage can be checked.

When testing the generator on a test bench, place a jumper wire from armature to field terminal. Run the generator up to the approximate "cut-in" speed and connect generator terminal to a fully charged battery. Adjust the speed so as to obtain the ampere output at the specified voltage and then check the speed which should be within the limits indicated below:

6-VOLT GENERATOR

CUT IN

Volts	R.P.M.
6.4	420-440 cold
6.4	450-480 hot

MAXIMUM OUTPUT

Amps.	Volts	R.P.M.
27-25	8	1000-1100 and up—cold
27-25	8	1300-1380 and up—hot

When operating the generator on the test bench, do not run it at speeds having a higher output than the maximum noted in the foregoing table for any length of time, as this would cause overheating and possible damage to the armature or the field coils. After making check of generator output, reduce generator speed to the "cut-in" value and remove battery connection to prevent heavy discharge of current through the generator.

133—Generator Brushes

The generator brushes should be examined to make certain that they are free in the holders, seating properly, and not worn excessively. Brushes should be examined at 10,000 miles and again at 20,000 miles and at 5,000 mile intervals thereafter. Brushes, which are worn short or covered with oil, should be replaced to avoid damage to the armature, commutator and windings. Should inspection show the brushes badly worn or the commutator rough or worn so that the mica is even with the bars, the generator should be removed from the truck, completely dismantled, cleaned, the commutator turned and mica undercut, assembled, new brushes fitted and the generator "bench tested" before installing on the truck.

To fit new brushes, after assembling the generator, take a strip of No. 00 sandpaper cut the width of the commutator and long enough to lap two and a half times around the commutator and slide it, sand side up, around the commutator and under the brushes. Lap the end under, keeping the sandpaper tight on the commutator. Also be sure to wrap the sandpaper so that it will not unwind when the armature is rotated in the direction in which it is driven on the vehicle.

Rotate the armature and sandpaper slowly being sure to keep the sandpaper tight until the brushes show at least a 75% fit over the entire bearing face. After obtaining a proper seat to all the brushes, carefully remove the sandpaper so as not to cut the edge of a brush. Excessive use of sandpaper shortens the brush life and should be avoided. Blow out all sand and carbon dust from the generator. Run the generator on the test stand long enough to obtain a highly polished fit over the entire contact face of the brush before checking, or adjusting the generator output.

134—Turning Generator Armature Commutator

Care must be taken, when turning the commutator, because when finished it should not have over .002" eccentricity when tested with a dial test indicator with the armature shaft bearing seats resting on V-blocks.

135—Undercutting Generator Commutator

To undercut the commutator, a special undercutting tool can be used or one can be made by taking a short piece of fine tooth hack saw blade and grinding the offset of the teeth to just fit the width of the mica slot. Be sure to undercut the mica square the full width of the slot and $\frac{1}{32}$" deep. After undercutting, polish the commutator with No. 00 sandpaper to remove any possible burred edges of the commutator bars.

136—Ammeter

The ammeter shows only the current flowing to or from the battery as the case may be, and does not indicate the entire generator output. The current supplied for ignition, lights and accessories is automatically deducted from the generator output reading.

Because of this, the ammeter should never be used as an accurate check for generator current output.

No adjustments are provided for the ammeter and failure of the unit to properly indicate should be corrected by replacement of the unit.

IGNITION SYSTEM

The ignition system contains the distributor and coil, the latter of which produces the necessary high voltage to be distributed at the right instant by the distributor to the spark plugs for ignition of the fuel in the combustion chambers of the engine.

DISTRIBUTOR

The distributor contains a set of breaker points (Fig. 132), which are timed to open and close the circuits to the spark plugs depending on engine speed. This is taken care of by a governor operated by centrifugal weights in the base (16, Fig. 132) of the distributor which regulates the spark timing according to speed.

