MAINTENANCE MANUAL

4 TON 6 x 6

DIAMOND T MOTOR CAR CO.

CONTRACT NUMBER — CANADIAN
C.D.L.V. 587

SERIALS
969A0555
969B0205 TO 969B0606
9750001 TO 9750307
975A0001 TO 975A0811

DIAMOND T MOTOR CAR COMPANY
FACTORIES: CHICAGO, ILLINOIS, U. S. A.

FORM 975-1

In order that motor vehicles may be maintained in such condition as to avoid unnecessary repair, and to outline routine of operation which will lead to the same result, some suggestions are offered in the first section of this book. These may be obvious to the experienced operator but are nevertheless offered for the assistance of those who may not have had the opportunity of learning the hard way.

The second portion of this manual is intended to assist in those maintenance operations usually handled in the shop. It is sincerely hoped that this book will be of material help, but recognizing that in the scope of such a publication the major points only can be covered, we cordially invite interrogation should further information be required.

SERVICE DEPARTMENT
DIAMOND T MOTOR CAR CO.

MT 1193

SGV TD
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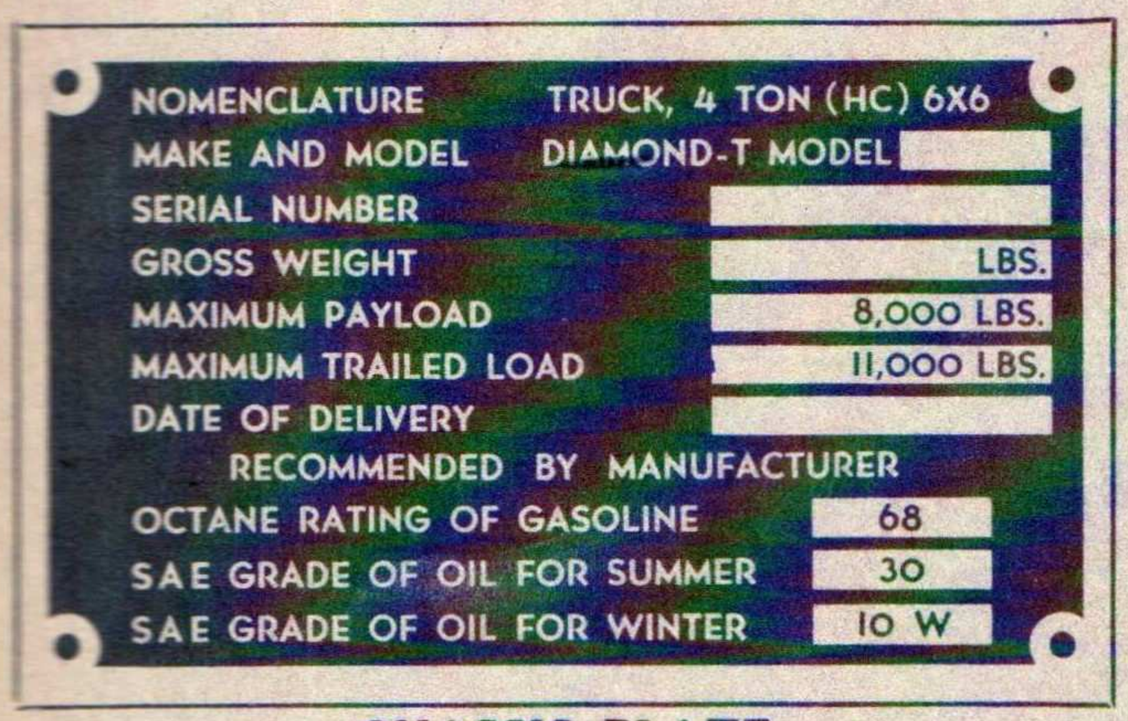
CONTENTS

SECTION ONE

CARE and OPERATION

INSTRUCTION PLATES AND SERIAL NUMBERS

Special instructions governing the operation of units appear on plates mounted in the cab. Serial numbers of the engine, chassis, winch and power take-off are given on plates mounted on the units as indicated below the illustrations which follow.

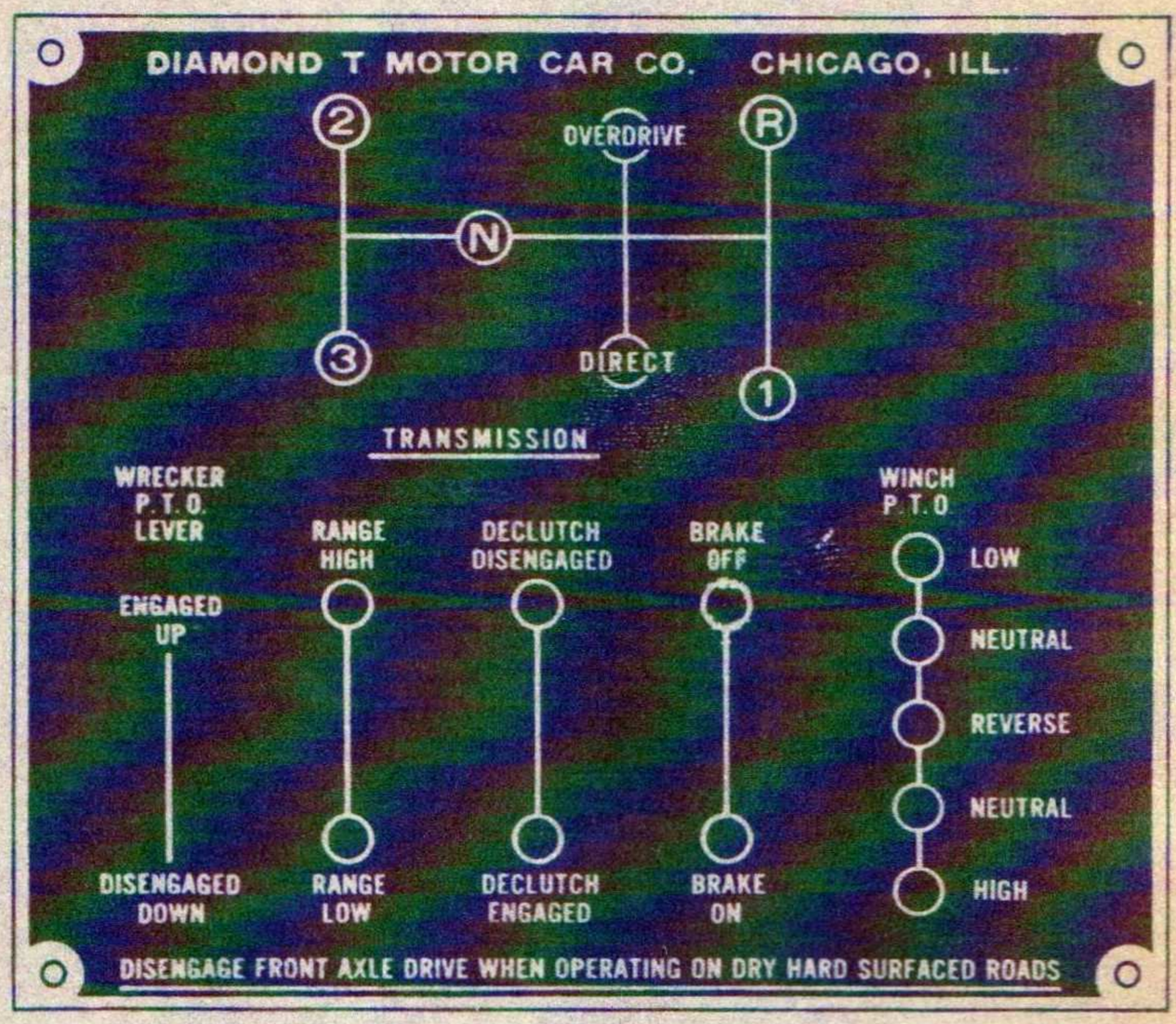


CHASSIS PLATE

Located on left side of cowl under hood.

ENGINE PLATE

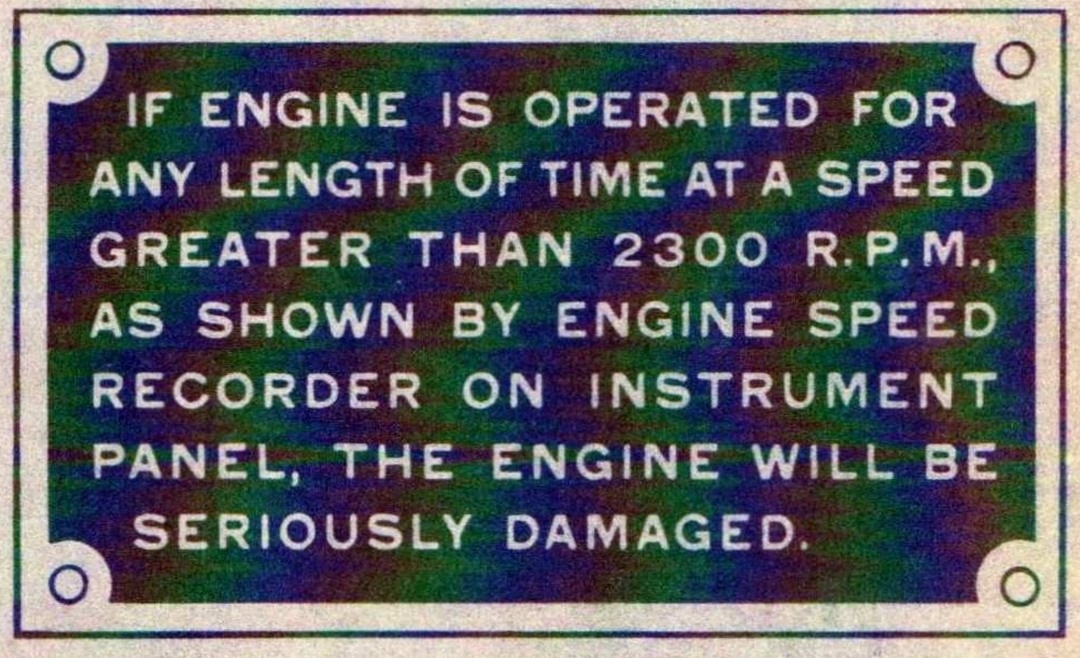
Located on left side of cylinder block.



SHIFTING PLATE

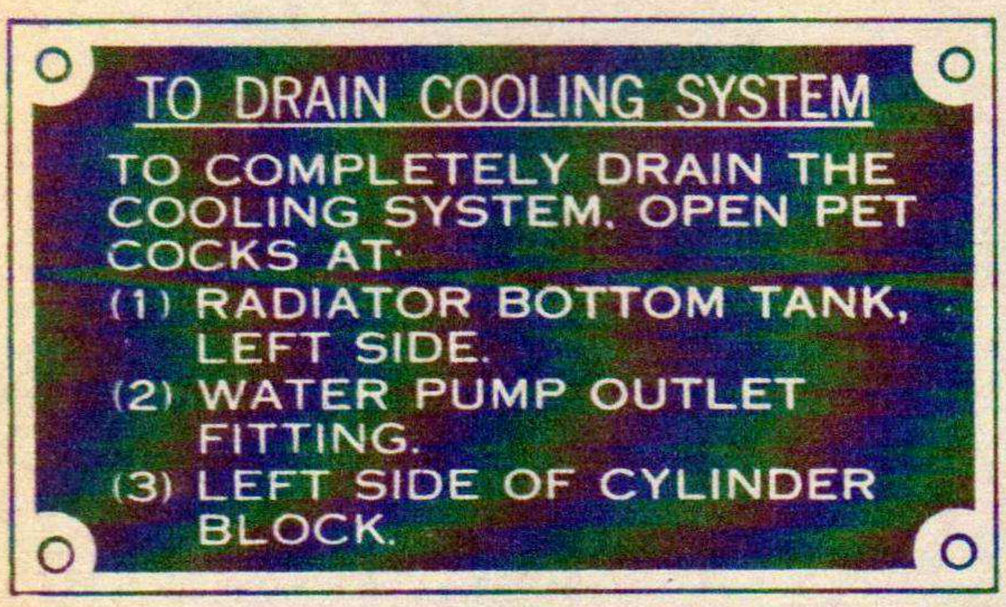
Located in middle of cowl inside cab

Note: Wrecker P.T.O. shift shown at left side of plate only applies to Model 969B and does not appear on shift plates on other models.



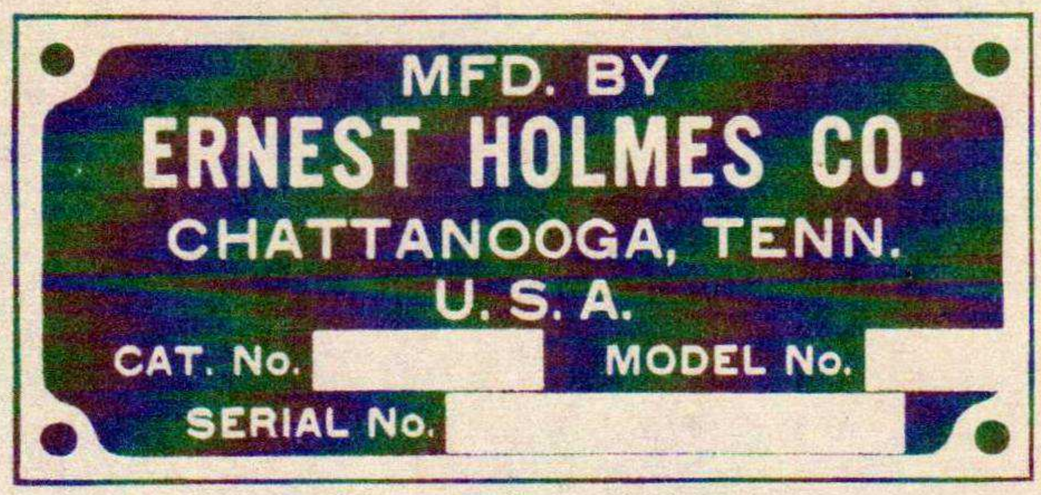
CAUTION PLATES

Located over the windshield inside cab.



COOLING SYSTEM PLATE

Located over windshield inside cab



WRECKER SERIAL PLATE

(Model 969B only)

Located on right side of wrecker frame just back of cab.

POWER TAKE-OFF SERIAL PLATE

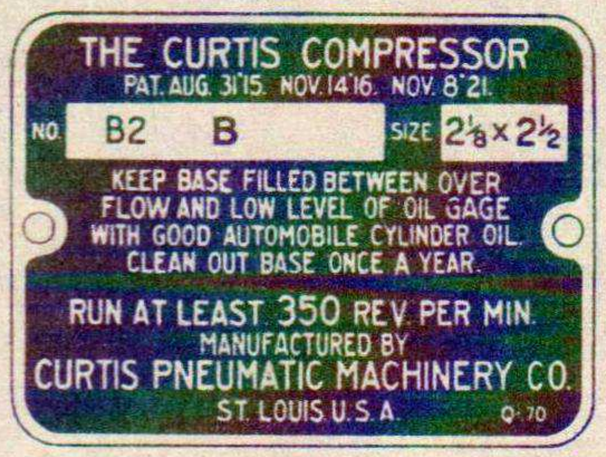
Located on power take-off shifting cover.

WINCH PLATE

Located on top of gear box on winch.

WINCH CAUTION PLATE

Located in middle of cowl inside cab.

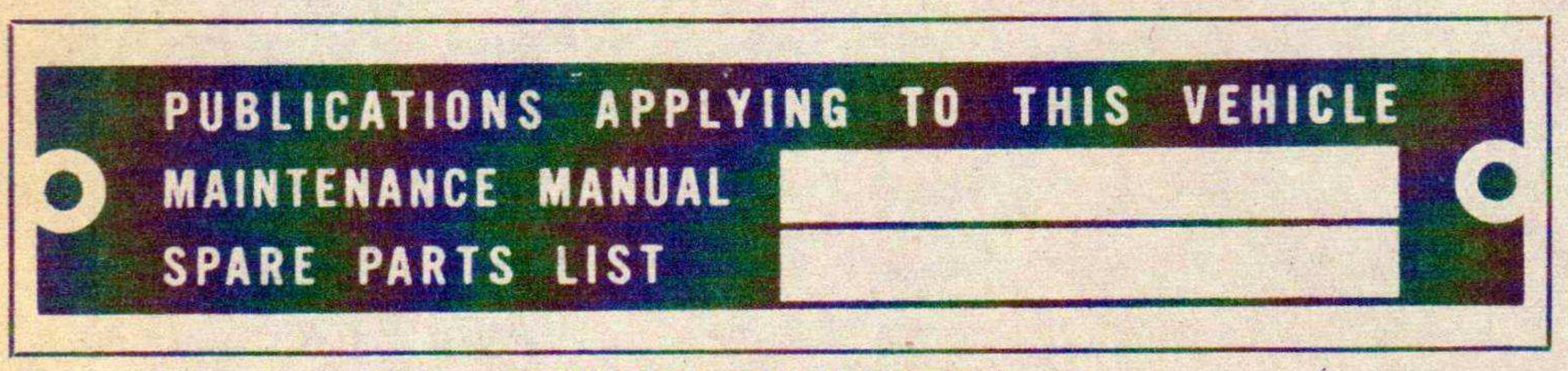


WRECKER AIR COMPRESSOR PLATE

Located on compressor block

AIR COMPRESSOR ENGINE PLATE

Located on Engine Blower Housing



PUBLICATION PLATE

Located on left side of cowl under hood.

MAIN UNIT SERIAL NUMBERS AND TYPE DESIGNATIONS

Frame — Serial number stamped on right side rail over the front spring rear hanger.

Front Axle — The front axle serial number is stamped on the top of the housing banjo and that of the front axle carrier is on a boss beside the filler plug.

Rear Axles — The forward rear axle serial number is stamped on the rear face of the banjo, close to the deck, while that of the rear axle is located just above the filler plug. The serial numbers for both rear axle carriers are located on a boss at the top of the housing.

Transfer Case — The transfer case serial number is stamped on a boss on the case, next to the filler plug.

Transmission — The transmission serial number is located either on the rear face of the case, to the left and just below the main shaft, or in some cases, to the left of the countershaft bearing cap.

Electrical Accessories — Generator, starting motor, distributor, starter switch and solenoid switch have plates designating model and manufacturing data. Generators also carry serial number on plate.

Steering Gear — Identification number is stamped on top of gear housing.

Battery — Type designation is stamped on cell connecting bar.

Air Compressor — Plate shows model and manufacturing data.

Governor — Plate shows serial number.

GENERAL DRIVING INSTRUCTIONS

Good driving is perhaps the most important requisite for long and satisfactory service of any automotive vehicle. A real driver is more than a machine with one hand on the transmission lever and the other on the steering wheel. He must be able to think and feel his truck. He must recognize any unnatural condition such as vibrations, scrapings, knocks, clicks, sluggishness, etc.

The following instruments, described later in this section, are provided to assist the driver in noticing unusual conditions and to give warning before trouble develops.

Fuel Gauge	Speedometer	Front Battery Ammeter
Ammeter	Tachometer	Air Pressure Buzzer
Viscometer	Temperature Gauge	Air Pressure Gauge
	Oil Pressure Gauge	

PRELIMINARY —

Before starting engine, check as follows:

1. See that there is sufficient oil in the crankcase and fuel in the fuel tank to cover the day's requirements. Watch for leaks in the fuel and oil lines.
2. The radiator must have sufficient water and the fan belt must be properly adjusted.
3. The tires must be properly inflated—65 lbs. pressure.
4. Check lights, horn and air brake equipment.

STARTING ENGINE —

1. Place transmission lever (33) in neutral position.
2. Set hand brake lever (35).
3. If the engine is cold, crack hand throttle (22) about 1/5 open, and pull choke button (24) until it is half open. These steps may not be necessary when the engine is warm. If it is very cold, it may be necessary to choke the engine more.
4. Insert ignition key into ignition switch (25) and turn to "on" position.
5. Push clutch pedal (32) to floor and hold there until engine starts.
6. Press starter button to start engine. If the engine doesn't start, do not ruin battery with prolonged starter operation.
7. Adjust the throttle and choke controls for even idling and release clutch pedal.

STARTING TRUCK —

It is important that the air pressure gauge reads at least 70 pounds before starting the vehicle.

1. Push clutch pedal (32) downward to disengage clutch.
2. The transfer case shifting lever (37) should be shifted into either high or low position. (When loaded or starting up-grade start in low range.)
3. Shift the transmission lever (33) into first speed. (See shifting diagram.)
4. Release hand brake lever (35).
5. Push down on accelerator pedal (29) to speed up the engine; gradually release the clutch pedal; feed sufficient gasoline to insure a smooth even start.

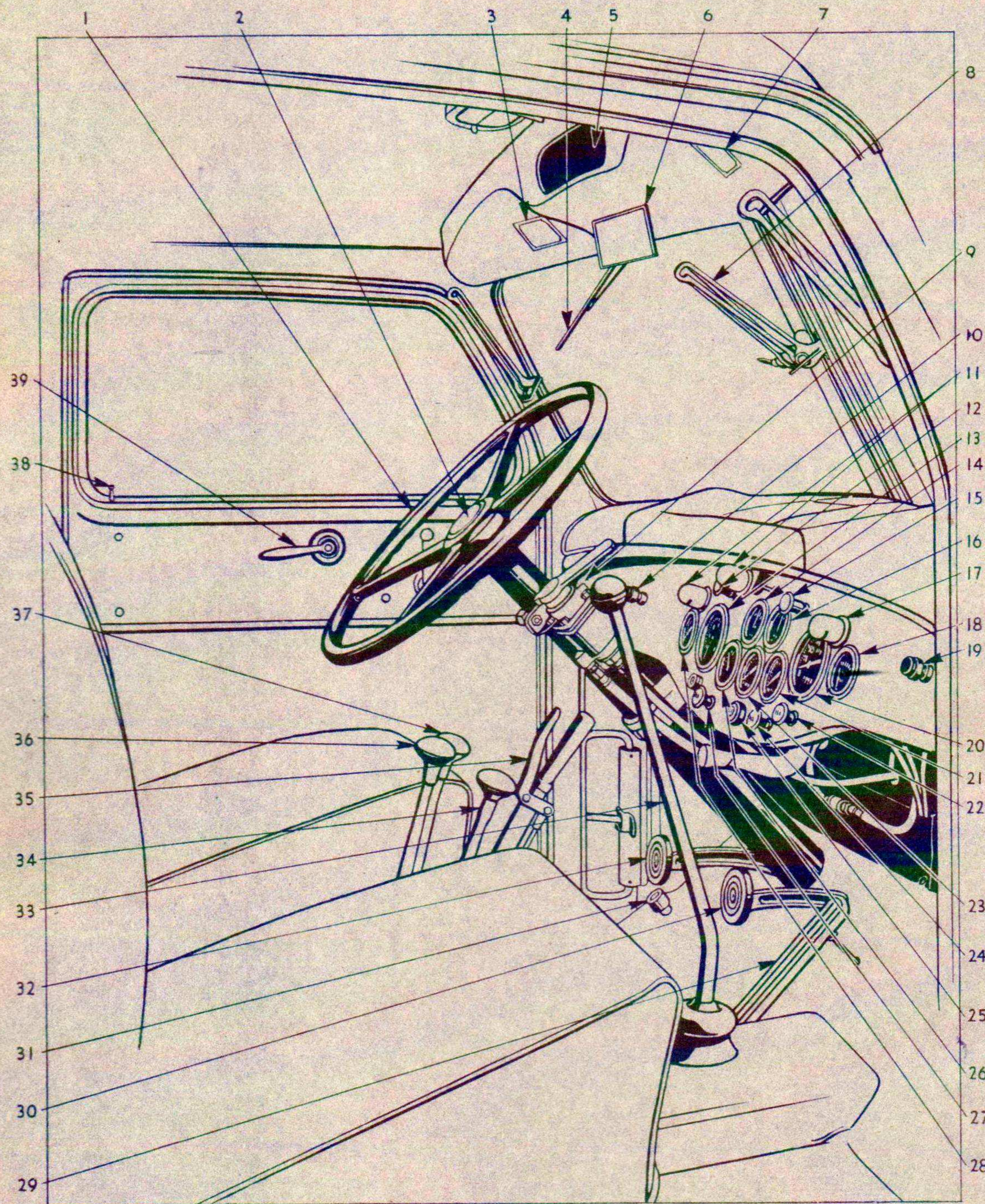
GEAR SHIFT — TRANSMISSION —

After the vehicle is started, to increase speed it is necessary to shift through the transmission to the high position. (See the shifting diagram).

As the truck increases speed, release the accelerator pedal, disengage the clutch and move the transmission lever into neutral and then into the second speed position. Then release the clutch pedal smoothly and at the same time accelerate the engine.