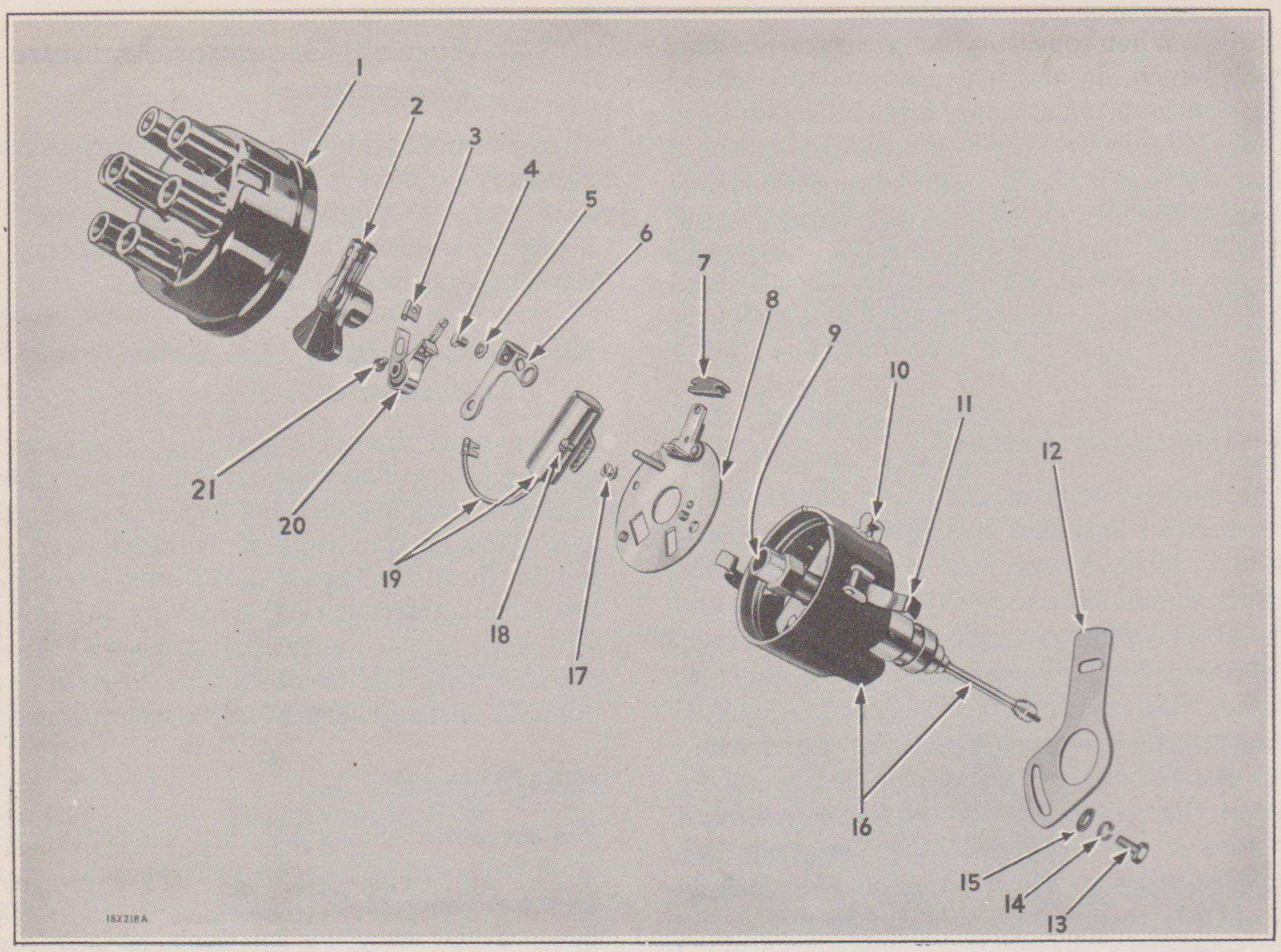


Fig. 132—Distributor

1—Cap
2—Rotor
3—Breaker arm spring clip
4—Adjustable breaker point lock screw
5—Adjustable breaker point lock screw lockwasher
6—Adjustable breaker point
7—Terminal slot cover
8—Breaker plate
9—Cam sleeve felt wick
10—Oil cup
11—Cap spring
12—Lock plate
13—Lock plate fastening screw
14—Lock plate fastening screw lockwasher
15—Lock plate fastening screw plain washer
16—Base assembly
17—Breaker plate screw
18—Condenser fastening screw
19—Condenser
20—Breaker arm
21—Breaker arm spring clip terminal screw

137—Distributor

Removal and Installation

To remove the distributor, remove the cap, disconnect the small primary lead wire at the distributor, remove the hold down screw and withdraw the unit.

When installing the distributor assembly on the engine, see that number one piston is at top dead center on compression stroke and the distributor rotor is in number one firing position.

138—Breaker Points

Adjustment

Since the breaker points are timed to open and close at the exact instant necessary for efficient engine operation, the adjustment of the points is an important factor in correct distributor operation.

A special tool (MT-166) may be used to very accurately adjust breaker points without the necessity of cleaning the points with a hone or file, thereby increasing breaker point life. The breaker points are adjustable by means of an eccentric, therefore the points do not turn and they maintain their relative positions. The small amount of metal transferred from one point to the other does not affect the adjustment when using special tool MT-166 because the amount of movement of the breaker arm is measured rather than the space between the points.

When using special tool MT-166, the distributor assembly should be removed from the engine.

Fasten the assembly in a vise. Clamp the special dial indicator fixture on the distributor housing as shown in Fig. 133. Set the dial indicator rod with a slight load against the breaker

arm in line with the breaker point and 90° or perpendicular to the breaker arm. With the breaker arm rubbing block on the low side of the distributor shaft cam, set the dial indicator to zero (0). Rotate the distributor shaft and turn the adjustable breaker point screw after loosening lock screw until the dial indicator reads .020" with the breaker cam rubbing block on the high point of the cam. The cams on the distributor shaft may be checked for uniformity by rotating the distributor shaft and checking each cam individually.

Breaker points can also be adjusted with a feeler gauge, but the small amount of metal transferred from one point to the other will not permit accurately measuring the gap, therefore the points must be dressed so that they are clean and make flat contact with each other.

To adjust breaker points, rotate the distributor shaft so that the breaker point rubbing block is on a high point of the cam. Then loosen the locking screw 1, Fig. 134 and turn the adjusting screw 2 until the gap "A" is .020". Tighten the lock screw and recheck the adjustment.

After the breaker point gap has been properly adjusted, the ignition timing (Subject 141) should always be checked and set to the correct specification.

Breaker Arm Spring Tension

If the breaker points and the spark plugs are properly adjusted, and the engine misses at high speed, the breaker arm spring tension should be checked with scales available for this purpose. The tension at the breaker points should be 18 to 20 ounces. Correct tension may be obtained by shifting the breaker arm spring in its slot until the tension is correct. Make certain that the copper conductor strap, parallel to the spring, is not tight against the spring. If the conductor strap is drawn too tightly it is likely to fracture.

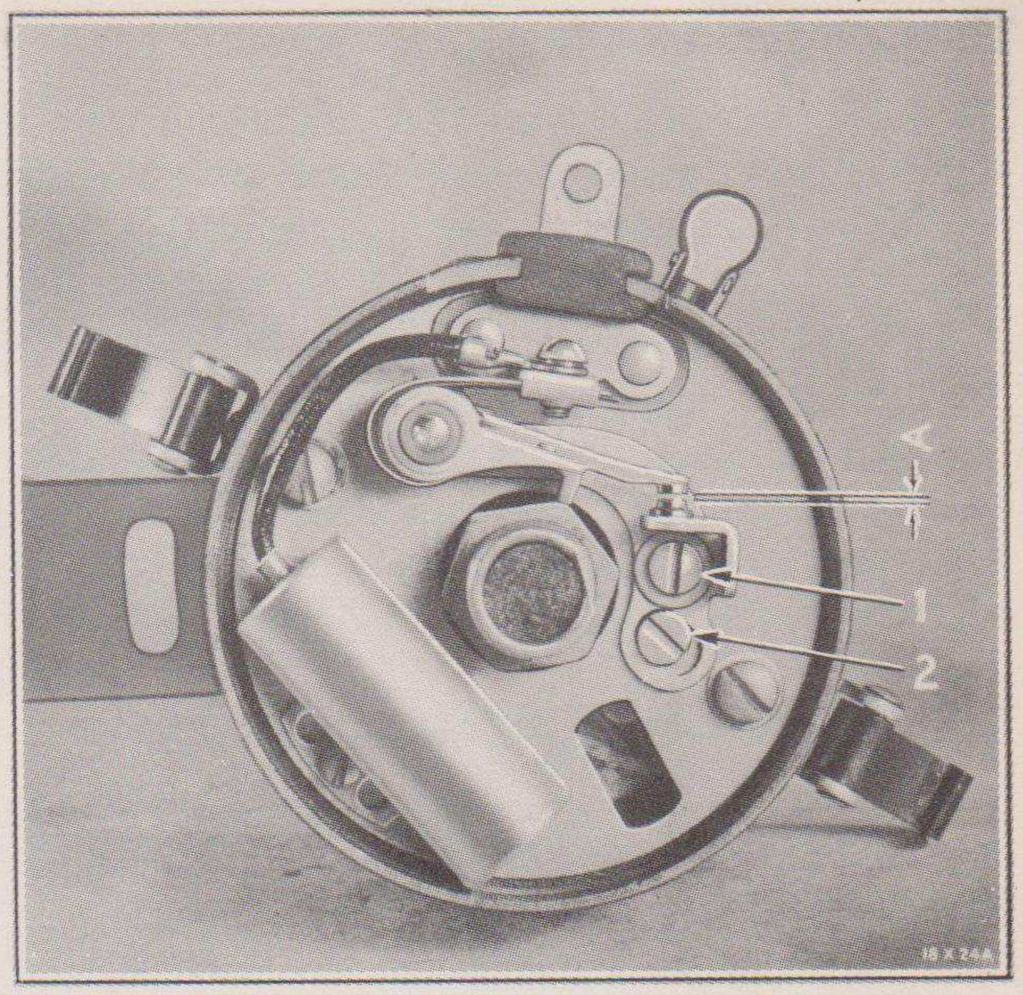


Fig. 134—Distributor Breaker Points

1—Adjustable breaker point lock screw
2—Adjustable breaker point adjusting screw
A—Breaker point gap (.020")

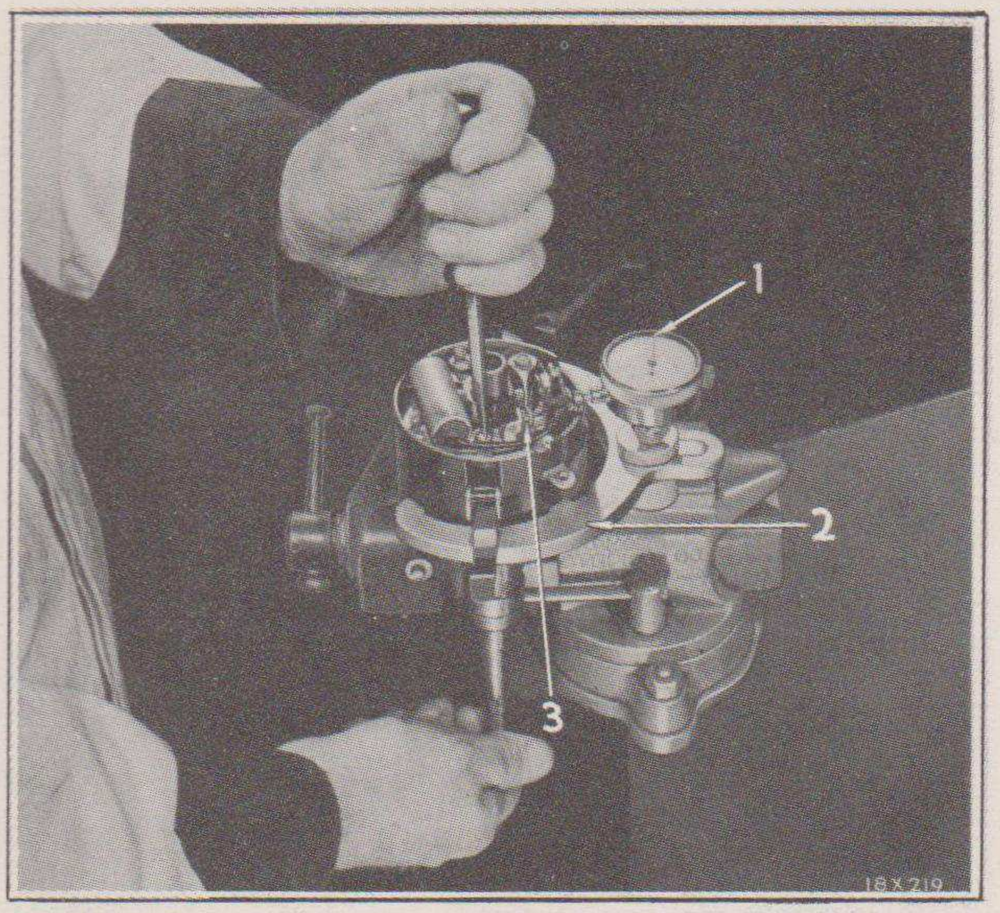


Fig. 133—Setting Distributor Point Gap with Dial Indicating Fixture (Tool MT-166)