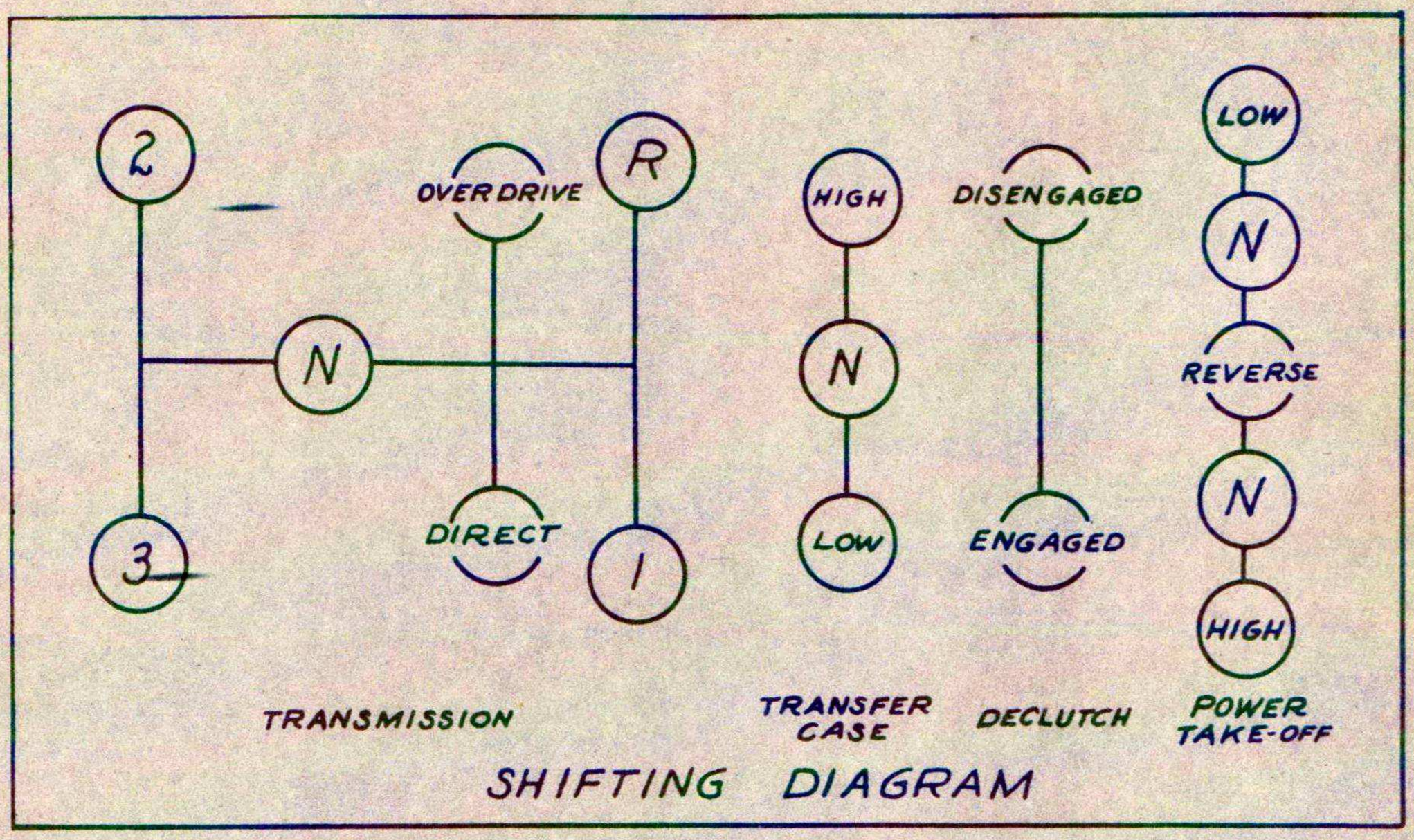
Repeat this for each step in the transmission until it is in driving gear. Shifting should be accomplished with a smooth, positive, and yet unhurried, movement of the transmission lever.

CAB EQUIPMENT



1. Steering Wheel
2. Horn Button
3. Warning Plate
4. Windshield Wiper
5. Glove Compartment
6. Rear View Mirror
7. Caution Plate
8. Windshield Sector Arm
9. Hand Air Valve
10. Windshield Wiper Control
11. Instrument Lights
12. Main Light Switch
13. Tachometer
14. Ammeter
15. Panel Light Switch
16. Front Battery Ammeter
17. Instrument Light
18. Viscometer
19. Windshield Wiper Control
20. Speedometer
21. Temperature Gauge
22. Hand Throttle Button
23. Oil Pressure Gauge
24. Choke Button
25. Ignition Switch
26. Fuel Gauge
27. Spark Control Button
28. Air Pressure Gauge
29. Accelerator Pedal
30. Brake Pedal
31. Dimmer Switch
32. Clutch Pedal
33. Transmission Lever
34. Power Take-off Shift Lever
35. Hand Brake Lever
36. Declutching Lever
37. Transfer Case Shift Lever
38. Night Latch Button
39. Remote Control Handle

GEAR SHIFT — TRANSMISSION — (Continued)



The tachometer is a valuable aid to intelligent gear ratio selections in the transmission. Best performance will be obtained with the engine operating between 1800 R.P.M. and 2300 R.P.M. If conditions are such that the vehicle cannot maintain its speed in the gear ratio being used, shift down in the transmission to keep the engine operating between the recommended limits. When shifting up in the transmission, do not select a higher ratio until after the engine speed reaches 1800 R.P.M.

When it is necessary to reverse the truck, follow the proceedure outlined for starting the truck but shift into reverse position in the transmission.

It is very important that every shift made is complete and the gears fully in mesh. Incomplete shifting leads to uneven gear tooth wear and expensive repair. With a little experience the driver will feel the poppets engage when gears are completely in mesh.

It is good driving practice to drop a step in the transmission before the vehicle loses too much speed and the engine starts to labor. It is easiest to double-clutch when shifting into a lower gear as follows:

1. Disengage clutch and release accelerator pedal.
2. Move transmission lever into neutral position.
3. Release clutch pedal and accelerate engine to synchronize it with vehicle speed.
4. Disengage the clutch once again and shift into lower gear.
5. Engage clutch smoothly while accelerating the engine.

Important—Never force transmission lever into position or shift into lower gears at high engine speeds. When going down hill, it is recommended that the same gear ratio in the transmission be used as would be required in climbing that hill.

GEAR SHIFT — TRANSFER CASE —

It is good practice to operate the vehicle in high range over hard surfaced terrain when there is easy rolling. When there are extreme grades, or when the conditions are so difficult as to require high traction, the low range should be utilized, especially when heavily loaded, to help the engine to "hold on" in the main transmission.

The shift from high to low speed should never be attempted unless the vehicle is standing still or being operated at low speeds.

1. Disengage the clutch and move the shifting lever to a neutral position.
2. Release clutch and accelerate engine.
3. Disengage the clutch again and move the shift lever into the low position.
4. Release clutch and accelerate engine to synchronize with vehicle speed.

Important—Shift smoothly, never forcing the shifting lever as a sudden shock of gear engagement is likely to damage the transmitting parts.

The shift from low to high may be accomplished at any speed, whether the vehicle is in motion or standing still. Follow the same procedure outlined above except shift into high in the third step.

FRONT AXLE ENGAGEMENT —

The front axle may be engaged or disengaged at any speed. It will be found easier to operate the declutching lever (36) with the vehicle in motion. It is not necessary to use the clutch when engaging or disengaging the front axle.

It is not possible to drive in the low range with the front axle declutched because of stops on the transfer case and declutcher control levers. When in the high range, it is possible to engage or disengage the front axle at will. This is advantageous under easy rolling conditions where the front drive is not required.

HOW TO STOP THE TRUCK —

This vehicle is equipped with air brakes providing exceptionally great braking capacity. A person inexperienced with this type of brakes must exercise caution until quite familiar with them, for his own as well as his passengers' comfort and safety.

1. Release accelerator pedal and depress the brake pedal (30) gradually to apply the brakes smoothly.
2. When the truck's speed is down to from ten to fifteen miles per hour disengage the clutch and shift the transmission into neutral.
3. When the vehicle is completely stopped, release clutch pedal, set hand brake and release brake pedal.

When another unit is trailed behind this vehicle, the air lines are arranged so that when the foot pedal is depressed the brakes are applied on both the truck and the trailed unit. However, the hand brake valve will operate only the trailer brakes.

WINCH OPERATION —

The power take-off is used to obtain motive power for winch operation. The power take-off unit has a high and a low speed forward, one reverse speed and two neutral positions, as illustrated on the shifting diagram above the dash. An automatic brake is provided on the worm shaft to sustain the load while the take-off is being shifted.

Important—Follow instructions on the winch caution plate in cab.

Hooking On—Disengage the sliding clutch on the winch and pull the cable from the drum the necessary length. If the winch line is under a strain, shift the take-off into reverse.

Pulling — It is first necessary to engage the sliding clutch, seeing to it that the shift handle poppets are locked. Then depress the clutch pedal and shift the power take-off lever (34) into the low position. (When the load is light it is possible to use the high range). The clutch pedal is then released and the engine accelerated to pick up the load.

Important—Winch pulling speeds are based on an engine speed of 1000 R.P.M., which should not be exceeded in winch operation.

Stopping — To stop pulling, it is necessary to release the clutch pedal and shift the power take-off into neutral.

Reversing—To reverse the winch, it is necessary to disengage the clutch, slip the take-off lever into reverse and to release the clutch pedal. When reversing it is not necessary to accelerate the engine.

COLD WEATHER OPERATION —

Several additional precautions are necessary in cold weather. If the temperature is at any time below freezing (32° F.) an anti-freeze solution may be used in the cooling system to prevent freezing.

It is important to get the operating temperature of the engine up to normal (160° to 180°) as quickly as possible and to keep the temperature up to normal at all times using a radiator cover when necessary.

Avoid the use of the choke as much as possible. Too rich a mixture will increase the amount of unburned fuel that will wash the oil from the cylinder walls and get down into the crankcase to dilute the oil. To help avoid this, allow several minutes for the engine to warm up after it is started and before the load is applied.

The use of a better grade of fuel in cold weather will help minimize crankcase dilution. Some fuels contain traces of sulphur which in presence of normal products of combustion will unite to form acids that will attack metal surfaces.

Change oil more frequently in cold weather. Frequent oil changing will help to rectify the more rapid dilution and increased condensation that may occur in cold weather.

Use an oil light enough in body to flow at a temperature 10° lower than the lowest expected. Observation of the above precautions will reduce the formation of "sludge" in the crankcase to clog the oil screen and oil passages.

CAB EQUIPMENT —

(Numbers refer to illustration on page 0-6.)

Windshield Sector Arms— (8) After loosening the thumb screws, the windshields may be opened outward and upward in an arc hinging at the top. They may be held in any desired position by tightening the screws against the sector arms.

Windshield Wipers — (4) — Dual windshield wipers are provided, each wiper being controlled independently. The wipers are operated by air pressure and swing in a wide arc for clear vision. Control valves are mounted on either end of the dash (10 and 19). Wiper speed is controlled by turning these knobs.

Glove Compartment — (5) — This compartment is located above the "V" in the windshield and provides a convenient space for small articles.

Front Battery Ammeter — (16)—An indicating ammeter (without graduations) is mounted on the left side of the dash. It indicates when the front battery (which does not register on the ammeter in the charging circuit) is not being charged.

Tachometer — Dash (13) — A tachometer, or engine revolution counter, is provided to aid the driver in maintaining definite engine speeds and in intelligently changing gear ratios in the transmission and transfer case.

The tachometer has a set hand with a lock, making it possible to enforce safe engine speeds, either in driving or winch operation, by recording the maximum engine speed reached after setting.

CAB EQUIPMENT—(Continued)

Spark Control— (27) — A manual control, mounted on the dash to the left of the ignition switch, is provided to advance and retard the spark as driving conditions warrant. The spark should be retarded with the engine lugging to eliminate spark knock.

Ammeter — (14) — A conventional type ammeter is located near the center of the dash. It is useful in checking operation of generator and regulator.

Fuel Gauge — (26) — An electric type fuel gauge is mounted above and to the left of the ignition switch.

Oil Pressure Gauge — (23) — An oil pressure gauge is located at the center of the dash and is an indicator of the efficiency of the engine lubrication.

Temperature Gauge — (21) — This gauge is located above and to the right of the ignition switch. It registers the operating temperature of the engine which should be 160° to 180° for good performance.

Speedometer — Dash (20)—A conventional mileage recording speedometer is used with a speed range of 60 miles per hour.

Choke Button— (24) — A choke control button is mounted on the dash, to the right of the ignition switch. The choke is used to assist in starting the engine, especially when cold. Choking the engine results in an overly-rich mixture which washes lubricant from the cylinder walls and dilutes the crankcase oil. For this reason the choke should be used only when necessary.

Air Pressure Gauge— (28) — This gauge registers the air pressure (in pounds per square inch) available for brake application. This gauge provides a convenient method of checking the operation of the compressor and is as much a warning signal as the buzzer.

Important — Do not start the vehicle with less than 70 lbs. air pressure. If the gauge should read below 50 lbs. pressure with the vehicle in motion, stop at once and ascertain cause of low air pressure.

Viscometer — (18) — This gauge indicates the condition of the crankcase lubricant. When the viscosity is not normal it is an indication of an improper grade of oil, a sludge condition, or dangerous crankcase dilution.

Main Light Switch — (12) — This switch, located at the top of the dash, controls the complete lighting circuit. When the button is flush with the dash all of the lights are out. When pulled out against the latch stop, the blackout lights come into service. With the latch depressed and the button pulled to the second out position all the service lights come into operation. For day driving the stop lights only are in circuit with the button pulled to the full out position.

Ignition Switch — (25) — A conventional type ignition switch is located on the center of the dash. When the ignition key is inserted in the lock and turned to the right, the ignition circuit is closed.

Hand Throttle Control — (22)—The throttle button, mounted at the right of the choke, is used when starting or making adjustments on an engine. It should be kept in idling position (flush with dash) during all ordinary driving.

Dimmer Switch — (31) — The dimmer switch, located on the toe board to the left of the clutch, is operated with the left foot and controls the selection of the upper or lower headlamp beam. Pushing down on the switch changes from one selection to the other.

Clutch Pedal — Toe Board (32) — When the clutch pedal is pushed to the floorboard the engine is disengaged from the transmission, making it possible to shift gears. The clutch pedal should be released smoothly with the vehicle in gear. Do not ride with foot on pedal as it will cause excessive wear on the clutch facings.

Brake Pedal— Toe Board (30) — The brake pedal controls the air valve in the air braking system. The pedal should be depressed gradually to permit a smooth brake application.

Accelerator Pedal— Toe Board (29) — The accelerator pedal is operated with the right foot and controls the speed of the engine by controlling the amount of gasoline fed to it.

Transmission Lever — Floor Board (33) — This lever is used to select the various gear ratios provided in the transmission according to the shifting diagram already explained. The lever controls this selection (5 speeds forward and 1 reverse) through a set of shifting forks and rails.

Starter Switch — Floor Board — This switch is operated by pressing downward with the foot. It connects the two batteries in series to provide a 12-volt starting circuit, and should be released as soon as the engine starts.

Transfer Case Lever — Floor Board (37) — This lever is used to select either high or low range in the transfer case, according to the position shown on the shifting plate. It is necessary to engage the front axle before shifting into the low range.

Declutching Lever — Floor Board (36) — This lever is used to engage and disengage the declutching unit to the front axle. This lever may be shifted without the use of the clutch pedal.

Hand Brake — Floor Board (35) — The hand brake is controlled by a lever mounted inside the cab. The brake itself is the large disc type (14″ diameter) with double shoe application to insure a safe, powerful emergency unit.

Power Take-off Lever — Floor Board (34) — The power take-off lever is used to engage the take-off gears with the transmission for winch operation. As illustrated on the shifting plate, the power take-off has a high and a low range, a reverse and two neutral positions.

Hand Air Valve — (9) — This valve is mounted on the steering post and is used to control the brakes on the trailed unit.

LUBRICATION

The primary function of a lubricant is to reduce friction, that is, to provide a fluid film between moving parts to prevent wear by abrasion. The lubricant must also prevent damage to parts by overheating, and in some cases the oil is circulated to carry heat and dirt away from the moving parts.

Proper lubrication is of vital importance in obtaining the maximum of satisfactory service with any vehicle. For this reason, it is urged that the operator pay particular attention to this section. The most important part of lubrication maintenance is to arrange for regular periodical inspection and lubrication periods that conform with the requirements imposed by the service to which the vehicle is subjected.

AT THE END OF FIRST 500 MILES — Lubricants used at the factory are of a type to assist during the break-in period, and are not necessarily of the recommended type for continuous operation. Therefore, it is desirable that the vehicle be completely relubricated at the end of the first 500 miles. It is best to drain the oils immediately after the vehicle has ceased operation as the heat of the oil makes possible a more thorough draining.

LUBRICATION MAINTENANCE

Air Cleaner — The oil pan, or sump, of the air cleaner must be kept supplied with engine oil at all times. Renew this oil whenever the engine lubricant is changed, or under dusty conditions of operation, more frequently, as experience may determine.

The sump is easily removed by loosening two thumb screws and twisting it off. Fill with the same grade oil as used in the crankcase, up to the oil level mark.

Clean the filter mesh in the upper portion of the air cleaner as often as is necessary, according to instructions given in the air cleaner section.

Air Compressor — Automatically lubricated from the engine.

Axles —

Differentials — Oil is added through a filler plug in the side of the banjo housing and is drained through a plug in the bottom. The lubricant level should be checked every 1000 miles and oil added as required.

It is recommended that the differential lubricant be renewed every 5000 or 10,000 miles, depending on the severity of service. Use an S.A.E. 140 gear oil in the summer and an S.A.E. 90 in the winter.

Chemical changes in the lubricant and metallic particles, resulting from wear, make it desirable that the differentials be flushed from time to time. It is suggested that this be routine practice semi-annually, when making seasonal changes. Use a light flushing oil.

The drive gear chamber breather must be clear at all times. It is advisable to remove the breather fittings every 1000 miles and to soak them in gasoline and to blow them out with compressed air. More frequent cleaning may be necessary under difficult operating conditions.

Front Axle Universal Joints — For lubricating these universal joints use only a non-fibrous grease as follows:

Above 32° F.	32° F. to Zero	Sub-Zero
No. 2	No. 1	No. 0

Lubricate through the rifle drill in the shaft to insure proper distribution of the lubricant.

Chassis — Lubricate the chassis every 1000 miles with a good grade of grease as specified in the tables in this section. Refer to the chart for the locations of the chassis fittings.

Electrical —

Battery — Keep the battery terminals covered with a thin coat of vaseline or petroleum jelly to prevent corrosion.

Distributor — The distributor shaft is lubricated through an oiler on the outside of the distributor base. Add a few drops of medium engine oil every 2000 miles.

Working parts in the distributor also require attention, care being taken to not over-oil as this tends to produce sluggish operation of the instrument. The breaker cam should be given a light wipe of grease about twice a year. At this time also, place one drop only of light oil on the breaker arm pivot pin. Also add a few drops of light oil through the hole in the top of the breaker cam.

Generator — The armature is mounted on ball bearings at both ends. The bearings are packed half full of a good quality heat resisting grease at assembly. A few drops of medium engine oil should be added, through the oilers located over the bearings, about every 5000 miles.

Starter — The three starter bearings are of an absorbent bronze bearing type. The intermediate and drive end bearings receive oil through the flywheel housing and require no external lubrication. The commutator end bearing has an oil hole in the commutator end cap and should be given 3 to 5 drops of medium engine oil every 5000 miles. When disassembling the starter, wash out the bearings and soak them in oil before assembly.

Engine —

Oil Level — The oil level in the crankcase is determined by a bayonet or dip stick type of gauge. Wipe off gauge and reinsert to determine the oil level accurately. The oil level should be maintained at or near the 4/4 mark on the stick.

Oil Changing — Drain the crankcase and refill with fresh oil frequently. (Crankcase capacity—16 quarts). Oil should be changed more frequently when an engine is new than after it is well run in. This is because "wearing in" of various parts of a new motor will produce minute metal particles in the oil. Frequent changing will help the filter keep the oil clean.

The oil should be changed more frequently in cold weather or where the engine is frequently started when cold, as choking and cold running will tend to dilute the oil with unburned fuel and water. Water vapor is a normal product of combustion and this vapor will condense to form drops of water when it comes in contact with cold surfaces. Traces of water in the crankcase will therefore result from cold running and frequent oil changing will help to remove this water.

When changing oil, it is not advisable to flush out the crankcase with kerosene as it is impossible to drain all the kerosene out of pockets and passages and the kerosene that remains will dilute the fresh oil. Oil should be drained when the engine is hot, as after a day's run, as the oil will then be agitated and will run more freely and carry off more sediment.

The oil pan screen should be removed frequently and washed carefully and while this is removed, any sludge or sediment can be wiped off the bottom of the oil pan by reaching up through the oil screen opening.

Selection of Lubricant — The slight difference in cost for the best oils obtainable will be money well invested as this cost would be multiplied many times if repairs become necessary due to using cheap oil. Some oils contain traces of acids which are harmful and should be avoided. Some oils contain traces of sulphur which in itself is not harmful but which in the presence of certain products of combustion will form acids which will attack the metal surfaces.

A lighter weight of oil should be used in a new engine during the breaking in period of 2000 miles or fifty hours operation than can be used after the engine has been operated for some time. For breaking in a new engine, use S.A.E. 30 oil for normal summer conditions or S.A.E. 20 if cold weather conditions prevail. See Lubricant Specifications.

For cold weather or climate use an oil having a pour point at least ten degrees F. below the lowest temperature to be encountered. For example, if a temperature of zero° F. is to be expected the oil should flow or pour at 10° F. below zero. Such an oil as S.A.E. 20W will be suitable for such conditions.

Oil Filters — The oil filters should be serviced each time the crankcase oil is changed. Drain the sludge and foreign substances from the filters by removing the hexagon headed plugs at the base of the filter housings. Remove the top covers and lift out the cans (Filter Elements). Clean the cans of any sludge or dirt.

After cleaning the filters and refilling the crankcase with fresh oil, run the engine long enough to fill the filters with oil and then recheck the oil level. Add oil as required.

When the filters are no longer capable of keeping the oil clean, the elements should be replaced. Do this immediately after first noticing that oil is becoming dirty.

Fan Hub — The fan hub is lubricated through a Zerk fitting. It should be greased about every 1000 miles, that is, with each chassis lubrication. A good quality medium fibre grease should be used. The hub's capacity is about 2½ ounces.

Power Take-Off — The power take-off is mounted on the side of the transmission and is open to it so that it will be lubricated with the transmission. For this reason the transmission lubrication instructions apply to this unit. When draining the transmission, remove the lower cap screw in the rear bearing cap of the power take-off to be sure that all the oil is drained from the take-off case.

The winch drive shaft universal joints and slip joint, being similar to others used on this vehicle, are lubricated in a similar manner. (See Lubrication of Universal Joints.)

Shock Absorbers — The shock absorber fluid level should be checked monthly. Replenish only with genuine Houdaille fluid.

Springs — The front spring shackles are mounted in rubber bushings and require no lubrication. Do not grease or oil the springs as they are designed to use the friction between the leaves.

The rear axle rocker beam must be lubricated every 500 miles without fail as the wear limit for the bushings is only .025". Use a good quality engine oil; S.A.E. 60 in the summer and S.A.E. 20 in the winter.

Steering Gear — The steering gear housing should be kept full of lubricant. Lubricate through the pipe plug hole or fitting, in the top of the housing. Fill the housing slowly to allow air to escape through the vent hole in the lower end of the jacket tube. When the lubricant runs out of the vent hole the housing is full.

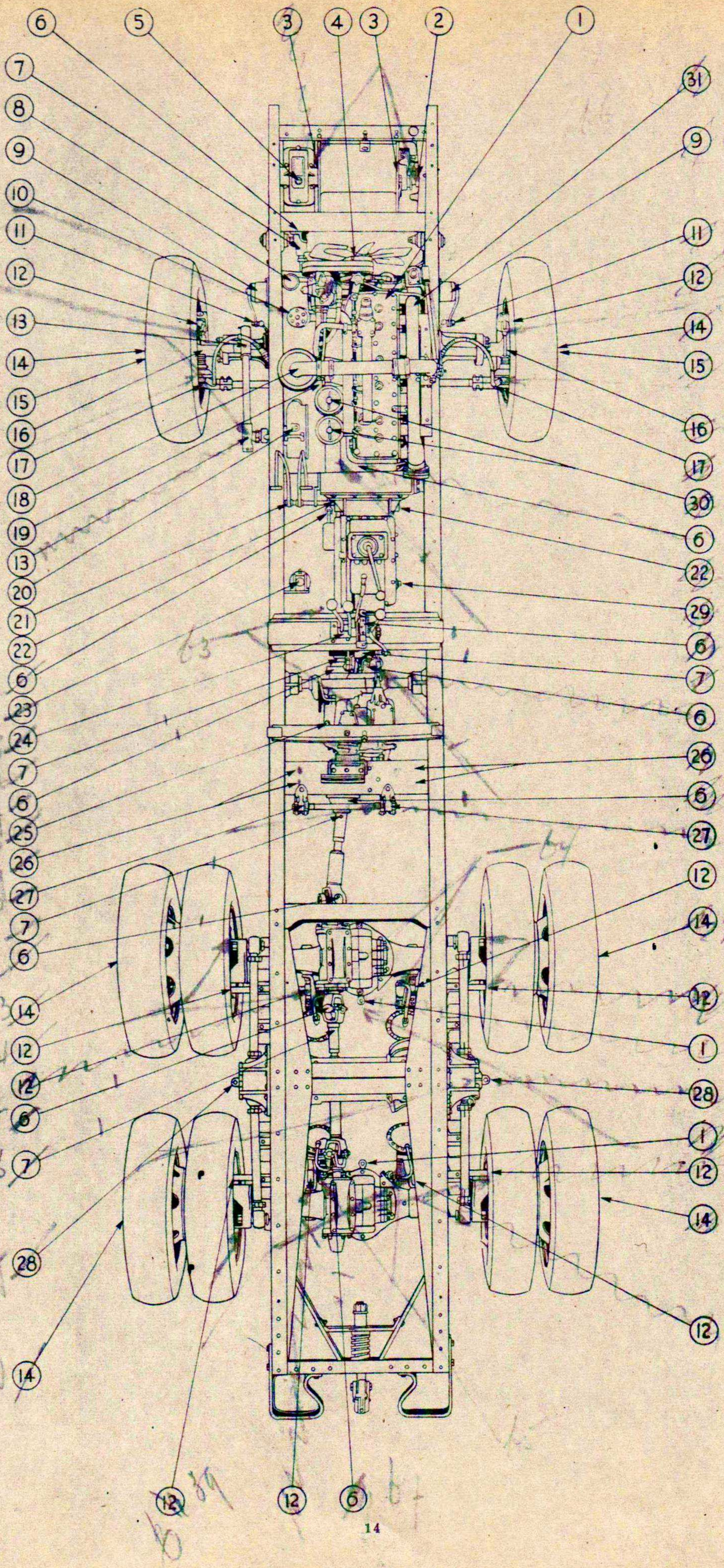
Important — Do not use ordinary grease. Lubricant should be a gear oil; S.A.E. 140 in winter and S.A.E. 250 in summer. Add lubricant every 5000 miles, or oftener under extreme conditions. Drain the steering gear housing and renew the lubricant seasonally.