1—Dial indicator (dial only is tool C-396)
2—Dial indicator fixture (fixture only less dial is tool MT-166-A)
3—Distributor point gap

Removal and Installation

To remove the breaker points (with distributor removed) lift off the rotor and remove the screw and clip which holds the primary lead wire, condenser lead wire and the breaker point spring. Lift the breaker arm assembly off its pivotal point. Remove the breaker point lock screw and lift off the breaker point plate.

When installing new breaker points, check the breaker arm spring tension and adjust the points to .020".

CAUTION: The slightest trace of oil, grease or dirt on the contact surfaces of the breaker points will aggravate pitting and burning, necessitating frequent replacement of breaker points. Under no circumstances should grease or oil be used for lubrication of the distributor cam. Use a small quantity of petrolatum on the contact arm bumper block when new points are installed.

139—Condenser

The condenser (19, Fig. 132), mounted on the breaker point plate, can be tested by using an accurate condenser tester. A defective condenser will cause burning of the breaker points which in turn will affect the performance of the engine.

The condenser may be easily removed after lifting off the distributor cap and rotor. It is fastened to the breaker plate assembly by a screw.

140—Governor Weights and Springs

To remove the governor weights and springs in the base (16,Fig. 132) of the distributor, remove the two breaker plate screws and bearing retainer clips which are adjacent to the distributor cap clips, and lift out the breaker plate assembly. The governor weights and springs will then be accessible. Governor springs must never be distorted; neither should the spring support posts be bent to alter the governor advance. Use original equipment type springs for replacement.

141—Ignition Timing

In low altitudes with standard brands of non-premium gasoline, the engine will give its best performance if timed 2° A.T.D.C.

With this timing, there will be a trace of spark ping from 10 to 30 miles per hour when accelerating with wide open throttle from 10 miles per hour.

When using lower grade fuels, or after carbon has accumulated, spark ping may be excessive with the engine timed at specified timing. In such cases the timing should be retarded not to exceed 4 degrees (.007″) later than specified.

In high altitudes there is less tendency for spark ping, and the same thing is true in low altitudes when using premium gasolines. In such cases improved performance may be obtained by advancing the spark not to exceed 4 degrees (.007″) ahead of specified timing.

Within the foregoing limits, i.e., from 4 degrees (.007″) earlier to 4 degrees (.007″) later than specified timing, a good rule to follow is to advance the spark until a slight ping is audible when accelerating from 10 miles per hour with wide open throttle.

Adjusting Ignition Timing

The distributor should be moved clockwise to retard, and counter-clockwise to advance the ignition.

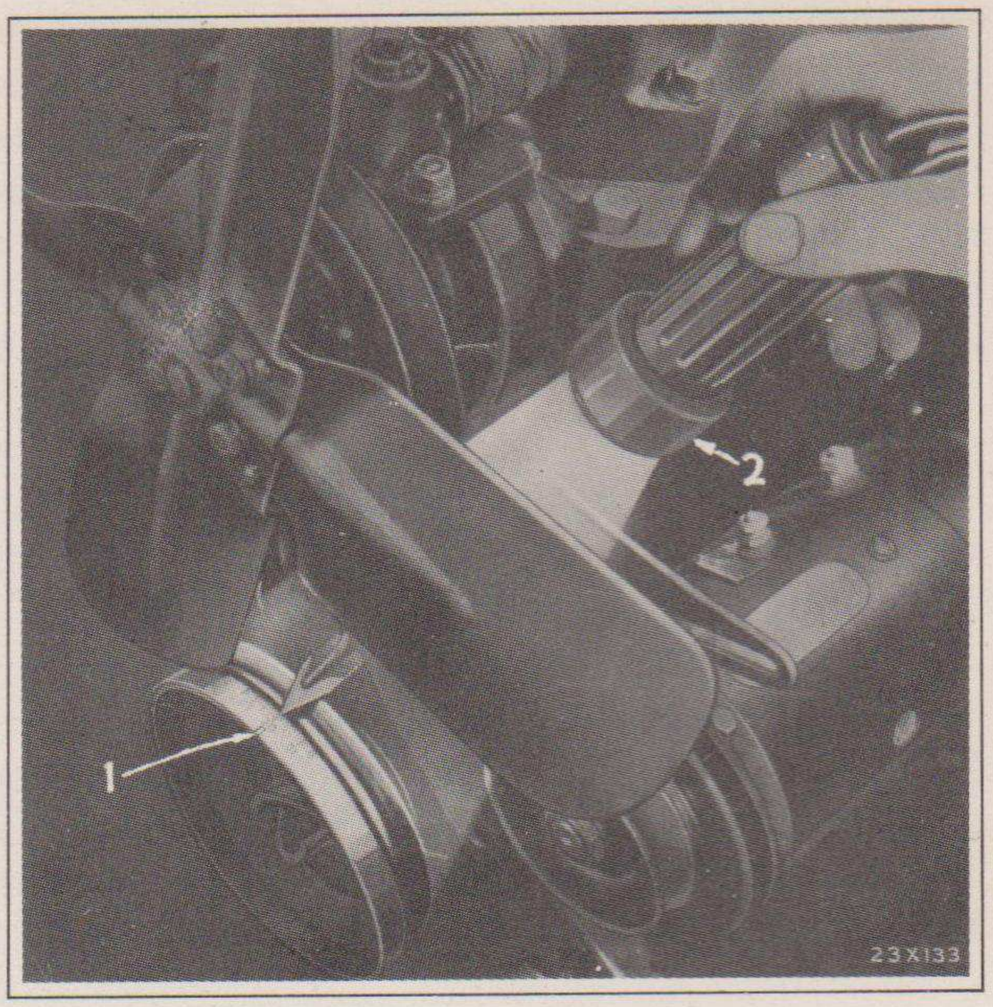


Fig. 135—Timing Light
1—Chalk mark 2—Tool C-374

(a) Using a Timing indicator over No. 6 cylinder (Fig. 136), bring the piston up on the compression stroke until the piston is at top dead center.

(b) Loosen the clamp cap screw (3, Fig. 137) and rotate distributor body until breaker points just start to open. This may be checked by means of a test lamp connected

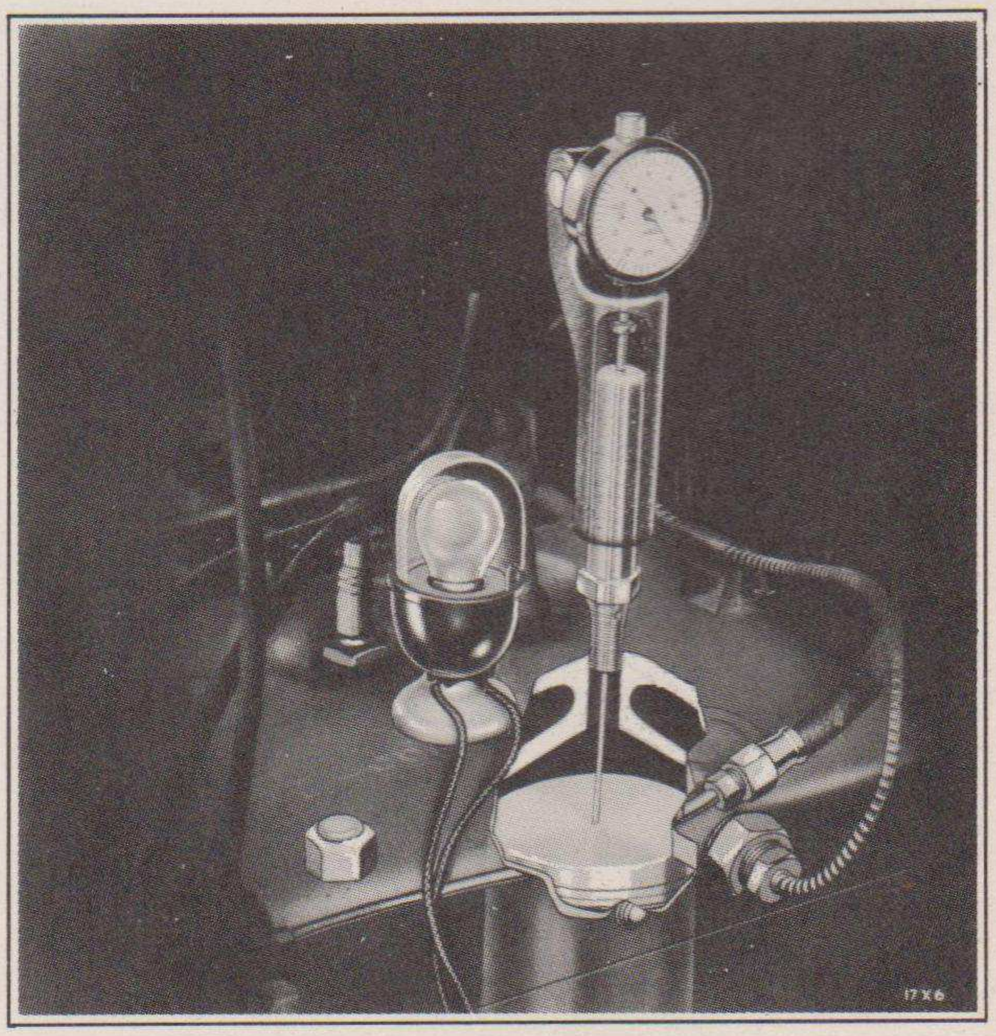


Fig. 136—Timing Indicator (Tool C-435)