Tachometer Adapter — The tachometer adapter is lubricated from a grease cup in the distributor base. Keep cup full of a medium fibre grease. Give cup a slight twist when checking crank case oil level.

Transfer Case — Lubrication is positively carried to all internal parts of this unit by the splashing action of the gears, provided that the proper lubricant is used and that the required level is maintained. The case should be filled level with the filler hole.

A drain plug is provided for flushing this case.

(Continued on page 14)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LUBRICATION CHART

Ref. No.	Description	Type Fitting	No. of Fittings	Capacity Imp. Gal.	COMMERCIAL LUBRICANT (Manufacturer's Specification) Lubricant	Summer	Winter	Mileage	SERVICE LUBRICANT British W. D. for U. K. Specified	Alternative	D. N. D. Canada Summer	Winter
1.	Axles (Differential)	Plug	3	Ft. axle 1½ gals. Re. axles ¾ gal. ea.	Gear Oil	S.A.E. 140	S.A.E. 90	5000 to 10,000 ①④	Hypoid 90	C600	390	360
2.	Winch Clutch	Zerk	1		Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
3.	Winch Drum Spindle	Zerk	3	3 oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
4.	Fan Hub	Zerk	1	2½ oz.	Fibre Grease	No. 2	No. 2	1000	Grease G.S.	—	632	602
5.	Winch Gear Case	Plug	1	⅜ gal.	Gear Oil	S.A.E. 140	S.A.E. 90	5000②	Hypoid 90	C600	390	360
6.	Universal Joints	Zerk	10		Gear Oil	S.A.E. 140	S.A.E. 90	2500	Hypoid 90	C600	390	360
7.	Slip Joints	Zerk	5		Gear Oil	S.A.E. 140	S.A.E. 90	2500	Hypoid 90	C600.	390	360
8.	Engine Crankcase	Filler Cap	1	3⅓ gal.	Engine Oil	S.A.E. 30	S.A.E. 20	500	M-160	M-120	65	45
9.	Shock Absorber Body	Plug	2		Houdaille Fluid #1404			②	M-220	M-160	575	595
10.	Tachometer Adapter	Cup	1	½ oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
10.	Distributor Shaft	Oiler	1	2 drops	Engine Oil	S.A.E. 30	S.A.E. 20	1000	Engine Oil	—	Engine Oil	Engine Oil
10.	Breaker Cam				Petrolatum			5000	Vaseline	—	665	665
11.	Shock Absorber Link	Zerk	4	4 oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
12.	Brake Camshafts	Zerk	12	¾ lbs.	Water Pump Grease	Waterproof Lubricant		1000	Grease G.S.	—	604	604
13.	Drag Link	Zerk	2	2 oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
14.	Wheel Bearings (Front & rear)			3 lbs.	Hard Fibre Grease	No. 3	No. 3	5000 ②	Grease G.S.	—	632	602
15.	Front Axle Univ. Joint	Plug	2	2 lbs.	Fibre Grease	No. 2	No. 1	500	Grease G.S.	—	632	602
16.	King Pin	Zerk	2	2 oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
17.	Tie Rod	Zerk	2	2 oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
18.	Air Cleaner			⅓ gal.	Engine Oil	S.A.E. 50	S.A.E. 20	500 ③	M-220	M-160	140	51
19.	Water Pump	Cup	2	1 oz.	Water Pump Grease	Waterproof Lubricant		100	Grease G.S.	—	604	604
20.	Steering Gear Housing	Plug	1	⅝ gal.	Gear Oil	S.A.E. 140	S.A.E. 90	5000	Hypoid 90	C-600	390	360
21.	Pedal Support	Zerk	1	½ oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
22.	Clutch Release Shaft	Zerk	2	1 oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
23.	Brake Valve	Zerk	1	½ oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
24.	Operating Levers	Zerk	5	2 oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
25.	Transfer Case	Plug	1	⅝ gal.	Gear Oil	S.A.E. 140	S.A.E. 90	5000 ①	C-600	Hypoid 90	140	100
26.	Hand Brake Shoe Pins	Zerk	4	2 oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
27.	Hand Brake Cross Shaft	Zerk	2	1 oz.	Fibre Grease	No. 2	No. 1	1000	Grease G.S.	—	632	602
28.	Rear Axle Rocker Beam	Plug	2	⅛ gal.	Engine Oil	S.A.E. 60	S.A.E. 20	500	M-220	M-160	140	51
29.	Transmission	Plug	1	2½ gal.	Gear Oil	S.A.E. 140	S.A.E. 90	5000 ①	Hypoid 90	C-600	390	360
30.	Oil Filters							5000 to 10,000	Renew cartridge when oil becomes dirty			
31.	Generator	Oiler	2	5 drops	Engine Oil	S.A.E. 30	S.A.E. 20	5000	Engine Oil	—	Engine Oil	Engine Oil
	Accelerator Shaft	Oiler	2	2 drops	Engine Oil	S.A.E. 30	S.A.E. 20	1000	Engine Oil	—	Engine Oil	Engine Oil
	Throttle Rod	Oiler	2	2 drops	Engine Oil	S.A.E. 30	S.A.E. 20	1000	Engine Oil	—	Engine Oil	Engine Oil

NOTE: For lubrication of Wrecker and Wrecker Compressor Unit, Model 969A, see page O-45

① — Check level each 1000 miles.
② — Check level each 2500 miles.
③ — Change oil at each crankcase change.
④ — Clean breathers.

Transfer Case *(Continued from page 11)*
Inspect the breather on top of case, seeing that it is clear for the passage of air. Check the oil level every 1000 miles and add as required. Renew the transfer case lubricant every 5000 miles. Use a good quality non-foaming gear oil; S.A.E. 140 in summer and S.A.E. 90 in winter.

Transmission — A magnetic drain plug is fitted into the bottom of the transmission case. This plug will not completely drain the power take-off case so that it is also necessary to remove the lower cap screw from the rear bearing cap on the take-off case when draining the unit. Wipe magnetic plug clean of metal particles before replacing.

Chemical changes in the oil and metallic particles resulting from wear make it desirable that the case be drained at least once every 10,000 miles. This should be done after a run with the transmission thoroughly warm.

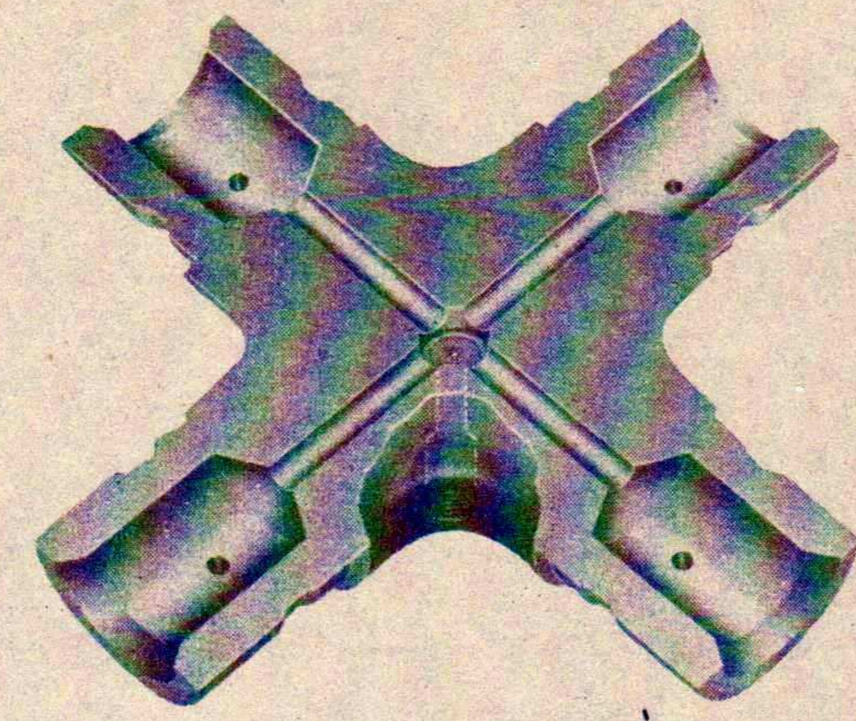
After draining, flushing is urgently recommended. Replace the drain plug and fill the transmission with a light flushing oil. Slip the transmission into reverse and the transfer case into neutral and run the engine at a moderate speed for about 10 minutes. This will wash out the old oil clinging to the interior surfaces. Be sure to thoroughly drain the case before filling with fresh lubricant.

To refill, first remove all dirt around the filler plug. Use non-foaming good quality gear oil; S.A.E. 140 in summer and S.A.E. 90 in winter. Do not overfill as the excess lubricant will serve no useful purpose and may cause trouble. Too high an oil level will cause excessive churning with consequent high oil temperatures. It may also leak past the front bearing into the clutch housing.

Oil level inspection should be made every 1000 miles and oil added when required.

Universal Joints — The illustration shows a cross section of a trunnion cross showing oil channels and chambers. A high pressure lubrication fitting hole leading into a central oil chamber feeds the lubricant to the four oil reservoirs of the needle bearings. These are well protected against oil leakage and ingress of foreign matter. A relief valve is assembled in the central chamber to prevent damage to the oil seals when extremely high pressure is used. This valve also serves as an indication when the reservoirs are full.

Never use grease or heavy oil on these needle bearings as it would tend to block the passages. The slip



joint is fitted with a high pressure fitting and should be lubricated every two or three thousand miles.

Water Pump — The water pump is lubricated by means of grease cups. There are two of these cups, one on each side of the pump housing. Give the cups a slight turn when checking crankcase oil level. Keep them filled with a good grade of water pump grease.

Wheel Bearings — The wheel bearings are adjustable for wear and should be checked every 2500 miles. When they are found in need of adjustment, remove the hub and repack the bearing. Use a good quality hard fibre cup grease. (No. 3 only).

In normal service it is recommended that the wheel bearing be repacked and adjusted every 5000 miles. Refer to the section on wheel bearings.

Winch — The worm gear case has a filler plug at the top, an oil level plug at the side and a drain plug at the bottom. The case should be filled to the oil level hole, using an S.A.E. 140 transmission oil in summer and an S.A.E. 90 in winter.

Alemite fittings are located on the drum, (each end), end frame, and on the universal joints of the shaft from the power take-off. A light grease or a heavy oil should be used in these places.

If the sliding jaw clutch should stick, clean this shaft with gasoline and re-oil it with a light oil. Control clevises, pins, slip joint shaft, etc. should be lubricated with a squirt can from time to time.

TABLE I (P. & C. FORM) REVISED 4/11/40

Automotive Greases:	General Lubricants, Fibre Type				Waterproof Lubricant
Grade	No. 3 (Hard)	No. 2 (Medium)	No. 1 (Soft)	No. 0 (Semi-Fluid)	Water Pump
Penetration, A.S.T.M. (Unworked)	190–250	280–360	350–450	—	60–100
Soap Content, % Total	13–18	6–14	4–8	1.5–4	25–32
Type of Soap	Soda (1)	Soda (1)	Soda (1)	Soda (1)	Calcium
Moisture, % (Max.)	1	1	1	1	2
Melting Point, °F., A.S.T.M. (Min.)	315				200
Corrosion, A.S.T.M.	Nil	Nil	Nil	Nil	Nil
Free Fatty Acid or Alkali, % Max.	0.4	0.4	0.4	0.4	0.4
Mineral Oil Viscosity at 100°F, S.U.S. (Min.)					100-300
Viscosity at 210°F, S.U.S. (Min.)	120	120	120	120	
Foreign Matter, % Max.		0.1	0.1	0.1	0.1

(1) Sodium or Sodium and Aluminum.

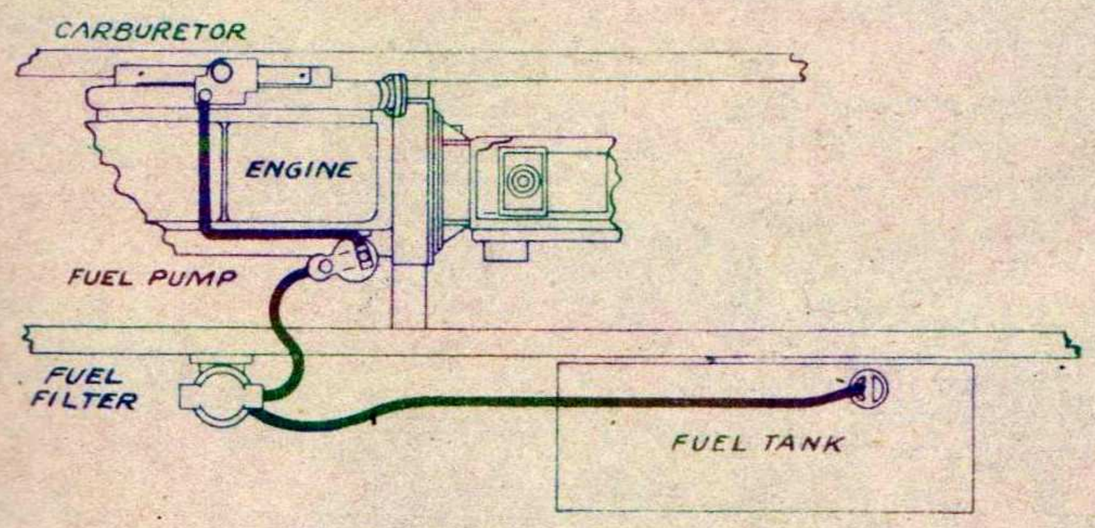
FUEL SYSTEM

The fuel system consists of the fuel tank, fuel lines, fuel filter, fuel pump, air cleaner, carburetor, governor, manifold, exhaust tube, muffler, tail pipe and the carburetor controls. The various units are incorporated into an efficient system to deliver a clean, metered, atomized fuel into the combustion chamber.

FUEL TANK AND LINES —

All fuel lines running between the tank, fuel filter, fuel pump and carburetor are copper or flexible tubing covered with loom. Flexible tubing is used between the fuel pump and frame to eliminate any danger of fuel line breakage due to vibration.

A 40 gallon fuel tank (vented at cap) is located on the outside of the left hand frame rail, just below the cab. The tank is strapped securely in place to prevent any movement which might damage it. The straps should be checked periodically and kept tight.



The fuel tank cap is held to the tank filler tube by a short chain so that it will not be lost or misplaced. This cap should be replaced immediately after filling the tank to keep the gasoline clean.

Gasoline Gauge — The gasoline gauge is of the electric type and requires very little attention. Do not attempt to repair the gauge or the tank unit.

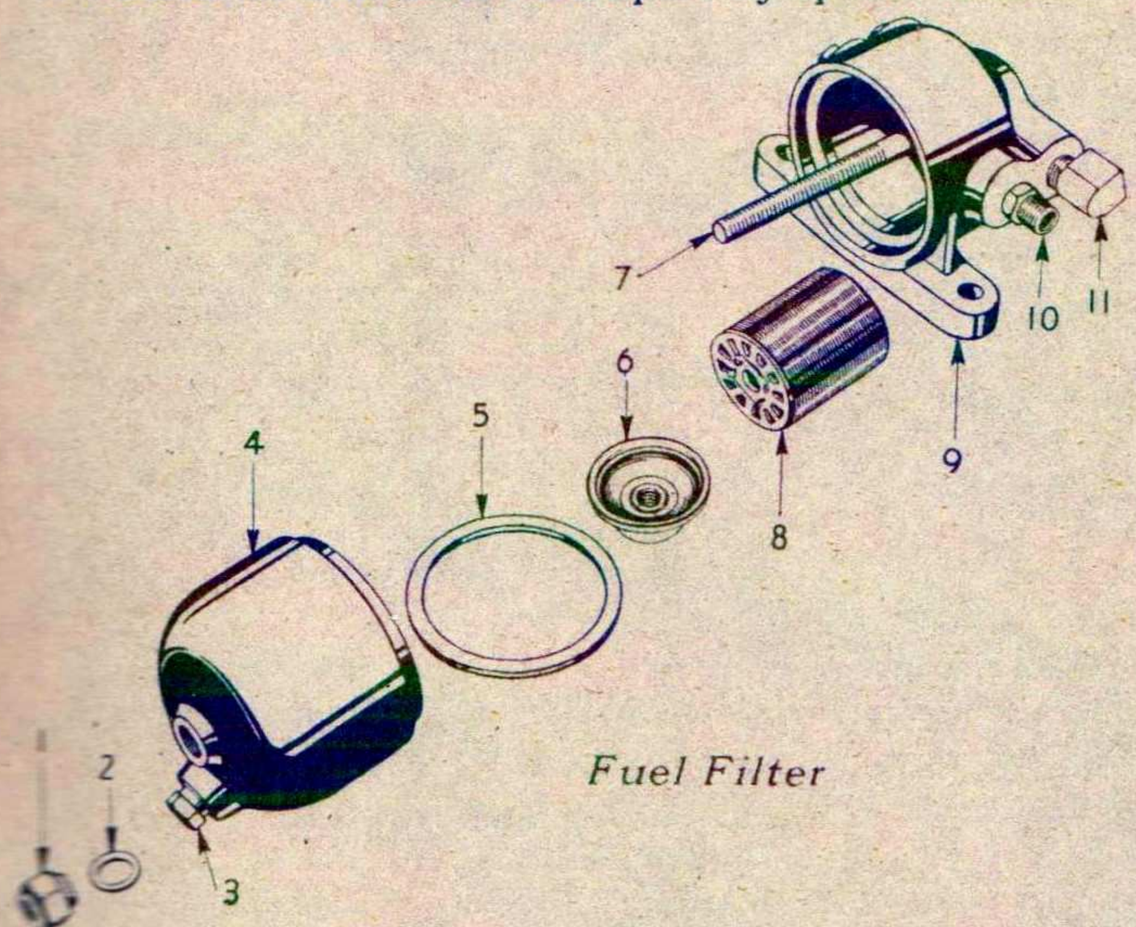
If the gauge does not register, check as follows:

1. Check all wires and connections.
   a. Turn on ignition switch and ground wire from switch to panel gauge. A spark indicates that the wire is in good condition.
   b. Check circuit breaker.
2. Ground tank unit terminal to tank. If the panel instrument is functioning, the gauge will read full. This indicates that the tank unit is defective.
3. If the indicator showed no deflection, the fault is a damaged panel gauge. (Be sure that the wire is in good condition.)

If defective parts are found, they must be replaced.

FUEL FILTER —

A fuel filter is mounted on the outside of the left hand frame rail between the fuel tank and pump. It consists of a filter element encased in a cast iron bowl. The element is the laminated type, made up of a series of thin discs held apart by spacer shims.



Fuel Filter

1 Bowl nut
2 Bowl Nut gasket
3 Drain plug
4 Filter bowl
5 Bowl gasket
6 Element Nut
7 Assembly stud
8 Filter element
9 Filter head
10 Inlet fitting
11 Outlet fitting

The filter bowl should be drained frequently to remove water and foreign matter that has collected and should be periodically cleaned as follows.

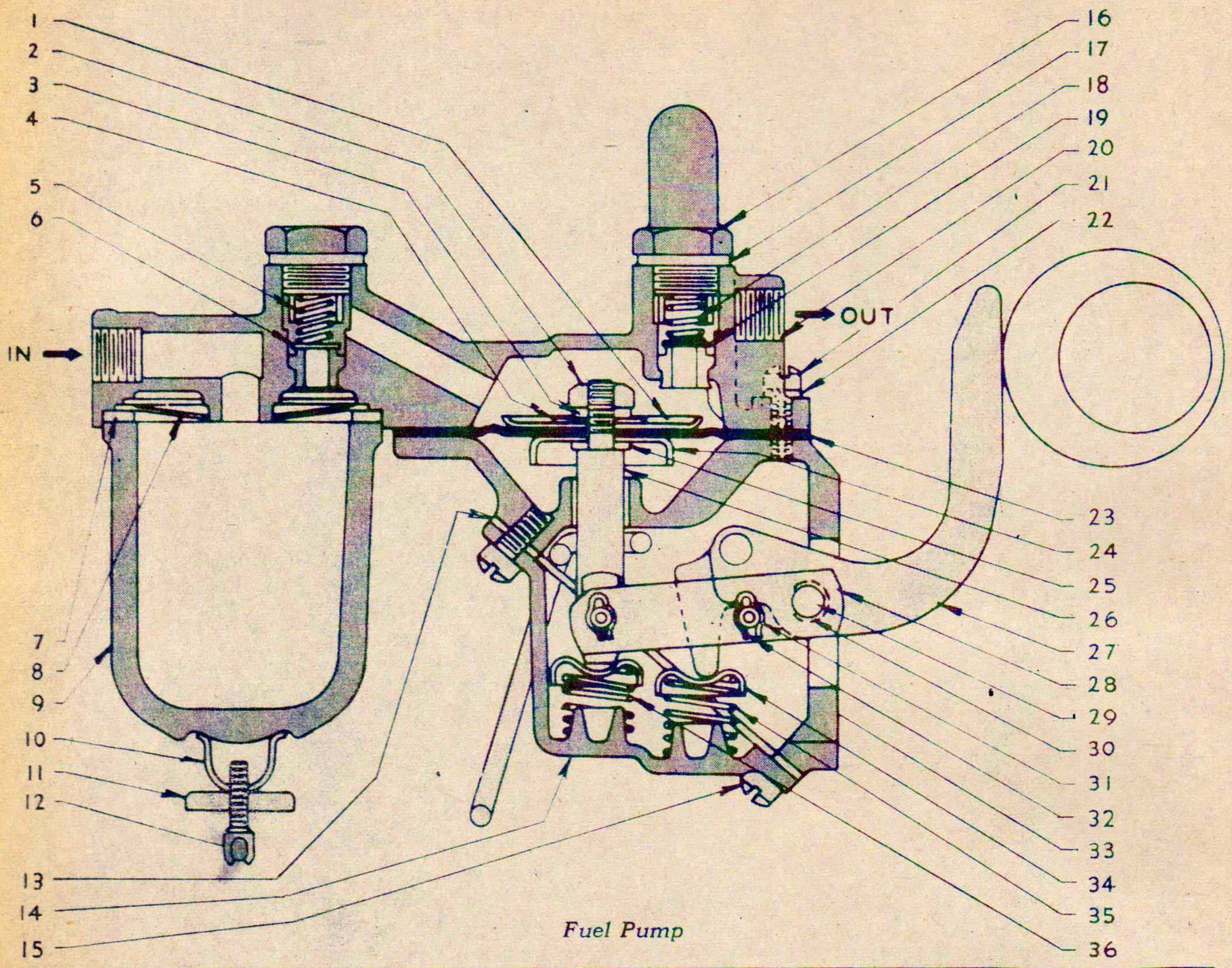
1. Remove bowl nut (1) and bowl (4).
2. Remove element nut (6) and element (8) from the assy. stud (7).
3. After the element washers have been slightly separated, the element and bowl are washed in gasoline or suitable solvent. If the accumulation is gummy, a brush will help to loosen it.

Caution — Use no tools to put element in place as finger tightness is sufficient.

FUEL PUMP —

A diaphragm type fuel pump, located on the left side of the crankcase is mechanically operated from a camshaft eccentric through a plunger pin working in a drilling in the crankcase. The pump is equipped with a hand operated priming lever, to be used to pump an initial supply of gasoline in the event that the carburetor bowl has been emptied.

The diaphragm (which is made of a specially treated material) is held between two metal discs and is actuated by the pump spring and the rocker arm linkage working from the camshaft. In its downward movement, the diaphragm causes a vacuum in the pump chamber which draws fuel from the tank into the fuel pump bowl. The pump spring then



Fuel Pump

1. Diaphragm Protector — Upper.
2. Diaphragm Nut.
3. Lockwasher.
4. Diaphragm Alignment Washer.
5. Inlet Spring.
6. Inlet Valve.
7. Gasket.
8. Screen.
9. Bowl.
10. Bowl Seat.
11. Bowl Seat Nut.
12. Bail and Screw Assembly.
13. Gasket.
14. Lower Cover.
15. Lower Cover Screw.
16. Valve Chamber Plug.
17. Gasket.
18. Outlet Spring.
19. Outlet Valve.
20. Cover and Valve Seat Assembly.
21. Cover Screw.
22. Lock Washer.
23. Diaphragm.
24. Diaphragm Protector — Lower.
25. Pull Rod Gasket.
26. Pull Rod.
27. Rocker Arm.
28. Link.
29. Rocker Arm Pin.
30. Retaining Ring.
31. Link Pin.
32. Link Pin Clip.
33. Body.
34. Spring Cap.
35. Rocker Arm Return Spring.
36. Diaphragm Spring.

forces the diaphragm up and the fuel through to the carburetor. When the carburetor is full, the needle valve builds up a pressure in the pump chamber, holding the pump spring down until more fuel is needed.