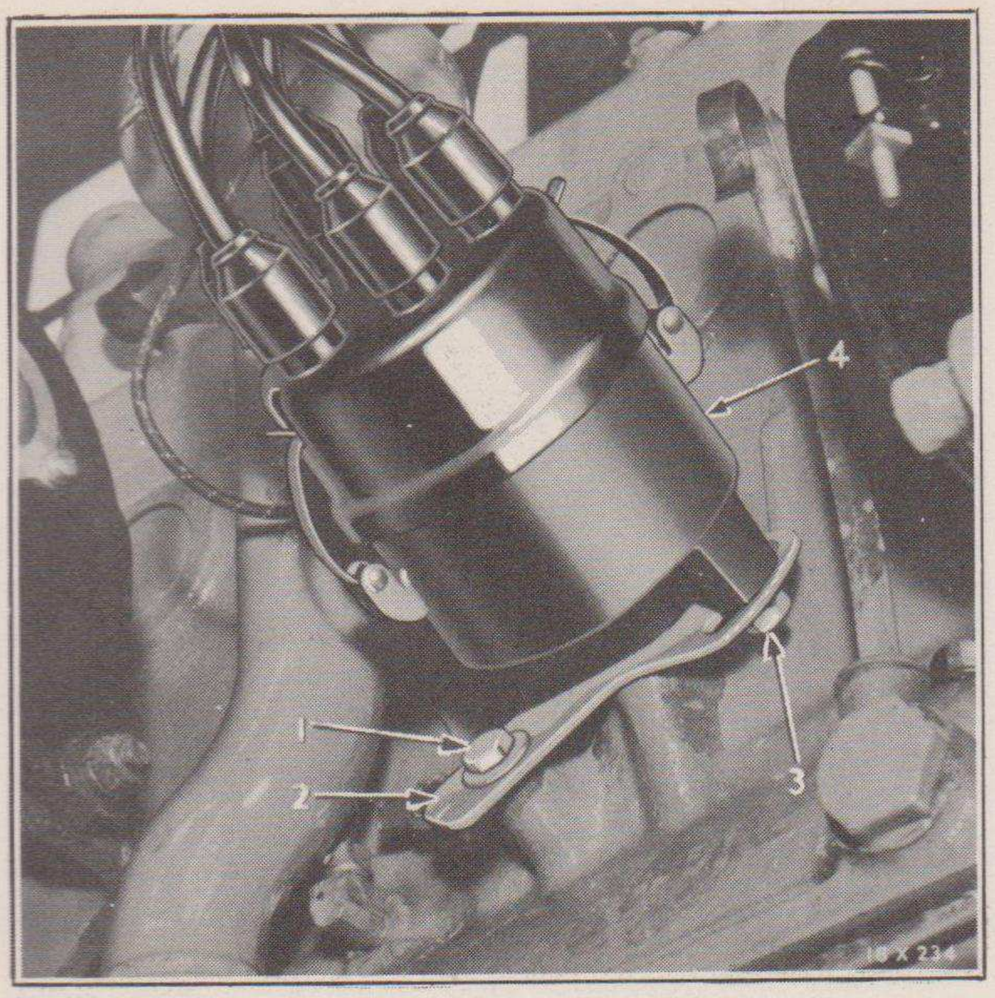


Fig. 137—Ignition Timing Adjustments
1—Minor adjustment lock screw
2—Adjustment control arm
3—Major adjustment lock screw
4—Distributor

between the distributor primary terminal and the battery (B) terminal of the current and voltage regulator. When the points are closed the light will be on, and as soon as the points break the light will go off. Press the distributor cam lightly against the direction of proper rotation so as to remove all backlash.

Minor changes in ignition timing may be obtained by loosening the adjustment control arm lock screw (1, Fig. 137) and rotating the arm slightly in the proper direction.

IGNITION COIL

The ignition coil transforms battery voltage into high voltage for the spark plugs. If there are indications that the coil is not delivering a satisfactory spark, first check all connections at the ammeter, ignition switch, coil and distributor to see that they are clean and tight.

142—Checking Ignition Coil

A quick coil check may be made by removing the coil high tension wire at the distributor cap and holding it near the cylinder head. With the ignition switch turned on and the starting motor cranking the engine, a spark should jump from the end of the high tension wire to the cylinder head. If the spark is less than ¼″ long, the ignition system should be tested with accurate electrical testing equipment, to determine the cause of the difficulty. The coil should be replaced with the same make and type if it is defective.

Removal and Installation

The coil is mounted on the steering column at the engine side of the dash. To remove the coil, disconnect the high and low tension wires and the ground wire at the base of the coil.

When replacing the coil it is very important that the ground wire (bonding strap) be securely tightened to make a good connection, otherwise radio interference may be encountered.

SPARK PLUGS

For best engine performance and economical operation, the spark plugs should be kept clean. They should be cleaned frequently in a sand-blast type cleaner which will remove the deposit formed by the use of chemically treated fuels for high compression engines. If this deposit is not removed, the engine may "miss" under heavy load or high speed driving. In addition to cleaning the electrodes, the porcelains should also be wiped clean every 2,500 to 3,000 miles.

143—Spark Plug Replacement

The spark plugs should be tested occasionally with a reliable tester and replaced if faulty. To insure maximum efficiency, replace the plugs every 10,000 miles.

When installing spark plugs, tighten them with a tension wrench to 26 to 32 foot pounds.

144—Spark Plug Adjustment

After cleaning the spark plugs, adjust the gap to .025″ using a round feeler gauge. (See Fig. 138.) Make all adjustments on the side wire of the plug. If the center electrode is bent, the porcelain may crack, resulting in plug failure.

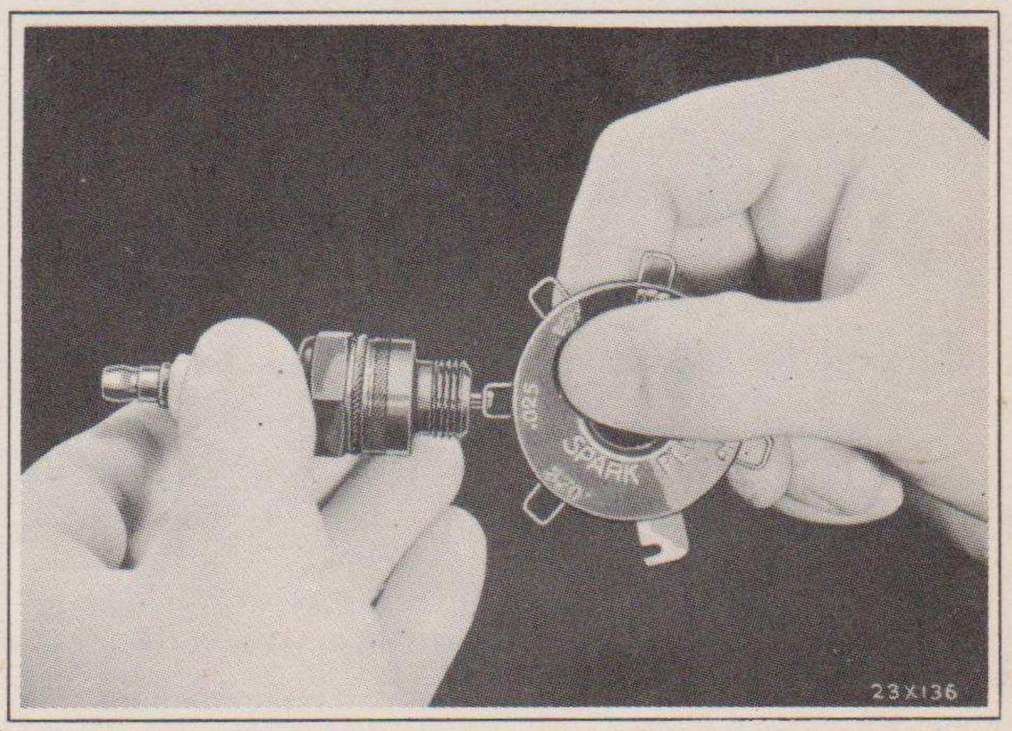


Fig. 138—Measuring Spark Plug Adjustment with Gauge

RADIO INTERFERENCE SUPPRESSION

Interferences and disturbances that cause poor radio reception are decreased or eliminated by various installations of suppressors, shielding, filters and bonding (grounding). The locations and purposes of these devices are explained under the following headings:

Suppressors
Shielding
Filters
Bonding (Ground connections)

145—Radio Interference Suppression

Suppressors

Seven suppressors are installed in the ignition circuit. One is installed on the spark plug wire at each spark plug and one on the high tension wire (center terminal) at the distributor cap. These suppressors have nominal direct current resistance of 10,000 ohms.

The suppressors are assembled to the high tension wires by screwing the suppressors onto the wires. See Fig. 139. Care must be taken when installing a suppressor to completely seat the connection. The wire and suppressor should not be merely pushed together. The spark plug ends of the suppressors are snapped on the plugs similar to regular spark plug wire terminal connectors.

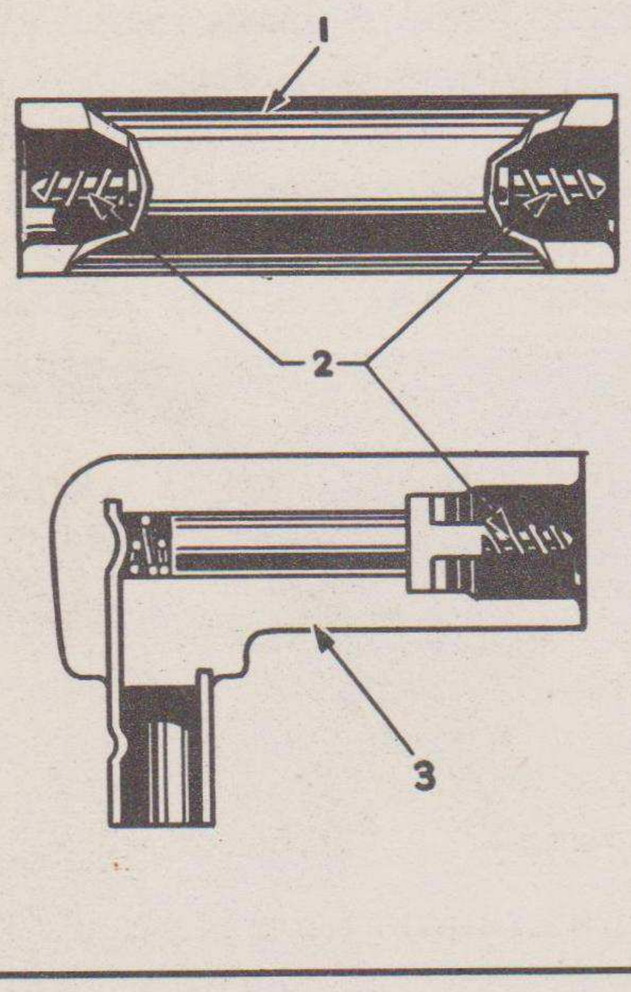


Fig. 139—Spark Plug and Distributor Suppressors
1—Distributor suppressor 2—Cable terminal screws
3—Spark plug suppressor