The diaphragm is actuated by linkage in order that the pump lever through the plunger pin may be in constant contact with the eccentric to insure quiet operation. Movement of the diaphragm is directly proportional to the amount of fuel used by the engine.

A glass bowl is clamped on the underside of the pump, away from the actuating mechanism. This acts as a sediment trap to prevent foreign matter entering the pump and to collect water from the fuel.

SERVICE INSTRUCTIONS —

Fuel pump repairs are divided into two classifications:

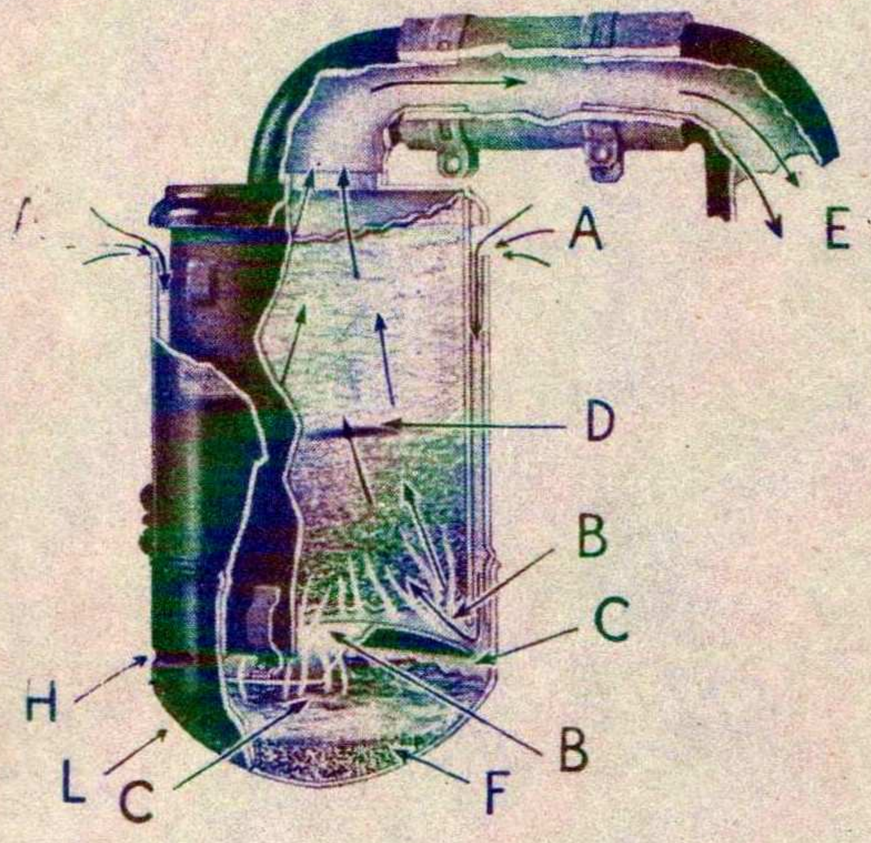
1. Repairs made without disturbing pump installation.
2. Repairs which necessitate removal and disassembly of the fuel pump.

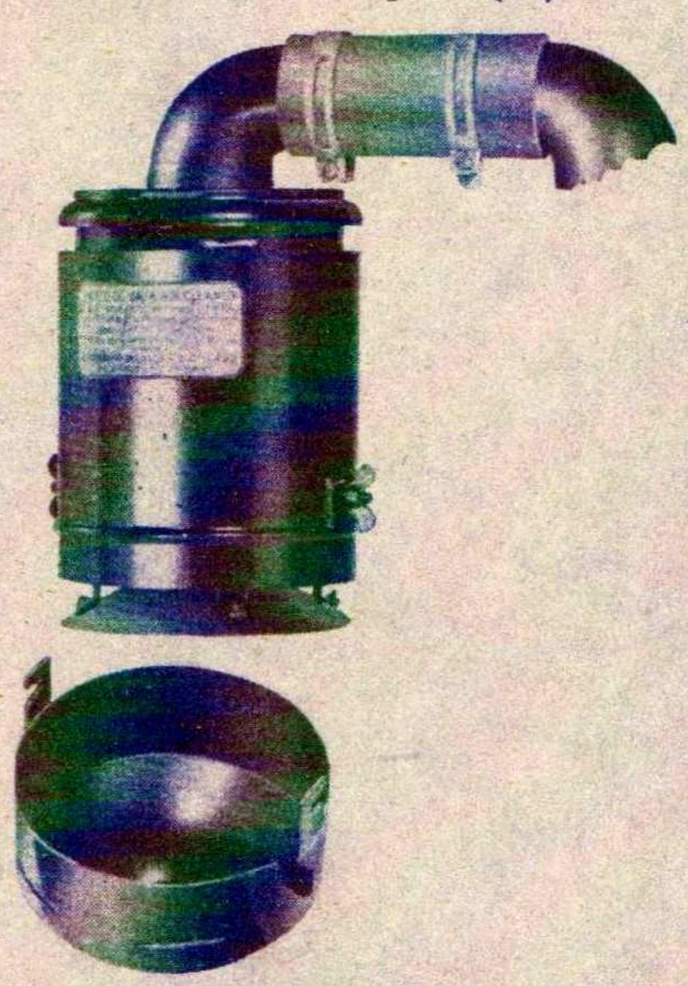
If there is evidence of lack of fuel at the carburetor check the float and needle valve for proper functioning, see that there is fuel in the fuel tank, check for leaks, be sure that the filtering screens in the fuel pump and carburetor are clean and that the discs in the fuel filter are not stopped up, check the gas line for split seams, kinks or obstructions and see that fuel pump cover plate screws are tight. (See Shop Maintenance section for further instructions.)

AIR CLEANER —

An oil bath air cleaner is mounted on brackets to the cylinder head at the left side of the engine. The air cleaner will thoroughly wash the air entering the carburetor, provided it is given proper attention.

The importance of regularly cleaning the air cleaner cannot be too strongly stressed. It is imperative that the operator understand the necessity of keeping the air cleaner in condition to properly function.





The air cleaner is intended to keep the dust out of the engine. The dust contains minute particles of abrasives and also acts as nuclei for the formation of others, which cause rapid wear in the cylinder walls, rings and pistons. This results in the loss of power as well as an increase in oil and fuel consumption.

If the air cleaner is allowed to become clogged up with dirt, air flow to the carburetor is restricted, causing overheating, crankcase dilution and excessive fuel consumption.

Operation — The dust laden air enters on all sides of the unit in a large but relatively thin film at (A). An induced spiral and rotary motion forces a large part of the grit and dust to deposit on the oiled surfaces of the inner and outer cases at (B). Additional dust is washed out when the air comes in contact with the turbulent oil bath at (C). The semi-clean air is then thoroughly filtered while passing through the filter element (D), which is kept clean and re-oiled by the splash of the agitated oil bath. The clean air proceeds to the engine at (E) while the dust is washed down into the sump at (F).

Servicing the Air Cleaner — The filter base or sump should be kept full of engine oil to the oil level mark. This part is easily removed by loosening two thumb screws on the lower part of the body and twisting the sump far enough to clear the thumb screw bolt.

Important — This sump should be examined frequently. Under extremely dusty conditions, check daily. Use a light oil in cold weather.

In order to clean the filter element, remove the assembly from the engine. The element is contained in the body of the cleaner and is easily washed in gasoline or other suitable solvent. Blow out with compressed air and soak in oil before reassembling.

CARBURETOR —

The Zenith Model IN167SJ carburetor is a downdraft unit of double venturi design. It is a balanced carburetor which maintains proper depression ratio between the air intake and the fuel bowl. Air cleaner restrictions have a minimum influence on mixture ratio. This construction protects bowl vent, well vent, idling air opening, etc., from admitting dirt because all air must enter through the air cleaner.

Main Jet System — All fuel for part throttle operation is supplied through the main jet orifice. Its influence is greatest at speeds from 25 miles per hour to maximum speeds.

When manifold depression drops, the power jet system comes into operation to supply the additional fuel for maximum power.

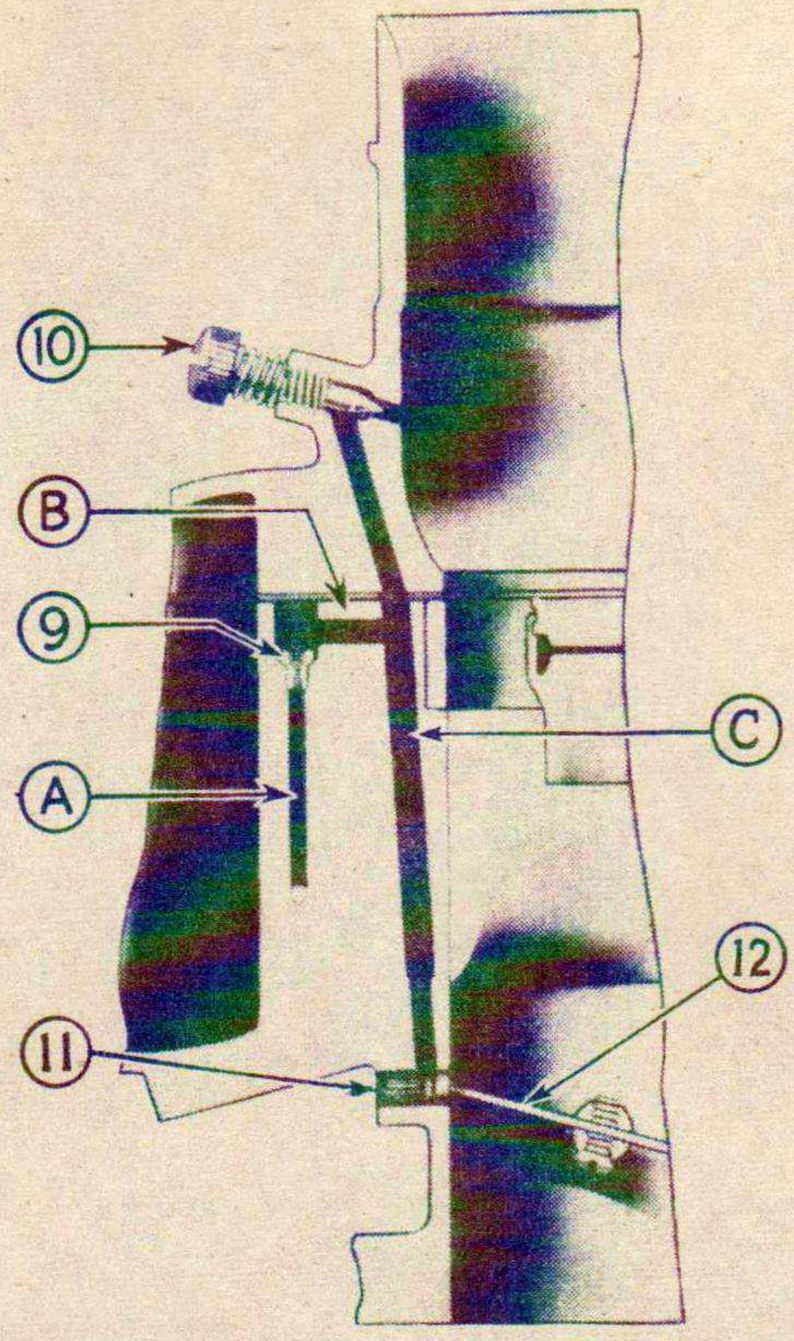
The main jet fuel passes through the main discharge jet (1) and into the air stream through the secondary venturi (2). The Main jet (3) is located in the fuel bowl.

Compensating System — The compensating system consists of the main discharge jet (1) and the well vent (4). The flow of fuel from the main jet (3) is controlled by the size of the well vent (4) and the size of the main discharge jet (1).

The proper seating of the main discharge jet and of the well vent is insured by a tapered seat. No gaskets are to be used.

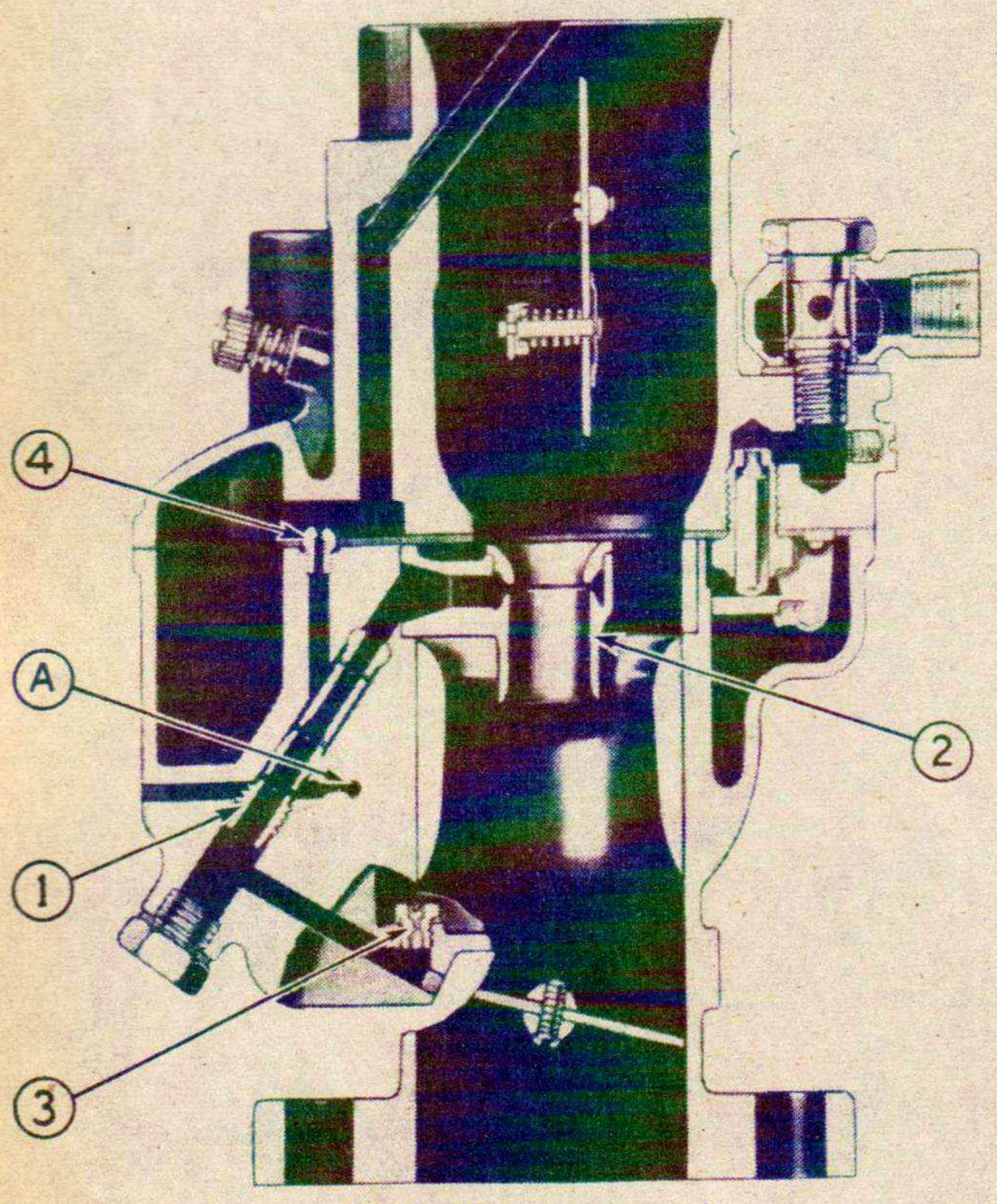
Idling System — The idling system consists of the idling jet (9) which measures the fuel and the idling adjusting needle (10) which regulates the air. The idling jet is calibrated in the side.

The idling jet receives fuel from the main jet (3) through the main discharge jet and channel A. The fuel then goes through the small calibration in idle jet (9) through the channel B and in channel C it mixes with the air admitted through the idle adjusting needle (10). The idling system functions only at idling and speeds below 20 miles per hour. At these speeds the throttle plate (12) is almost closed and there is a very strong suction past the edge of the throttle plate. The mixture of fuel and air from the idling jet is discharged through the priming plug (11). There is no gasket used under the idling jet.



Idling Jet System

Power and Accelerating System — This system supplies the extra fuel required for maximum power or acceleration. When the manifold vacuum is low, as when the throttle is opened quickly, when high engine speeds prevail, or when "lugging" with wide open throttle but low engine speeds, the vacuum piston assembly (6) drops in its cylinder. As it starts its downward stroke, the check valve (14) closes and fuel is forced through the power jet valve (7) and passes through channels E and F to the power and accelerating jet (5) through which it is measured into the air stream at a rate determined by the size of the metering orifice.



Main Jet System

This extra flow of fuel continues only as long as the manifold vacuum is low. As the vacuum increases, the vacuum piston assembly is drawn upward in its cylinder, the power jet valve closes, shutting off this extra fuel and the normal mixture proportions prevail.

Vacuum By-Pass — With the use of the vacuum operated power jet piston, the vacuum must necessarily by-pass through the governor and be taken from a point below the governor valve.

A by-pass plug screw (13) is provided to carry the vacuum past the carburetor and down into the governor. It is essential that both the governor and the flange gasket have openings to match with the by-pass channel.

If no governor is used, the by-pass screw must be removed and this hole left open. If this screw is not removed, the power jet will hold open all the time, with resultant lack of fuel economy.

Carburetor Adjustments — This carburetor has been engineered to meet the requirements of this vehicle and for this reason all adjustments affecting the quality of the mixture, except idling, are fixed adjustments. Carburetor jet sizes should not be changed.

Idling Adjustment — Make the throttle adjustment before attempting to adjust the idling. See the section on carburetor controls.

After the engine is warm, the idling adjusting screw is turned until the engine runs smoothly. Turn the screw clockwise to richen the mixture and counterclockwise to lean it. Adjusting the idling speed does not in any way affect the carburetor performance at higher speeds.

Throttle Adjustment —

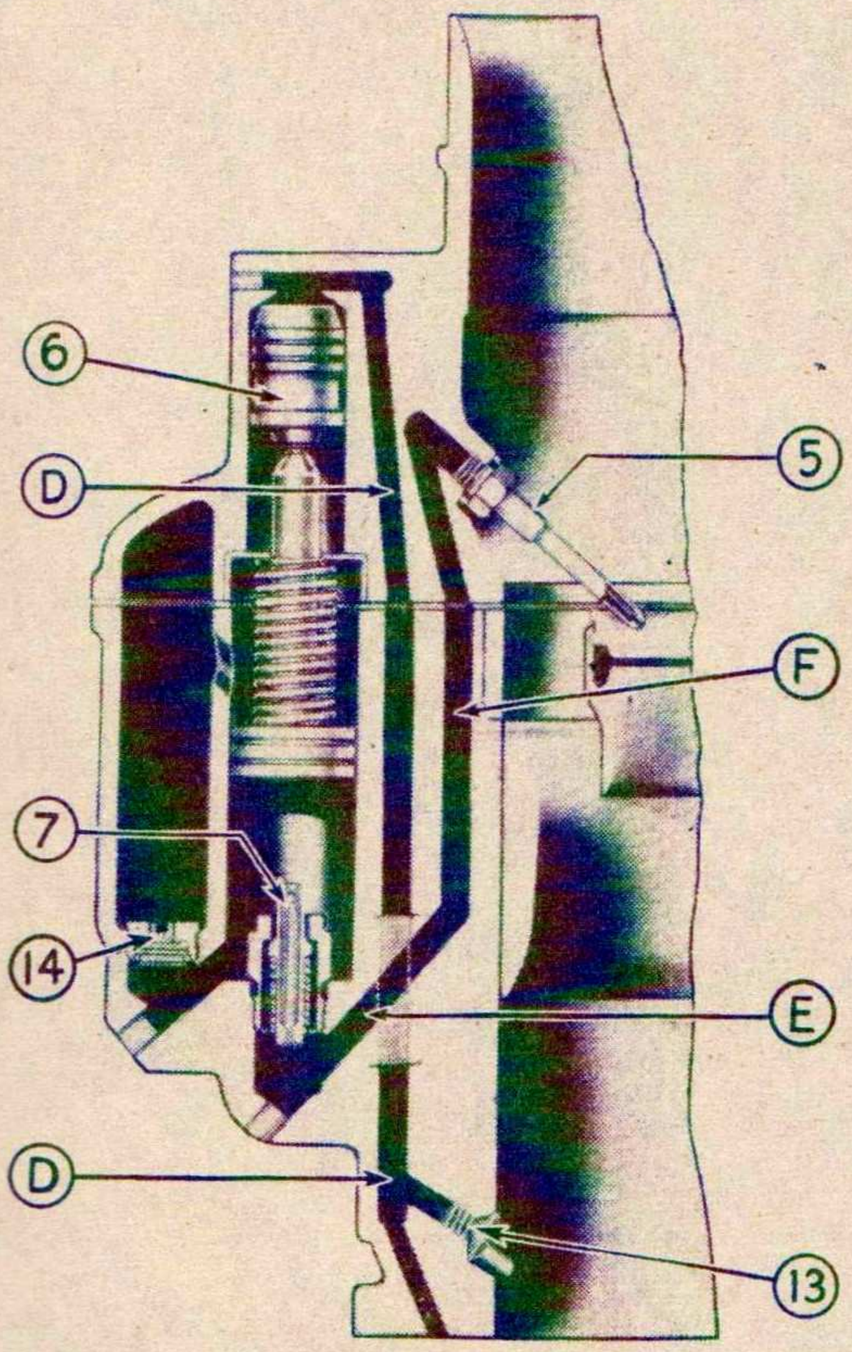
1. Tighten the throttle wire lock nut behind the instrument panel.

2. Push the throttle button flush with the dash and see that there is sufficient clearance between the throttle lever and the stop bracket to allow the throttle plate to return to the idling position.

3. If this is not the case, loosen the set screw holding the throttle wire and tighten when in correct position.

NOTE — Make this adjustment before making idling adjustment.

Choke Adjustment — It is essential that this adjustment is maintained in order to obtain maximum fuel economy.



Power Jet System

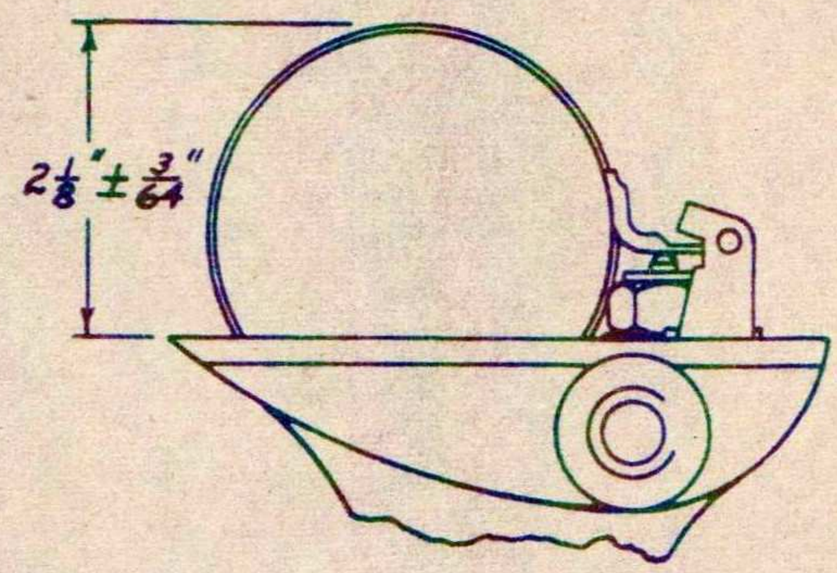
1. Tighten the choke wire lock nut behind the instrument panel.

2. Loosen the set screw at the carburetor end of the choke wire and push the choke button flush with the instrument board.

3. See that the butterfly choke valve is fully opened and tighten the set screw.

4. Tighten the outer wire clamp.

Pedal Controls — The accelerator pedal rod and the carburetor control linkage must work freely without binding. Lubricate this linkage with engine oil at the regular inspection periods.



FUEL LEVEL ADJUSTMENT

Fuel Level — Maintenance of the correct fuel level in the bowl is very important in obtaining fuel economy. This level may be checked with a conventional fuel level gauge or by removing upper cover assembly and measuring the height of the float. The float arm may be bent to obtain the proper adjustment. The illustration shows the method of checking the float level and gives the necessary dimensions.

Inspection — The carburetor should be thoroughly cleaned every 20,000 miles or once a year. All fuel passages should be blown out with compressed air. When the carburetor is reassembled, all gaskets should be new and the control rods must not bind.

A fine mesh type fuel screen is incorporated in the filter head assembly at the fuel inlet to the carburetor. The gasoline enters the carburetor through this mesh screen, fills the sump and is carried off to the bowl.