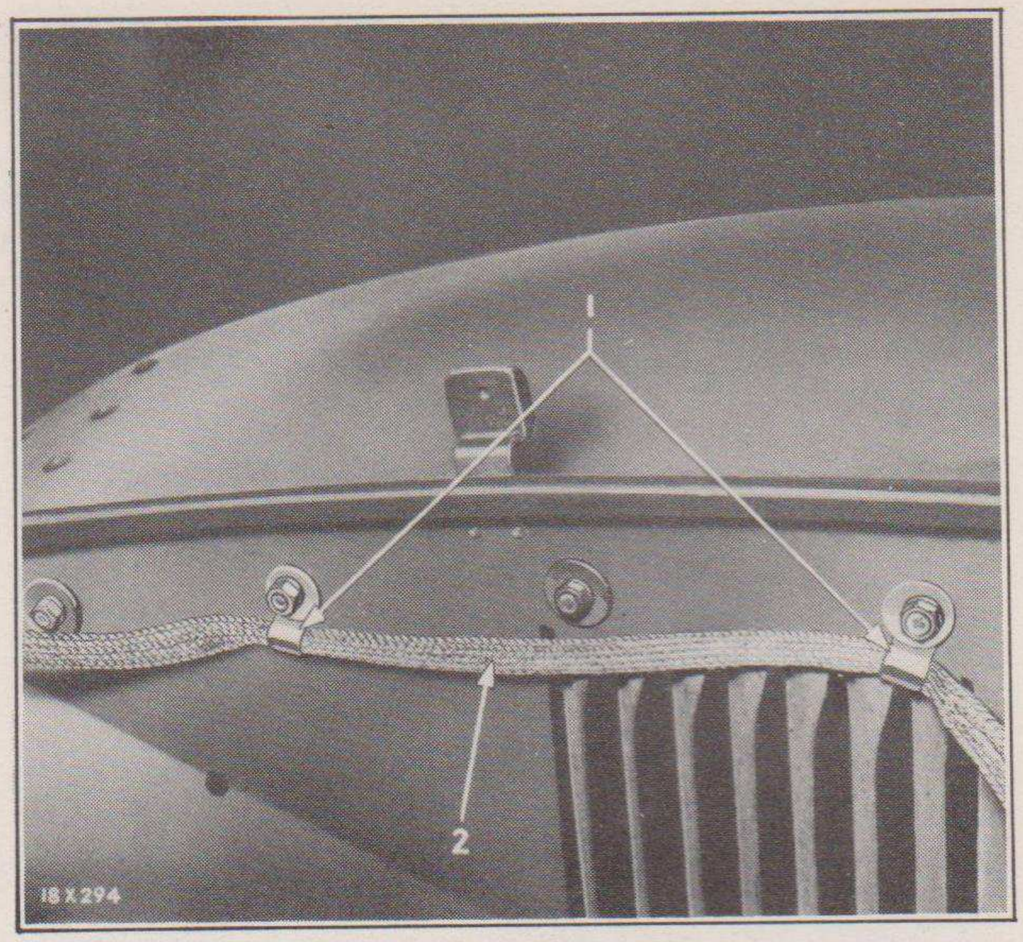


Fig. 140—Shielding Over Generator Cables
1—Bond or ground clips
2—Generator to regulator cable shield

Shielding

The armature and field wires from the generator to the voltage regulator are shielded with tinned copper braid to prevent pickup of ignition interference and radiation of generator armature and regulator interference by these

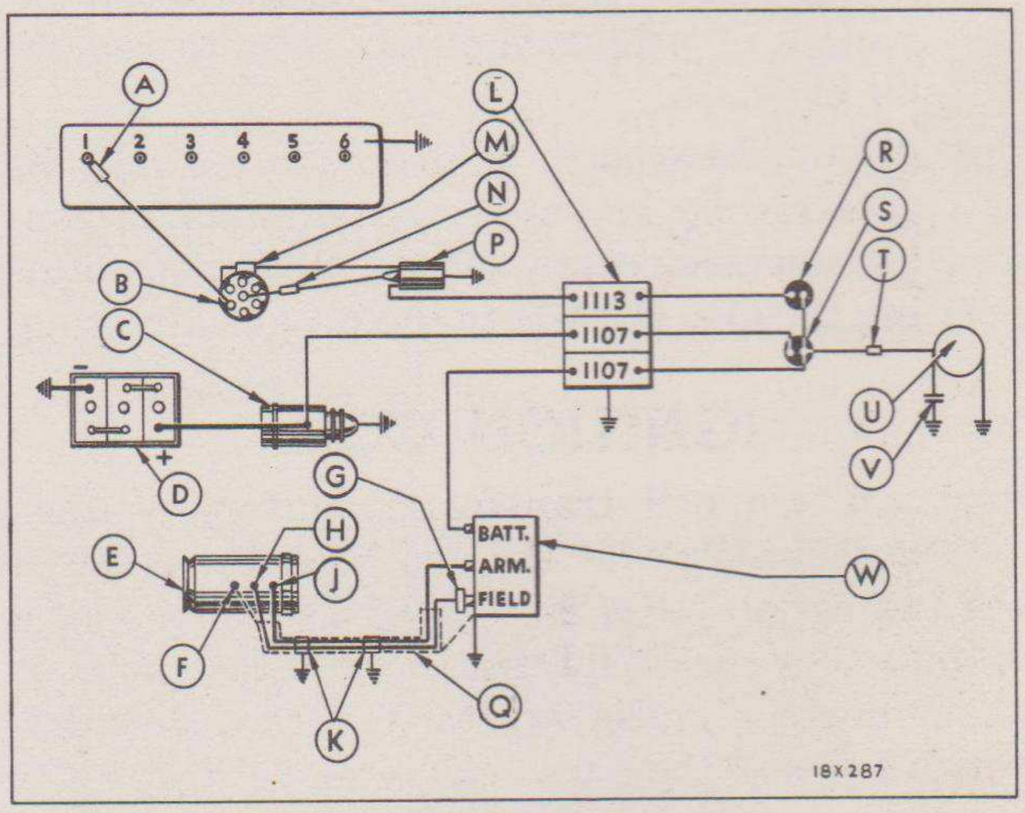


Fig. 141—Suppression Diagram
A—Spark plug suppressors (one on each plug)
B—Distributor
C—Starting motor
D—Main storage battery
E—Generator
F—Ground terminal
G—Filter
H—Field terminal
J—Armature terminal
K—Tinned clips
L—Filter assembly
M—Filter
N—Distributor suppressor
P—Ignition coil
Q—Braided tinned copper shield over generator wires
R—Ignition switch
S—Ammeter
T—Ventilator fan switch
U—Roof ventilator fan
V—Roof ventilator fan condenser
W—Voltage regulator