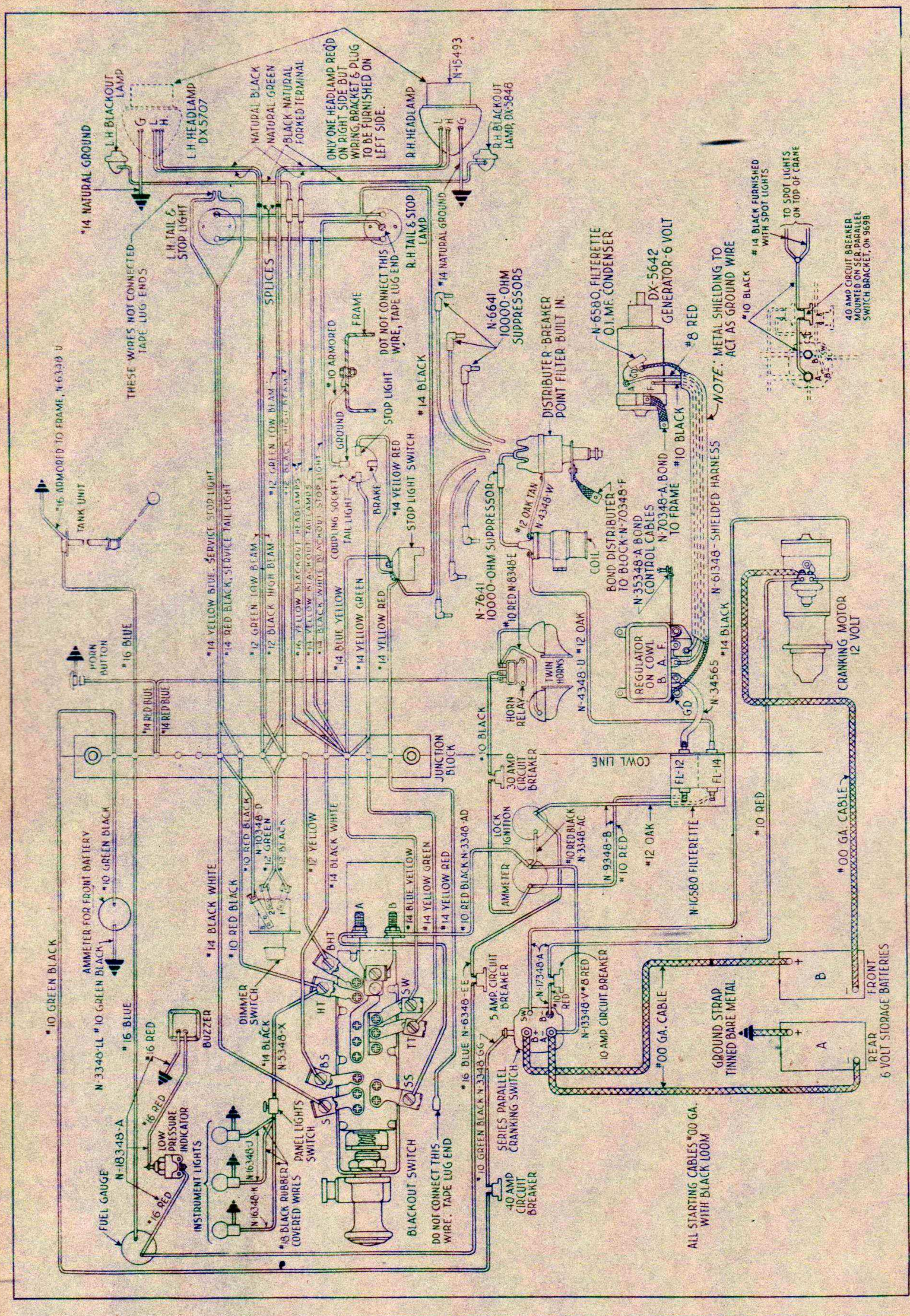
The filter is easily cleaned. After the hex nut in the filter head assembly has been removed, the screen is easily slipped off. The sump may be cleaned with a clean cloth, but the fuel channel must be covered to keep out dirt and water. The head assembly and wire mesh may be washed in gasoline and then blown off with compressed air. This filter must be cleaned from time to time, depending on conditions of operation.

GOVERNOR —

The governor is the mechanical flyball type, actuated by a gear drive through a pilot hole in the camshaft side of the gear cover. The conventional butterfly valve is located in the governor box between the carburetor and the manifold, and it is controlled by the flyball mechanism.

When a governor is used, it is essential that the vacuum which controls the power jet be drawn from a point below the butterfly in the governor. This explains the necessity of the vacuum by-pass and the plug screw below the throttle plate in the carburetor which has already been discussed.

The governor is set to limit the engine speed to 2300 R.P.M. and this setting should not be changed. This engine develops its peak horsepower at this speed and to over-run it results in a loss of power. Do not remove the governor seal.



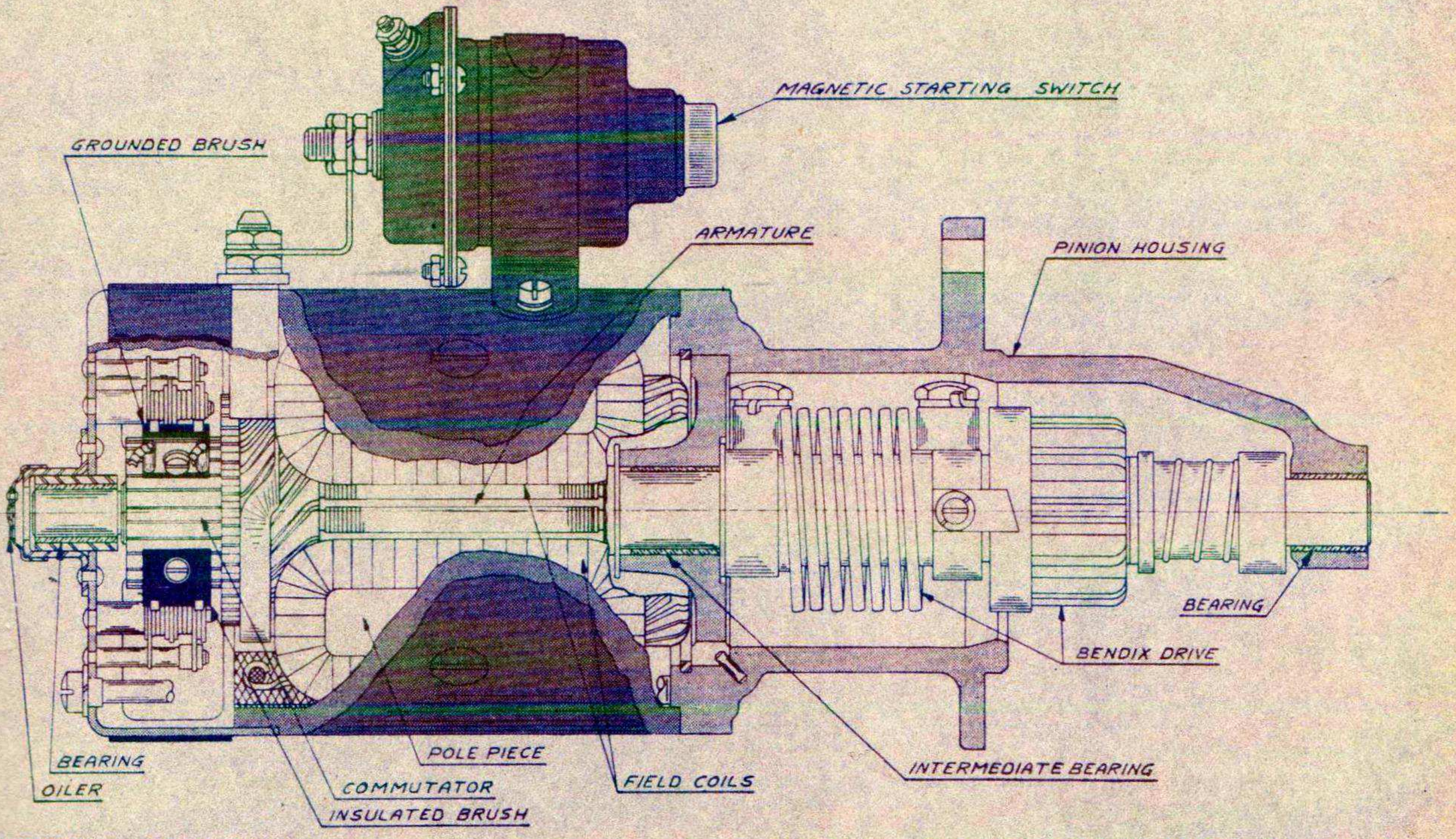
Wiring diagram shows color and wire size of each lead.

ELECTRICAL SYSTEM

The electrical system consists of a number of circuits feeding into or out of the battery. These are the starting circuit, the generating circuit, the ignition circuit and the lighting circuit. These circuits are illustrated in the diagrams following.

All wiring harness is fully protected with flexible conduit and all terminals are securely soldered. It is important to remember that good electrical connections must be tight and clean.

Periodic inspection of the wiring system is recommended.



STARTER MOTOR —

A 12-volt starting motor is used in this vehicle, energized by two 6-volt batteries in a series parallel circuit explained on the next page. The starter is the direct drive type which engages with the flywheel gear through the conventional bendix drive.

When the starting switch is closed and the starting motor turns over, the Bendix gear rides out to the end of the threaded bendix shaft and engages with the flywheel. When the engine starts, its speed is such as to overrun the starting motor through the flywheel and pinion, and hence the bendix gear is wound back on the bendix shaft and out of contact with the flywheel.

Tune Up Inspection — This inspection should include a check of the brushes and commutator, cleaning of the commutator if needed and a check of the bearings for wear.

The three bearings are of absorbent bronze which is able to absorb up to 25 per cent of its own volume in oil. The intermediate and drive end bearings receive oil thru the flywheel housing and require no external lubrication. The commutator end bearing is provided with an oiler in the end cap and should be given 3 to 5 drops of medium engine oil every 5000 miles. All bearings should be soaked in oil after having been washed out and the commutator end bearing should be packed with grease when reassembling. Do not over lubricate the bearings as the excess oil may deposit on the commutator and brushes and shorten the life of the motor.

The starting circuit should be given a complete voltage drop test to make sure there is no loss of starting motor efficiency due to poor or corroded connections. When making this test particular attention should be given to the ground connection of battery "A." The ground connection in the manual starting switch is used only during charging and should be checked as part of the charging circuit.

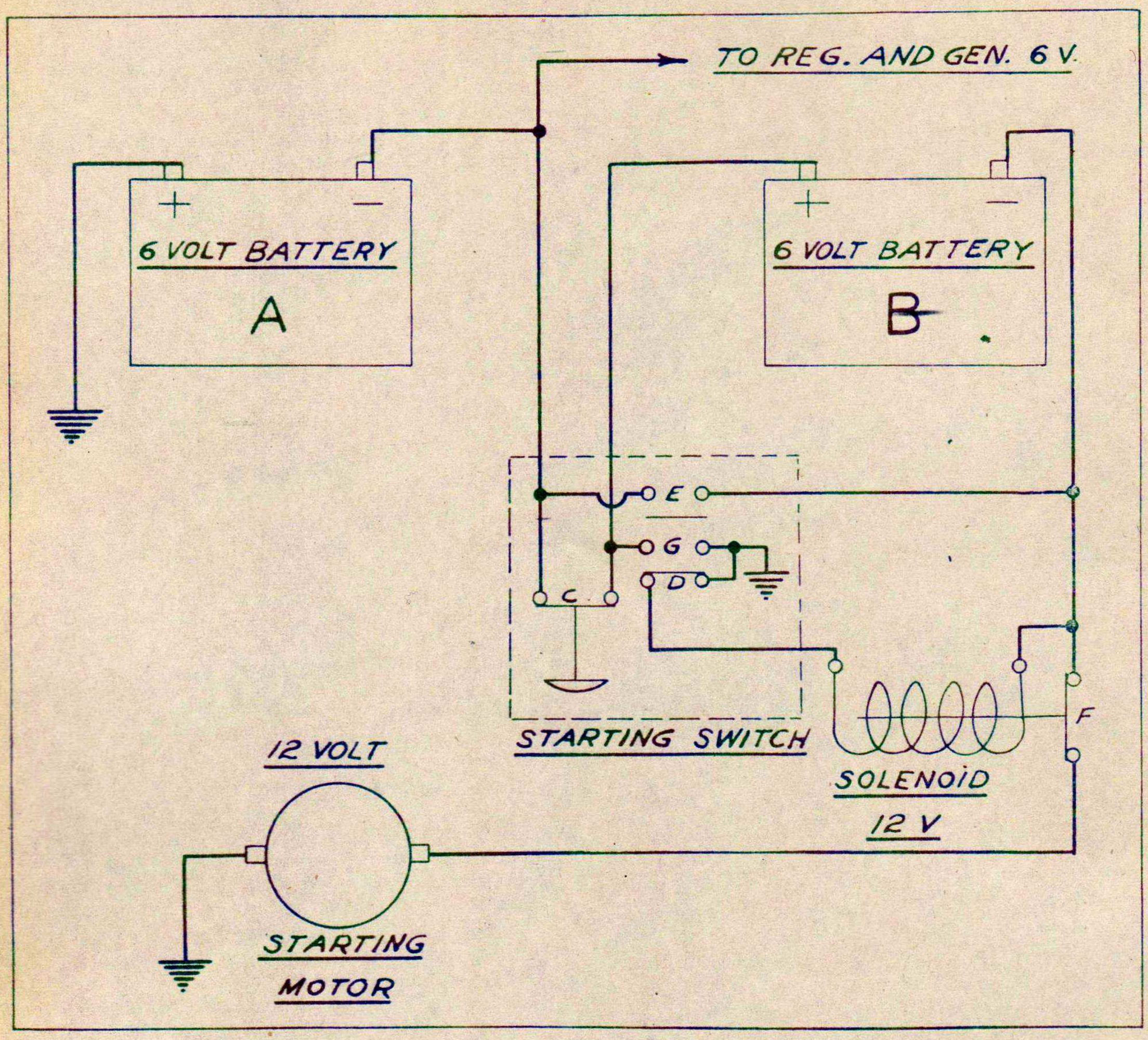
Starting Motor Trouble Analysis — If the starting motor is sluggish it might be caused by the battery, cables, terminals or connections. If the battery cables are corroded, they should be replaced. Be sure that all connections are clean and tight.

If there is no external fault, remove the motor cover band and check the brushes and commutator bars. The brushes must make good contact and the commutator bars should be clean.

If the commutator bars are burned, it might be an indication of an open circuited condition in the armature coils.

Worn or dirty bushings or a bent armature shaft might restrict starter speed sufficiently to prevent good performance.

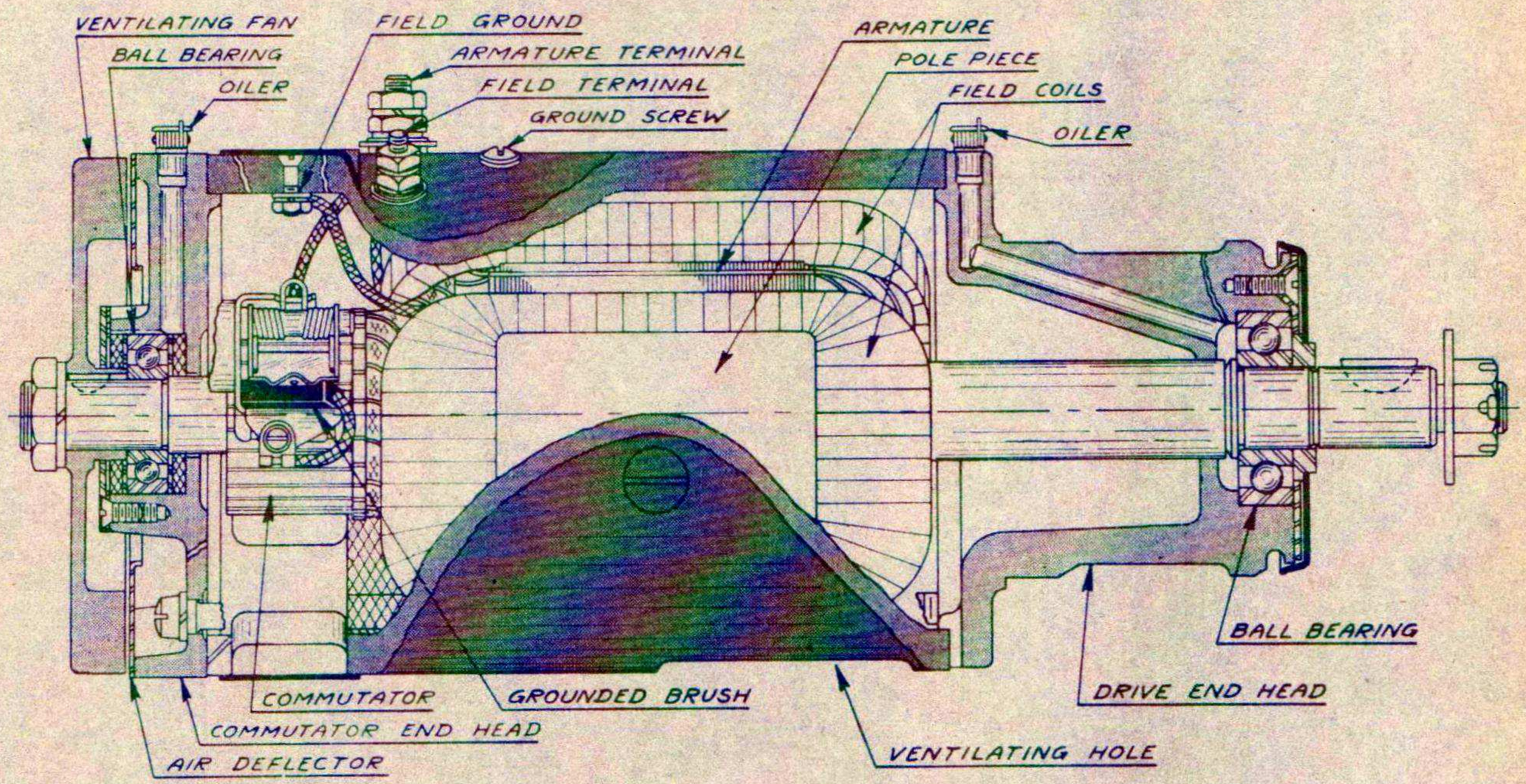
If the above are all in proper condition, it will be necessary to remove the starting motor for detailed examination by electrical specialists.



Series-Parallel Circuit — Two switches are used in this circuit, one a solenoid switch mounted on the starting motor and the other a manually operated series parallel switch.

The sequence of operation during starting is as follows: When the manual switch plunger is depressed the contacts "C" and "D" are closed while contacts "E" are opened. The closing of contacts "C" connects the negative terminal of battery "A" to the positive terminal of battery "B" thus connecting the two batteries in series. With contacts "D" closed the circuit is completed from battery "B" through the solenoid switch windings to ground. This energizes the solenoid and closes contacts "F" which in turn energizes the starting motor. The starting motor torque is transmitted to the engine through a conventional Bendix drive. Contacts "C" and "F" are heavy duty contacts as they both carry all of the starting current.

After the engine begins to operate and the manual starting switch is released the circuits are changed to that required for generator operation. This change over is accomplished as follows: Releasing the manual switch opens contacts "C" and "D" and at the same time closes contacts "E" and "G." With contacts "D" open the solenoid switch windings are no longer energized and spring action opens contacts "F" which disconnects the starting motor from the battery. With contacts "C" open the two batteries are no longer connected in series. The closing of contacts "E" connects the negative terminal of battery "B" to the negative terminal of battery "A," while with contacts "G" closed the positive terminal of battery "B" is grounded. Thus both batteries have their positive terminal grounded and both have their negative terminal connected to the generator. This parallel hook-up is held as long as the starting switch is left in the rest position. The lights and accessories are connected to the batteries so that they are always on a 6 volt circuit.



GENERATOR —

The generator is a gear driven, two pole, two brush air cooled unit with clockwise rotation at the drive end. The output is controlled by an externally mounted current-voltage regulator.

Cooling — Cooling is provided by means of the suction fan mounted on the commutator end of the armature shaft. Air is drawn thru the holes in the under side of the frame over the armature and field windings and out through the holes in the commutator end plate.

Bearings & Lubrication — The armature is mounted on ball bearings at both ends. These bearings are packed ½ full with a heat resisting grease at assembly. Additional lubrication should be provided every 5,000 miles by adding a few drops of medium engine oil to the hinged top oilers located over both bearings.

Brushes — The two brushes are mounted on reaction type brush holders riveted to the commutator end plate. These brushes are fitted to have 100% of the brush surface contacting on the commutator. When new brushes are installed it may be necessary to sand the brushes to obtain this fit. This can be done by cutting a strip of 00 or 000 sandpaper the exact width of the commutator and wrapping it tightly around the commutator with the sanded side toward the brushes. The armature is then turned in the direction of its driven rotation until the brushes are properly seated. Do not sand excessively as it merely shortens brush life. After sanding blow the sand and carbon dust out of the generator. Before testing the generator should be operated under load for a short time to obtain the 100% brush contact.

Brush spring tension can be checked by hooking a spring scale in the hole in the turned up lip of the brush arm and taking the reading just as the arm leaves the brush. The pull of the spring scale should be at right angles to the line of force exerted by the brush spring. This tension should be from 64 to 68 ounces.

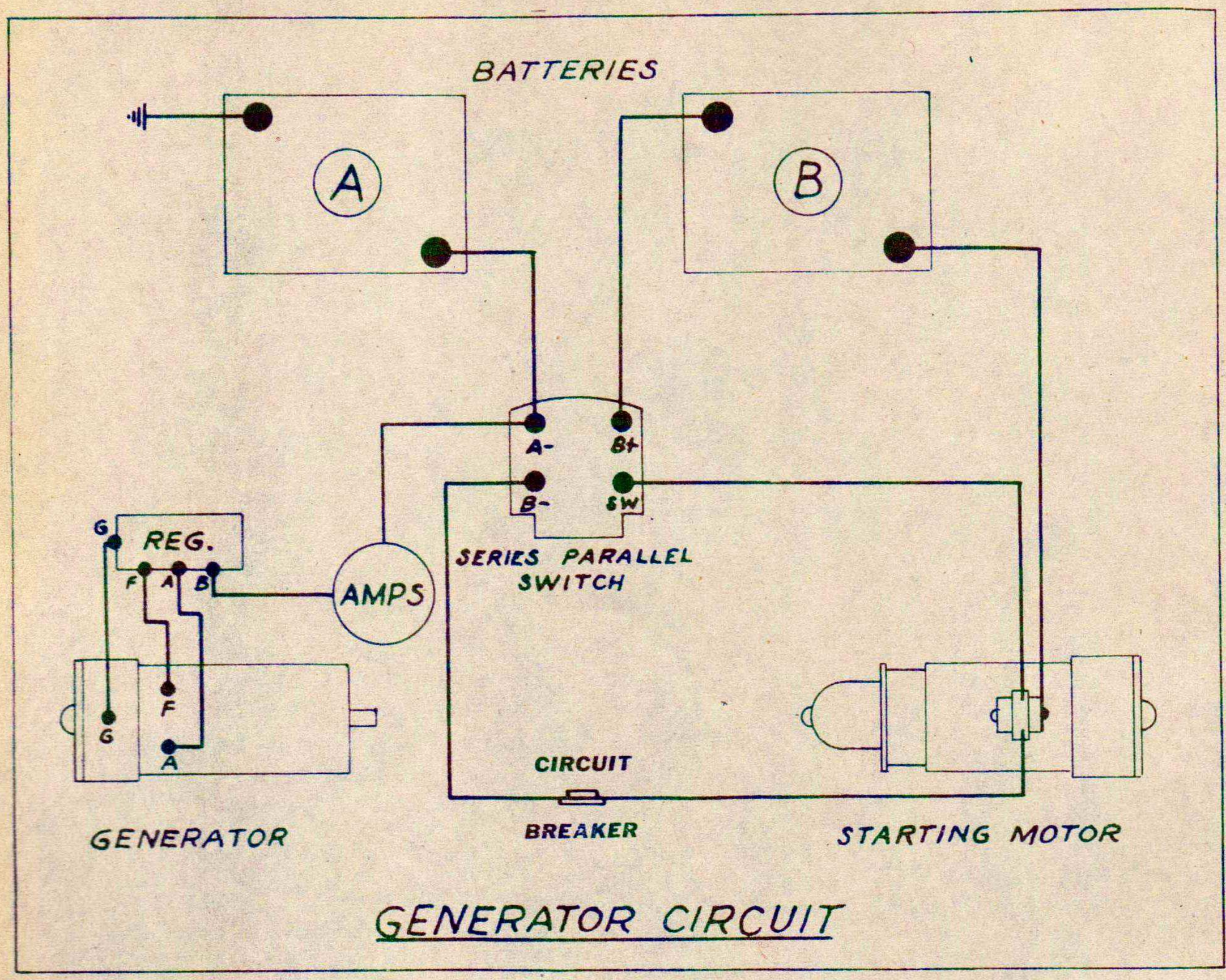
Inspection and Tune Up — Should trouble be encountered in the charging circuit the wiring between the generator and regulator and between the regulator and the batteries should be checked for loose and high resistance connections. Both battery ground connections should be checked to be sure they are clean and tight and that the contacts in the starting switch are working properly. The battery terminals should be cleaned and tightened.

The brushes should be inspected to see that they slide freely in the holders and that they are not worn out. If new brushes are needed they should be replaced as outlined above. If the commutator is worn or discolored it can be cleaned by holding a piece of 00 sandpaper against it while turning the armature slowly. If the commutator is worn or rough the armature should be removed and the commutator turned down. After turning the commutator under cut the mica to a depth of 1/32 inch. This cut should be clean and square.

Polarizing the Generator — It sometimes happens that the generator polarity is reversed after reconnecting the regulator. This will cause the cut-out relay points to burn and vibrate.

It is recommended that a jumper lead be held momentarily between the generator and battery terminals of the regulator, after the generator circuit has been connected. A momentary surge of battery current is sufficient to cause proper polarization.

Current Voltage Regulator — This regulator has three units each performing a distinct and independent function: 1st, the circuit breaker to close and open the circuit between the generator and battery; 2nd, the current limiting regulator to control the maximum output of the generator and 3rd, the



GENERATOR CIRCUIT

voltage regulator to hold the system voltage constant within close limits under operating conditions of the system's capacity.

Circuit Breaker — The function of this unit is to automatically open and close the circuit between the generator and the storage battery.

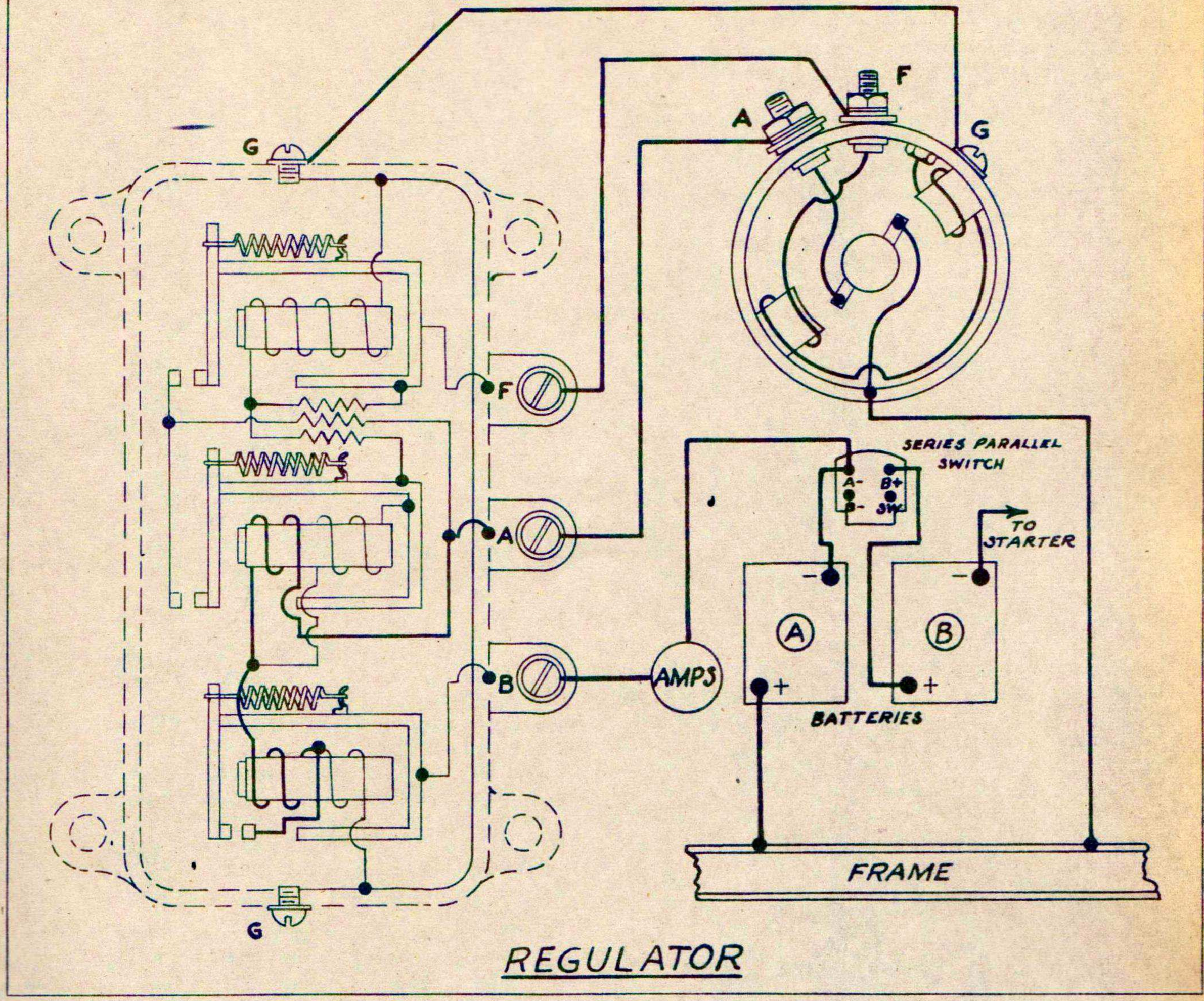
It consists of an electromagnet and a set of contacts. The electromagnet has two windings; one, the shunt coil connected across the generator like a voltmeter, and the other a series coil connected in series with the generator output like an ammeter. These two windings are both wound in the same direction. The contacts consist of one movable contact mounted on an armature operated by the electromagnet, while the other is a stationary contact. 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.

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—The current limiting regulator is an electromagnet with two windings. The main winding consists of heavy wire and is connected in series with the generator "A" terminal and the series winding of the circuit breaker.



REGULATOR

In operation when the generator output reaches its predetermined maximum, the regulator points are opened, inserting resistance in the field circuit and reducing the ampere output of the generator. Immediately upon the dropping of the output the points close, shorting out the resistance and the output rises completing one cycle of operation.

The second winding is connected in series with the generator field circuit and is connected so that the rise and fall of the field current 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—The electromagnet of the voltage regulator unit has a single winding which is shunt connected across the battery charging circuit. This connection is made at the circuit breaker in order that the battery rather than generator voltage will control its operation. 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 necessary as it requires a higher voltage to charge a battery when it is cold than when it is hot.

Checking the Regulator — The regulator is a delicate bit of electrical equipment which requires

Checking the Regulator *(Continued)*

special tools and instruments to make accurate tests and adjustments. Have this unit serviced on a properly equipped test bench.

However, before having this unit serviced it would be a good plan to check as follows:

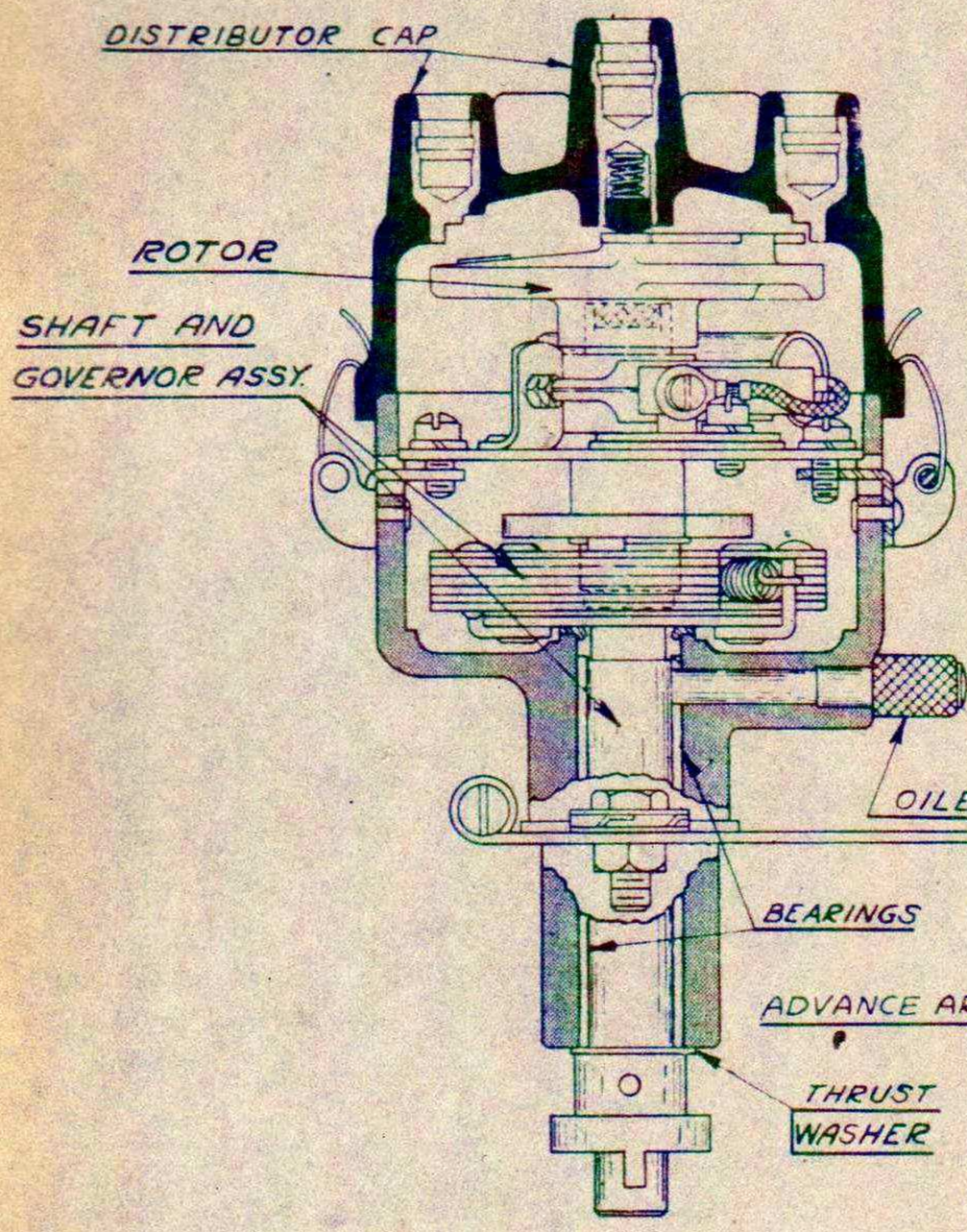
1. Check wiring in the regulator hook up.
2. Be sure all electrical connections are clean and tight.
3. Generator performance without the regulator in the circuit must be according to specifications.
4. The regulator installed at the factory is designed to work with the generator used in this vehicle. If any replacements have been made be sure that the regulator and generator function satisfactorily to together.

IGNITION SYSTEM —

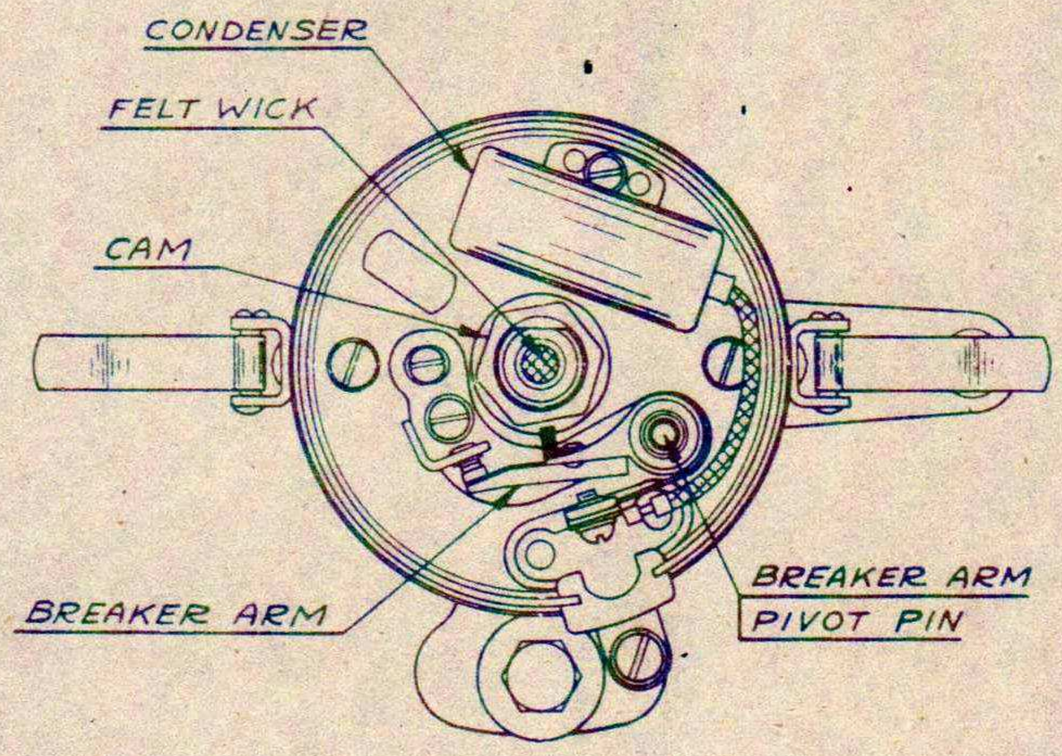
The ignition system is made up of the distributor, coil, condenser, and spark plugs. The function of the system is to deliver a hot spark to each cylinder at the proper instant and in the proper sequence to develop a maximum of power from the ignition of the fuel.

DISTRIBUTOR —

Tune-Up Inspection — The tune-up inspection of the distributor should include the removal and cleaning of the inside of the distributor cap, removal of the rotor, inspection of the breaker points with refacing and respacing if necessary, a check of the automatic governor to see that it is working freely, a test of the condenser, lubrication and finally a check and resetting if necessary of the timing of the distributor to the engine. At the same time where proper equipment is available the ignition coil performance should be checked.



Breaker points that show a grayish color and possibly are only slightly rough with no pit or crater showing and which have within .002" proper maximum gap need not be touched for refacing or adjustment. However, if the breaker points must be readjusted they should always first be refaced so as



to have a smooth, flat contact with each other. Also be sure they are properly aligned so as to have full face contact.

The governor can be checked for working free by turning the breaker cam in the direction of rotation as far as it will go and releasing. When released it should immediately return to its original position with no drag or hesitancy.

A test of the condenser should include both capacity and leakage. This can only be done with proper test equipment.

Lubrication — The drive shaft is mounted in absorbent bronze bearings located in the shank of the distributor housing. Every 2,000 miles a few drops of medium engine oil should be added to the oiler on the outside of the distributor base. Twice a year the breaker cam should be given a light wipe of grease and one drop only of light oil should be put on the breaker arm pivot pin. At this time the hole in the top of the breaker cam should be given a few drops of light oil. When the complete inspection is made the bearings in the distributor should be thoroughly cleaned, then lubricated before assembling the drive shaft in the housing.

Spark Plugs — If they are to give satisfactory performance, the spark plug gaps must be maintained close to .027". If the gap is set too close, the engine will not idle evenly and if it is set too wide, the engine will miss.

It is recommended that the gaps be checked and reset every 1,000 miles, as the points burn and separate in normal service. At this time also clean the plugs and examine them for cracks in the porcelain or other defects.

A spark plug will not normally give satisfactory performance after 10.000 miles of service and it is

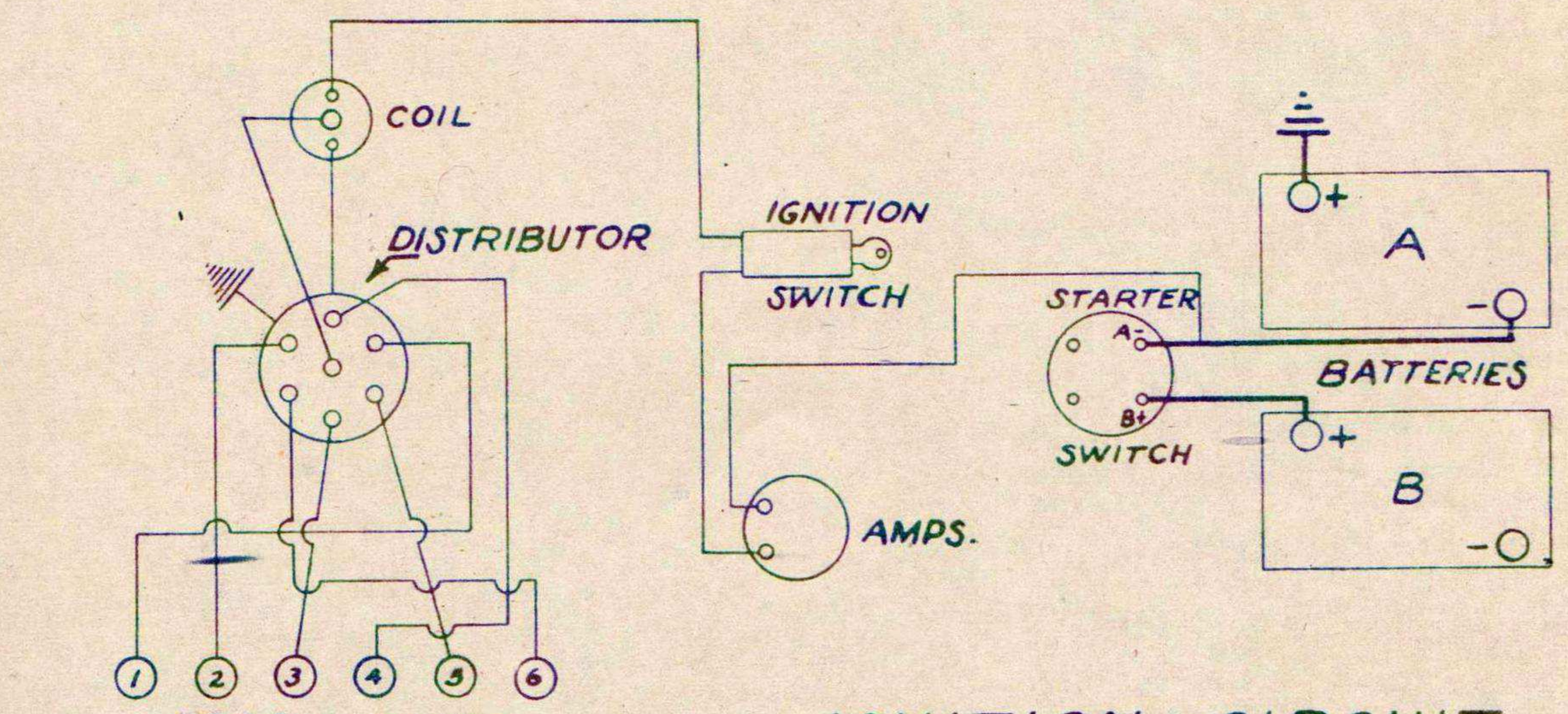
recommended that the plugs be changed every 10,000 miles.

If the engine misses or "pings" on the pull, it may be an indication that the spark plug gaps are becoming too wide. Always check the plugs first, when this symptom is noticed.

It is of utmost importance that spark plugs be

STORAGE BATTERY —

The storage battery equipment consists of two six volt units, Exide type XH-194, connected in series for a 12 volt starting circuit. For charging, lights, ignition, etc. the two batteries are connected in parallel for a 6 volt potential. A series parallel switch is standard equipment on each vehicle.



IGNITION CIRCUIT

screwed in sufficiently to give gasket a tight "bite" so as to give maximum heat transfer to cylinder head.

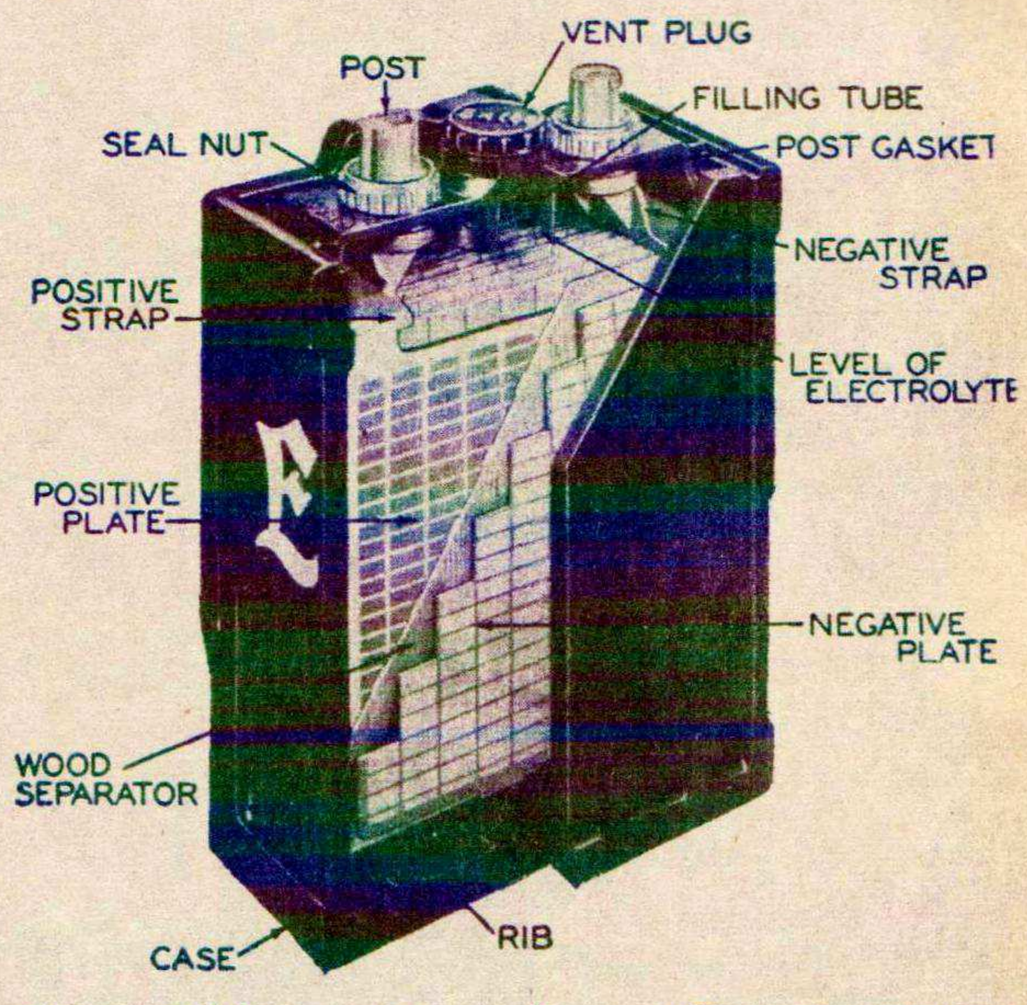
The wiring circuit for the ignition system is illustrated here. It will be noticed that this is a 6-volt system and that the two batteries are used only in series for the starting circuit.

Checking Ignition Timing—Before checking the timing the distributor must be given a thorough check. (See under Distributor.)

Using a conventional test lamp, proceed as follows:

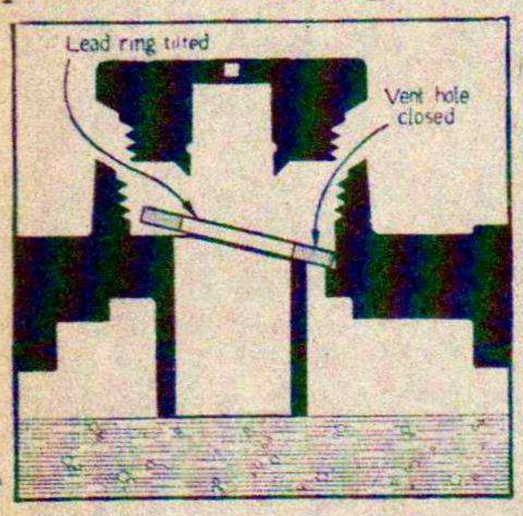
1. There is a timing hole located on the front face of the bell housing, slightly above center and directly behind the fuel pump on the left side of the engine. Crank the engine slowly until the mark on the flywheel is lined up with the center of the timing hole. It will be necessary to use a mirror between the fuel pump and the bell housing to see this mark.
2. Loosen clamp bolt in distributor arm and remove distributor cap.
3. Connect a conventional test lamp in series with the primary circuit.
4. Retard spark and turn on ignition switch. Lamp will light when contacts are closed and will not light when they are open.
5. Back off distributor slowly (Turn counter-clockwise) stopping the instant the light goes out and clamp assembly in position. Disconnect lamp and replace cap.

Adding Water — The water level in the battery should be checked once each week. Water should be added before the level lowers to the top of the separators. Distilled or drinking water should always be used.

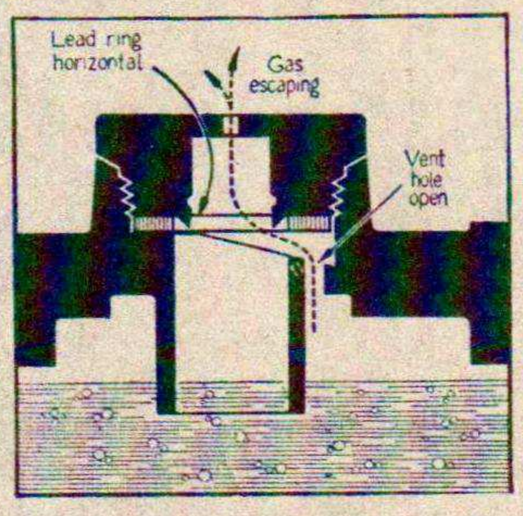


When adding water, add a sufficient amount to come to about $\frac{3}{8}$" above the tops of the separators.

that is, to the bottom of the cover well. These batteries have No-Over-Flo covers and vent plugs which act to limit the amount of water added. (See illustration). Excess water added rises in the filling tube or well only. Do not remove or injure the lead ring. Take care when adding water with a syringe not to push the lead ring off its seat.



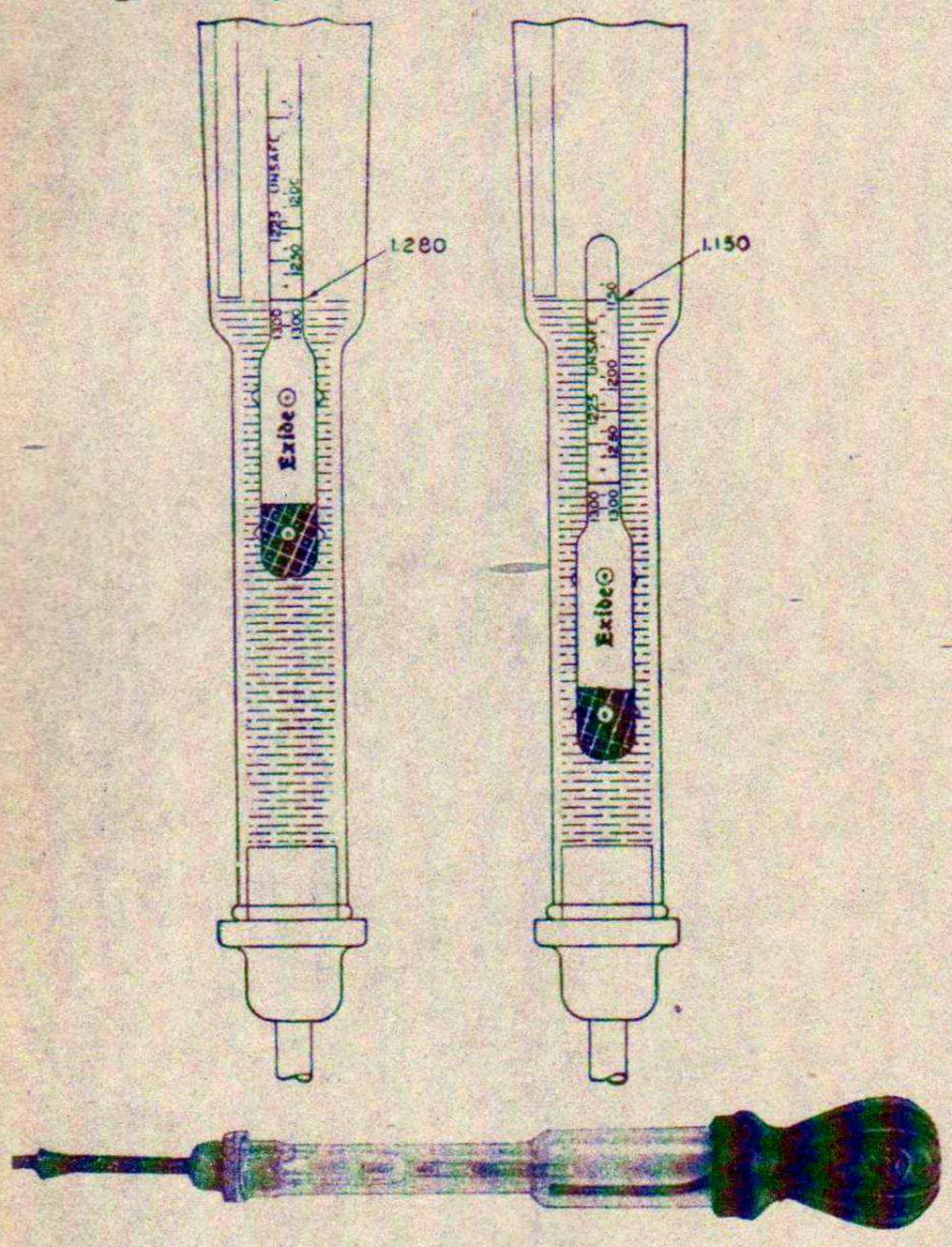
Lead ring closes vent hole. Trapped air limits addition of water to bottom of filling tube.



Replacing vent plug tilts ring and opens vent hole. for normal passing of charging gas.

It is desirable to keep a log on the water added to the batteries, recording the date and amount added. Two batteries of the same serviceable condition should require about the same amount of water when connected in parallel. If this is not the case check to see that electrical connections are clean and tight.

Hydrometer Readings — By means of hydrometer readings it is possible to determine if the batteries are fully charged, or the amount that they are discharged. When the specific gravity is high or strong, the hydrometer will not sink as far into the liquid (electrolyte) as when the specific gravity is low or weak.



To take a hydrometer reading, insert the nozzle of the hydrometer syringe in the electrolyte, squeeze the bulb and slowly release it, drawing up enough electrolyte to float the hydrometer freely. Holding the syringe vertically, the reading on the stem of the hydrometer at the surface of the electrolyte is the specific gravity of the electrolyte. Then return the electrolyte to the same cell.

The specific gravity for full charge should be 1.270 to 1.285. Readings above 1.225 are alright but whenever a reading is lower than that, the battery must be removed for a bench charge.

Specific gravity readings must be corrected for the temperature of the electrolyte in the battery at the time of testing. If such correction is not made the specific gravity reading is misleading as a measure of the condition of charge of the battery. The correction per 10° F. of temperature variation is approximately .004 in specific gravity. The following table indicates the correction that must be made for various temperatures:

Temperature of Electrolyte	Specific Gravity Correction
110F	Add 12 points to hydrometer reading
100F	Add 8 points to hydrometer reading
90F	Add 4 points to hydrometer reading
80F	No correction required.
70F	Subtract 5 points from hydrometer reading
60F	Subtract 8 points from hydrometer reading
50F	Subtract 12 points from hydrometer reading
40F	Subtract 16 points from hydrometer reading
30F	Subtract 20 points from hydrometer reading
20F	Subtract 24 points from hydrometer reading
10F	Subtract 28 points from hydrometer reading
0F	Subtract 32 points from hydrometer reading
–10F	Subtract 36 points from hydrometer reading
–20F	Subtract 40 points from hydrometer reading

Do not take hydrometer readings immediately after adding water. Allow a day or so for the water to mix with the electrolyte, otherwise the reading is false. If the battery is on charge and gassing, the water will be mixed within an hour.

Do not use the same cell each time to take the gravity readings. Change around to the various cells. This recommendation is made to avoid lowering the gravity of one cell due to possible loss of a small amount of electrolyte in taking gravity readings. Using all cells spreads the possible loss over all cells rather than have the loss taken by one cell.

Freezing — The freezing point of the battery electrolyte varies with its specific gravity as shown in the table which follows:

Specific Gravity	*Freezing Point*
1.275	–85° F
1.250	–62° F
1.225	–35° F
1.200	–16° F
1.175	– 4° F
1.150	+ 5° F
1.125	+13° F
1.100	+19° F

From this table it is easily seen that there is little danger of freezing in a temperate climate zone except with a completely discharged battery. If water is added to a battery in freezing temperatures and the battery let stand in the cold and not charged or used, the water will remain on top of the electrolyte and possibly freeze.

Corrosion — If any corrosion takes place, it must be scraped or brushed off. The battery should then be washed with or immersed in a baking soda solution. (Proportions — one pound of soda to a gallon of water). Be sure that the vent plugs are tight in place. After the acid has been neutralized, rinse, dry and cover with a light film of petrolatum or vaseline.

Lead does not corrode. Lead plated parts on which the lead plating is worn or scraped off should be replaced.

The acid in the electrolyte does not evaporate. It must be neutralized as outlined above. Avoid getting the baking soda solution inside the cell.

Care of Inactive Batteries —

1. A battery standing idle is subject to gradual self discharge. The rate of discharge varies with the temperature, time since charged, etc. Under average conditions a fully charged battery standing idle for 30 days will at the end of that time test approximately 1.230 specific gravity at 80° F.

2. If the battery is permitted to stand without charging for extended periods severe damage occurs.

3. Avoid damage to the battery. It should be given a bench charge at regular 30-day intervals. Each time the battery is recharged, it should be brought to a full charge.

Cautions — When working around the batteries, remember that all exposed metal parts are "alive" and that no metal tool or wire should be laid across the terminals as a spark or short circuit will result.

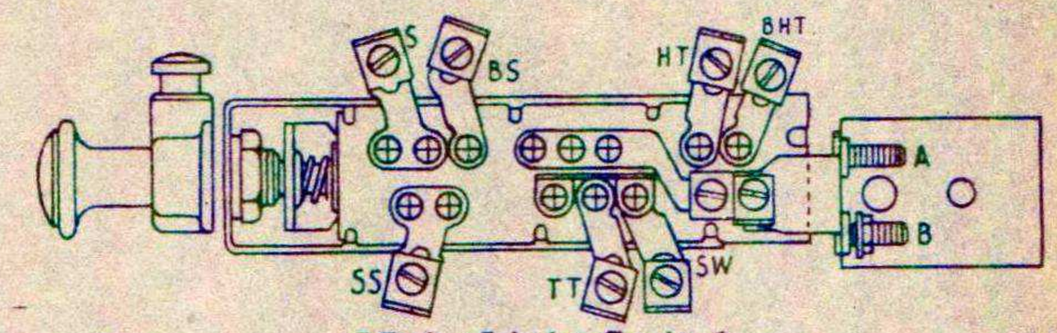
Sparks, lighted matches and exposed flames should be avoided near the batteries, gasoline tanks and fuel line. When necessary to tighten or loosen the clamped connections at the battery terminals, use a wrench of the proper size. Care must be taken that the wrench does not come in contact with any of the other metal parts of the truck or metal parts of the battery. When removing terminals, remove grounded or positive terminal first and when replacing terminals, replace grounded terminal last. This reduces possibility of accidental sparks.

Avoid pulling down so tight on the holddowns that the container becomes distorted. Make a snug fit — not necessarily the tightest fit.

LIGHTING SYSTEM —

The lighting system includes the main, dimmer, stoplight and dashlight switches, the headlights, blackout lights, stop lights, taillight, instrument lights, the coupling socket, circuit breakers, beam indicator and tell tale light.

Switches — The main light switch is mounted in the center of the dash and controls the service lights as well as the blackout lights. When the button is pushed flush against the dash all the lights are off. When it is pulled out against the stop button, the blackout head lamps, blackout tail lamps, and blackout stop light come into operation. By pressing the safety button, it is possible to pull switch to the second out position and the service lights are "On." For daylight driving pull the knob all the way out and the service stop lights only are in the operating circuit.



Main Light Switch

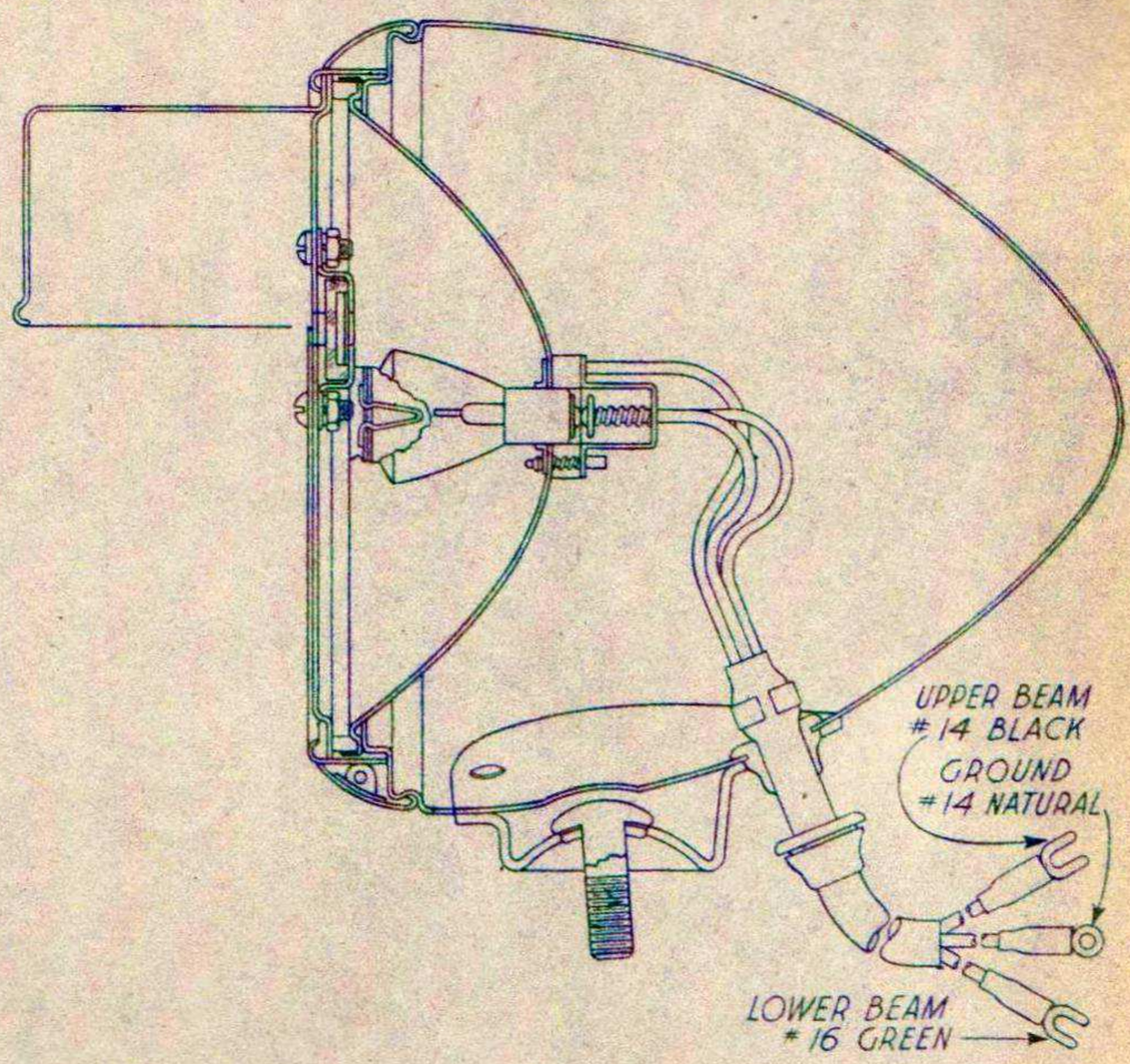
S—Service Stop Lights
BS—Blackout Stop Light
HT—Head and Tail Lights
BHT—Blackout Head and Tail Lights
SS—Stop Light Switch
TT—Trailer Tail Light
SW—Feed to Stop Light Switch
B—Battery
A—Auxiliary Feed

A dimmer switch is located on the floorboard for convenient operation with the left foot. This switch is used to control the upper and lower headlamp beams with the main switch fully on. A slight foot pressure will change from one beam to the other. A beam indicator light glows while the upper beam is being used.

The stop light switch is controlled by air pressure from the braking system. As the brake pedal is depressed, pressure is built up in the air lines and against the switch, closing the circuit.

A toggle switch is used to control the instrument panel lights, but is dependent on the main light switch.

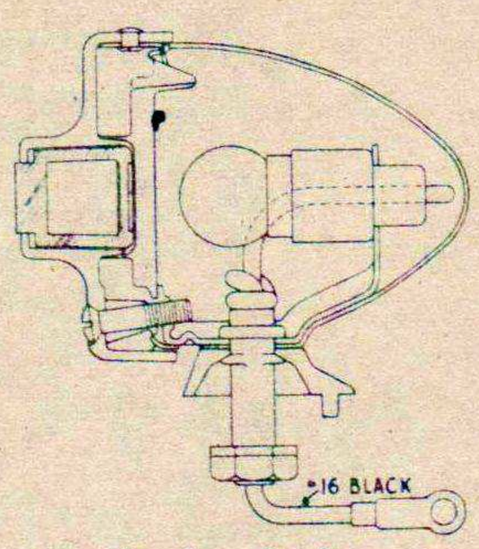
Lights — The headlamp is the double filament type of shrouded driving light. The upper filament



Lights (*Continued*)

gives the low headlight beam while the lower provides the high beam. The selection of these beams is controlled by a dimmer switch.

Blackout Lights—There are blackout headlamps, blackout tail lights and blackout stop lights on this vehicle. A blackout headlamp is illustrated here and its principal of operation is readily apparent. The door shield makes its dim glow visible in only a very limited plane.



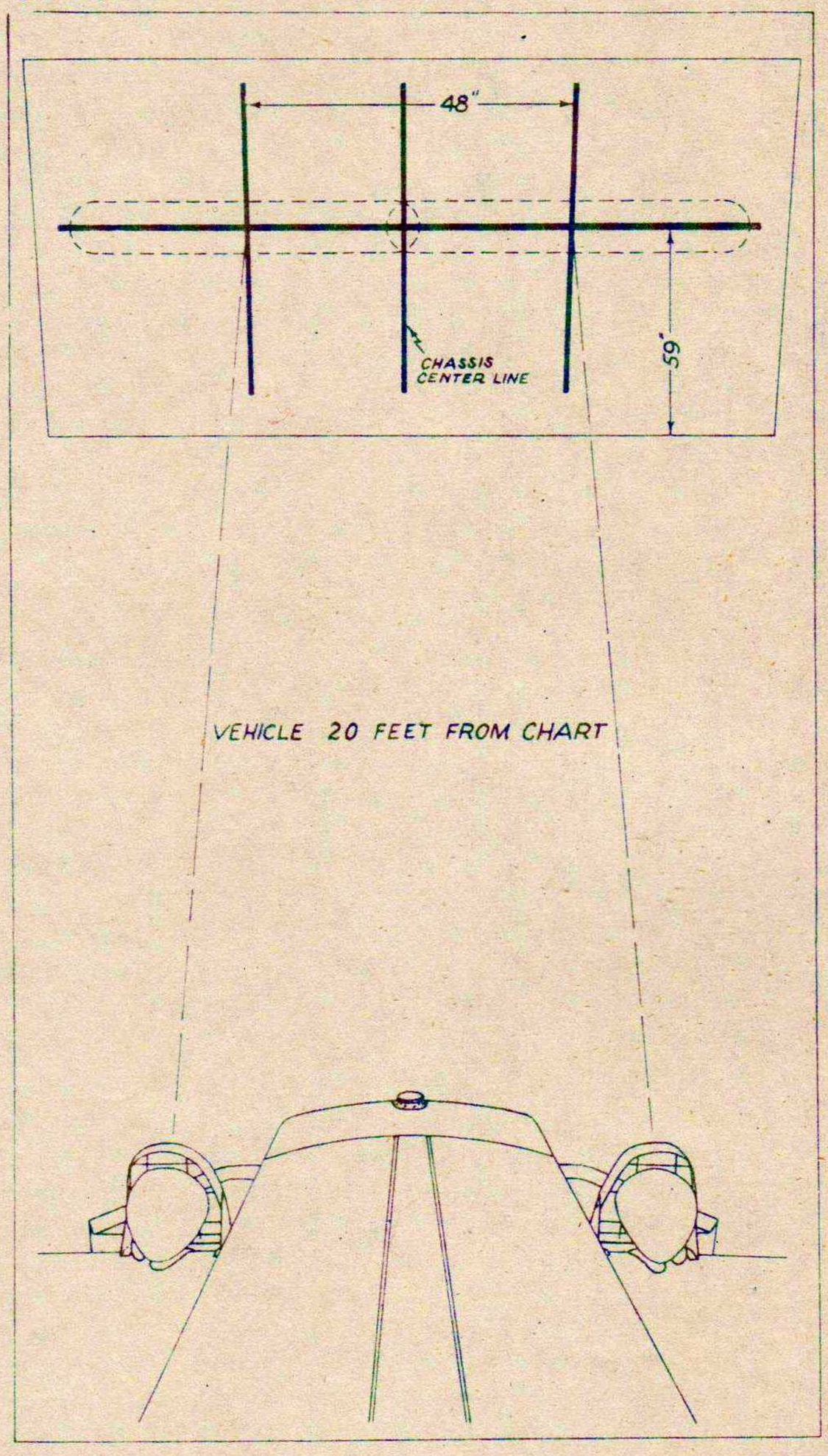
With the main switch in the blackout position the electrical circuit is completed through the blackout lights rather than the service lights.

Auxiliary Lights — In addition, a conventional lighting circuit is installed but not connected. There is a coupling arrangement for trailer lights when one is being pulled. There are three lights provided to illuminate the instrument panel which are controlled with a switch on the dash.

Circuit Breakers — Circuit breakers are used for the fuel gauge, horn relay, parallel switch, and parallel switch and starting motor. These safety devices prevent damage to delicate parts by breaking the circuit when it is overloaded.

Adjusting Headlamps — (When conventional type lamps are used). If maximum illumination and long life are to be achieved with these headlamps, it is essential that proper voltage be maintained across the headlamp circuit. Too high a voltage will burn out the filament while too low a voltage will give inadequate illumination. A low battery or poor electrical connections would cause a low voltage in the circuit and an over-charging generator might be responsible for a high voltage.

Safe driving practice demands that the headlamps be directed properly. A headlamp tester will give quick and accurate adjustment. A headlamp chart mounted on a vertical wall will give reasonably accurate results. Loosen the suppprt nut, direct beam properly on the chart and then clamp the lamp tightly in position.



LIGHTS—

Head Lamps	
Type	Sealed Beam
Number	DX5707
Bulbs	
Headlight (sealed beam unit—925086)	
Upper Beam	45 watts
Lower Beam	35 watts
Service Tail Lights (Mazda No. 63)	3 C.P.
Service Tail Lights (Mazda No. 1158)	21 C.P.
Instrument Lamps (Mazda No. 55)	3 Watts
Beam Indicator Lamp (Mazda No. 51)	1 C.P.
Blackout Lamps (Mazda No. 63)	3 C.P.
Wrecker Spot Light (Mazda No. 1183)	50 C.P.

CIRCUIT BREAKERS—

Capacities	
Fuel Gauge Breaker	5 Amps.
Horn Relay Breaker	30 Amps.
Parallel Switch Breaker	40 Amps.
Starter Motor Breaker	40 Amps.
Spot Light Breaker (969B only)	40 Amps.
Numbers	
Fuel Gauge Breaker	DX5738A
Horn Relay Breaker	DX5738B
Parallel Switch Breaker	DX5738C
Starter Motor Breaker	DX5738C
Spot Light Breaker (969B only)	DX5738C

ENGINE

This vehicle is powered with a 131.5 horse power gasoline engine of "L" head design. It develops its peak horse power at 2300 R.P.M. and is governed at that speed.

The engine will give long and satisfactory service if given the proper care. It will give its best performance at an operating temperature of 160° to 180° F., with all the accessories clean and properly adjusted, with the proper lubricant in the crankcase and with a good grade of gasoline. Do not abuse the truck nor allow the engine to labor unnecessarily.

The following discussion will apply to the engine used in this chassis, but not necessarily to those used in other models.

CYLINDER BLOCK AND CRANKCASE—

The cylinder block and crankcase are cast in one piece in order to permit more efficient cooling by extending the water jacket down lower on the cylinders. This construction also results in a very rigid unit, which provides a sturdy support for the crankshaft. The water jacket slopes inward toward the bottom which increases the lateral rigidity. The crankshaft is supported on seven main bearings of very liberal dimensions.

CYLINDER HEADS —

The cylinder heads are of the conventional "L" head design and are easily removed for service work on valves, pistons, rings, etc. There are sixteen bolts distributed over each head in order to assure that they are properly held in place. There is ample cooling capacity in the head to provide uniform cooling.

If the cylinder head has been removed for any reason, clean head and block surfaces thoroughly before replacing. Bolt holes in the block should be cleaned out as dirt in them may allow cap screws to bottom and thus prevent proper tightening of the head and head gasket. Use two or three studs as guide pins when replacing the head, to hold the gasket in position.

A new gasket should always be used when the head is re-installed. It is good practice to soak the new gasket in water before using it.

The cylinder head must be tightened down properly to obtain a tight gasket seal. Irregular or under tightening will result in water leaks and blown head gaskets.

The head cap screws should be tightened uniformly, working from the center out toward the ends. If a torque wrench is used, the recommended torque is about 52½ ft. lbs. Bolts should be tightened to this tension while the head is cold. After the engine has been given a good warm-up, the screws should be tightened again with the engine at normal operating temperature. It is a good plan to follow this up with a third tightening after the engine has seen service for a day or two.

MAIN BEARINGS —

This engine has seven thin shell precision type main bearings. The upper and lower shells are interchangeable and no scraping or reaming is necessary. Each shell has a small projection which fits into a recess and rests against the adjoining cap or case to prevent the shell from rocking or rotating. The bearings are adjustable for wear by the removal of shims. For proper clearances see the specifications section.

In construction these bearings are brass back shells with a thin babbitt lining. This bearing has the advantage that after the bearing metal is completely gone, the crankshaft will not be galled.

CONNECTING ROD BEARINGS —

The connecting rod bearings are also of the shell type and are of the same material and construction as the mains.

CONNECTING RODS —

The connecting rods used in this engine have cap bolts which are integral parts of the rod forging. This construction results in an extremely strong and rigid big end and is practically free from distortion.

PISTONS —

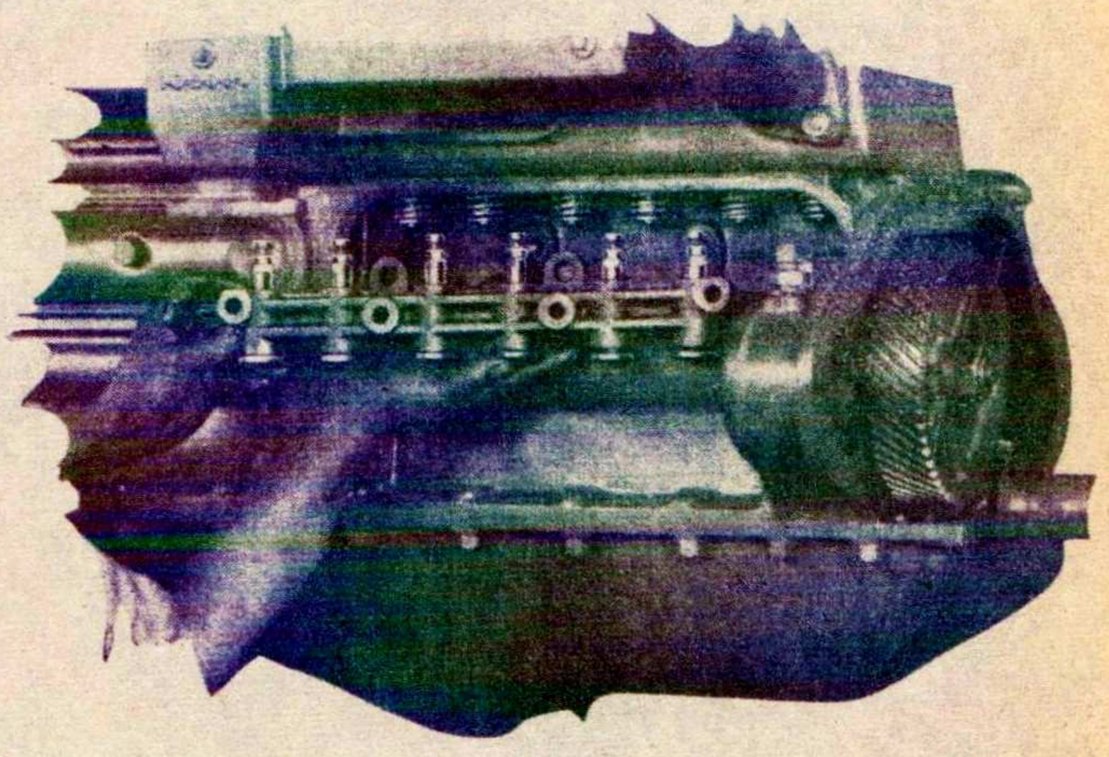
The pistons used in this engine are aluminum alloy split skirt with four compression rings and one oil ring. The metal of the piston forms a suitable bearing and therefore no bushings are required for the wrist pins, which have a working fit in the piston. The pin hole is diamond bored for this tight fit.

CAMSHAFT AND IDLER SHAFT —

The camshaft is supported on large diameter removable bearings in the crankcase. The idler gear is supported on a shaft which in turn is supported on a removable bushing pressed into the crankcase.

VALVES —

The valve guides are removable bushings pressed into the cylinder. The valves are forged from special



steels. An intake valve should never be used in an exhaust position but since intake and exhaust are the

same size, an exhaust valve can be used in place of an intake. Valve tappets are of the mushroom type and are guided in two removable clusters bolted to the crankcase.

ACCESSORY DRIVE —

The accessory drive for water pump and distributor is located on the side of the engine opposite the camshaft side. The accessory drive shaft is supported in a removable sleeve casting. The accessory drive sleeve with shaft can be removed without removing the front gear cover of the engine.

GENERATOR DRIVE —

Provision is made for a gear driven generator on the camshaft side. The generator is sleeve mounted and the generator gear meshes with the camshaft gear.

GOVERNOR DRIVE —

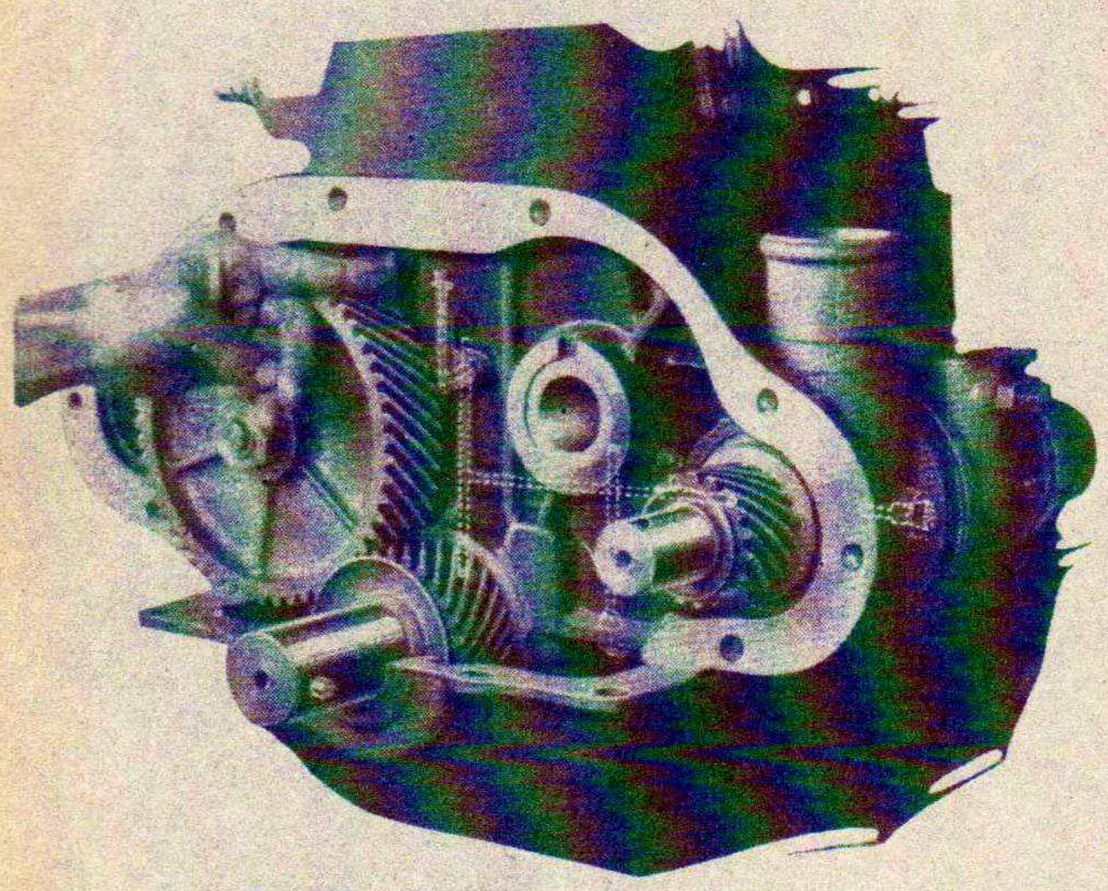
The governor operates on the centrifugal weight principle and the mounting is on the gear cover. This vertical type governor is driven from a helical gear which is bolted to the front face of the generator gear. This gear meshes with the driven gear on the governor.

FUEL PUMP DRIVE —

The fuel pump is mounted on the left side of the crankcase, close to the bellhousing. The fuel pump rocker arm is actuated by an eccentric at the rear of the camshaft. Since the camshaft is on the right side of the engine, the eccentric motion is transferred to the fuel pump by a plunger pin working between the rocker arm and eccentric.

OILING SYSTEM —

The oil pump is located in the crankcase and is driven by a spiral gear at the center of the camshaft. The oil pump driving gear on the camshaft is an integral part of the shaft. The oil pump is below the level of the oil in the crankcase and needs no priming.



The oil is delivered from the pump through a short copper tube to a suitable passage in the case which delivers the oil to the lubricating oil filter and through another passage back to the main discharge line or header. This header has a branch connecting to each main bearing. Thus there is force feed lubrication to all main bearings. The crankshaft is drilled to permit oil from the main bearings to be delivered under pressure to the connecting rod bearings.

Suitable drilled passages in the case deliver oil to the timing gears, idler gear bearing and accessory shaft bearing. (See illustration). Cylinder bores, tappets and valve stems are lubricated by the oil thrown off around the connecting rod bearings. The camshaft bearings are lubricated by gravity feed from oil collected in pockets.

Oil Pump — A gear type triple oil pump is used to insure an adequate oil supply for the engine. The oil delivered to the engine is always lifted from the sump in the bottom of the crankcase by two pumping gears in the bottom of the oil pump housing.

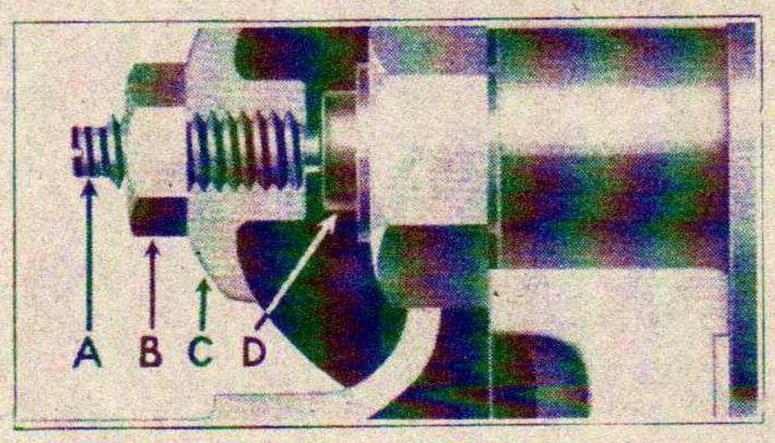
However, if the vehicle is on a steep grade so that oil rushes to either the front or rear of the crankcase, an auxiliary set of pumping gears is provided to deliver this oil back to the sump.

Oil Pan — The oil pan is an angle pan type, that is, it has angular traps to hold the oil from rushing to one end or the other when driving on steep grades.

There is a wire screen around the oil pump which is attached to and may be removed with a circular plate in the bottom of the oil pan. This should be removed and cleaned as frequently as is necessary under conditions of operation.

GEAR COVER —

The end play of the camshaft and idler shaft is controlled by adjusting screws through the gear case cover. These adjusting screws have a hard fibre plug inserted in the inner end which bears against a hardened steel plug in the end of the shaft. To make the adjustment, loosen the lock nut and with a screw driver tighten the screw with a light pressure and then back it up ⅛ turn before tightening the lock nut.



Gear Cover Adjusting Screw

A. Adjusting Screw.
B. Lock Nut.
C. Gear Cover.
D. Shaft thrust button.

COOLING SYSTEM

The cooling system (capacity—12 gallons) consists of the water pump, thermostat, fan, radiator, temperature gauge, pipes and rubber tubing. The entire cooling system is a unit and must function as such. A periodic and systematic inspection of each part of the unit is essential to maintain an efficient system.

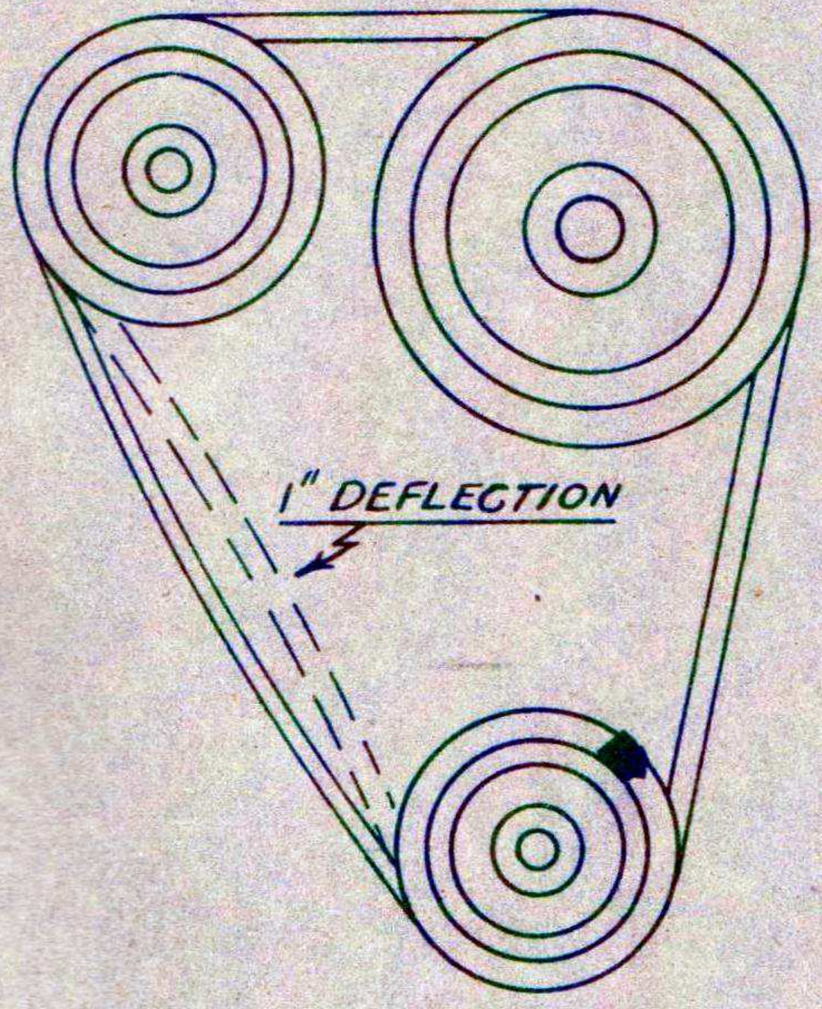
Engine temperatures should be maintained at 160° — 180° F. A cold engine allows the condensation of the products of combustion with a resultant acid condition leading to corrosion of polished parts and to rapid wear. The engine may heat over 180° F. when laboring, and this is not necessarily an indication of trouble, but if the cooling water reaches the boiling point the vehicle should be stopped and the cause of overheating determined.

Water Pump — The water pump assembly is mounted on the left hand side of the engine, close to the middle of the block. It is gear driven through a coupling, with the impeller located in the pump body.

It is the regular packing type which requires very little pressure from the packing nuts. When tightening packing nuts to stop water leak, use very little force and if the leak is not stopped the pump should be repaired. Split ring type packing is used so that the pump can be repacked without disassembling.

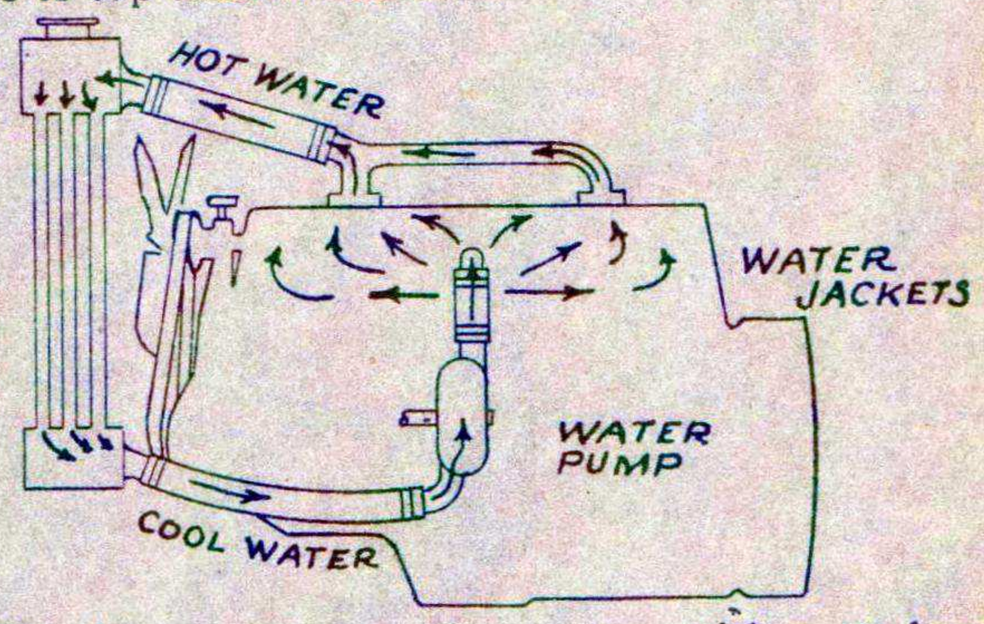
Fan — The fan is 6-bladed, driven by two "V" type belts which also drive the air compressor.

Fan Belt Adjustment — As the double belts drive both air compressor and fan, they must be kept in proper adjustment. The "V" type belt does not need to be extremely tight but is adjusted properly when it can be deflected about one inch as shown in illustration.



When making a belt adjustment, first loosen the clamping nut back of the fan assembly. Then turn adjustment screw in the top of the fan bracket until the desired condition is reached. Tighten clamping nut.

Water Circulation — The water pump forces circulation through the cooling system as illustrated. The heated water is cooled by the radiator which is connected to the engine at the top and to the pump at the bottom by means of rubber hoses. The fan draws air through the radiator core to cool the water. The pump draws cool water from the bottom tank of the radiator and pumps it through the water passages in the engine block around the cylinders and through the water outlet manifold and connecting hose to top tank of radiator.



This is a pressure cooling system with a mechanism in the radiator cap to keep the internal pressure of the system several pounds per square inch above atmospheric pressure. The radiator is always sealed unless the pressure increases beyond the setting limit, in which event the seal is broken and vapor, air or water escape through the overflow tube until such time as the internal pressure has returned to its proper level.

The principal advantage of this type of system is that water loss is very much reduced since vaporization is held to a minimum and the water loss due to unlevel terrain is eliminated. Since it operates at higher atmospheric pressure, the boiling point of the water is raised and the system's capacity is therefore increased.

Important — Remove radiator cap slowly and when replacing it be sure that it is screwed down tightly.

Cleaning Cooling System — Drain about three gallons of water from the system and replace it with an equal amount of boiling water which is saturated with common washing soda. Be sure that the system is completely filled. Cover the front of the radiator core and run the engine at a speed equivalent to 15 miles per hour for about 15 minutes. This will circulate the cleansing agent throughout the system. Disconnect the radiator outlet hose to drain the system and flush thoroughly with clear water.

Important — Do not allow cleaning mixture to come in contact with hood or fenders as it will attack painted surfaces.

Frozen Radiator — Freezing while the truck is running is generally confined to the lower part of the radiator as the water passing into the top of the radiator is always warm. As it passes down through the

Cooling System *(Continued)*

radiator it is rapidly cooled, so that the coldest water is always at the bottom.

Freezing naturally prevents any further circulation of water, so that the water around the cylinders gets very hot and finally boils. The danger of this condition is that the water may boil away and permit the cylinders to become overheated.

To Thaw Out Radiator — The best method of course is to get your truck into a warm garage and let it thaw out gradually. If you cannot do this the next best thing is to cover the radiator and hood with a blanket; let the engine run slowly until the blanket steams. Shut the engine off and let it stand for a few minutes and repeat the operation three or four times if necessary until the heat gradually thaws it out. DO NOT USE BOILING WATER TO THAW OUT A FROZEN RADIATOR.

Cautions —

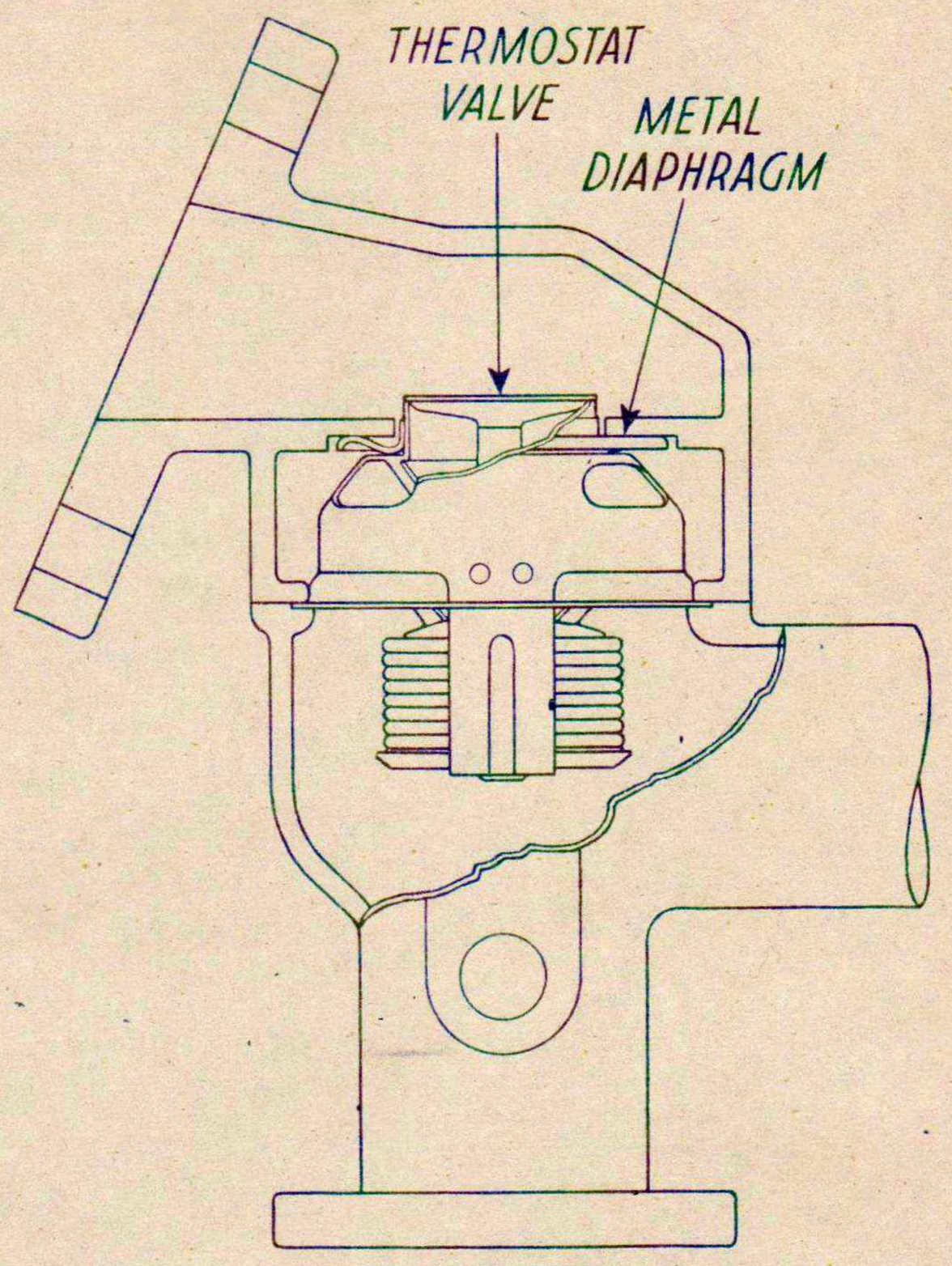
1. Do not use linseed meal, bran or any preparations to stop radiator leak. This will only afford temporary relief and may cause other damage. Have radiators repaired promptly.
2. Do not run engine without water in cooling system.
3. Do not add cold water to an overheated engine.

THERMOSTAT —

The thermostat is a valve controlling the flow of water to the radiator, for the purpose of raising the water temperature quickly after starting the engine, to a satisfactory operating range and maintaining it while running. It operates by means of the expansion of metals by heating, its normal position being closed. It is designed to be completely closed at 157° F. It is just cracking open at 162° F. (about .003″). It opens fully at a maximum temperature of 185° F.

Located in a chamber at the forward end of the water outlet manifold, the thermostat is provided with a gasket making a complete seal of the passage to the radiator, when cooling system water is at or below 157° F. When engine is started, circulation from the cylinder block and head water passages to the radiator being stopped by the closed thermostat, some water is allowed to pass through the thermostat body to a by-pass which returns it to the suction side of the pump. When the temperature of this small by-passed circulation is raised by the engine operation to between 157° F. and 162° F., the thermostat expands and commences to open its valve allowing circulation to go to the radiator. As the temperature rises, the valve continues to open until there is full circulation, with engine water jacket contents at from 170° F. to 185° F.

In winter operation, care should be exercised to see that thermostat is operating correctly. In summer operations under extreme heat conditions it may be desirable to remove the thermostat gasket so that the unit will be inoperative, and possibly the plugging of by-pass tube to prevent the short circuiting of cooling water may be necessary.



Thermostat

When installing a thermostat, complete filling the radiator slowly while the engine is running. When the engine is thoroughly warmed, recheck the water level.

Servicing the Cooling System — The coolant mixture may be lost from the cooling system through leaks, boiling, foaming, expansion or evaporation. Excessive boiling, evaporation or foaming may be the result of water impurities or a poorly operating circulating system. The loss by expansion is the result of over-filling.

The cooling system should be regularly inspected and serviced before adding any anti-freeze solution. The system must be cleaned thoroughly and all rust and scale removed.

New radiator and heater hoses should be installed as the anti-freeze solution may cause trouble with hoses old and water soaked.

The water pump seal must be tight, not only to prevent loss of liquid, but to keep air out of the system. Air in the coolant may cause foaming, oxidation or corrosion. The entire system should be inspected for leaks.

Cylinder head gaskets should be checked and replaced when necessary. Any leakage around the gasket is likely to result in a sludge or gum formation due to the mixture of engine oil, water, and anti-freeze, and may cause serious damage to working parts.

ANTI FREEZE SOLUTIONS —

In some localities an anti-freeze solution is a necessity during the winter months. A proper anti-freeze is selected after a consideration of local conditions and the type of service.

Ethyl and methyl alcohol are perhaps the most commonly used of present day anti-freeze solutions.

The alcohols have a comparatively low boiling point and are likely to be lost by evaporation on a warm day or with hard driving. The solution must be tested frequently to be sure that the alcohol is present in sufficient concentration to provide adequate protection.

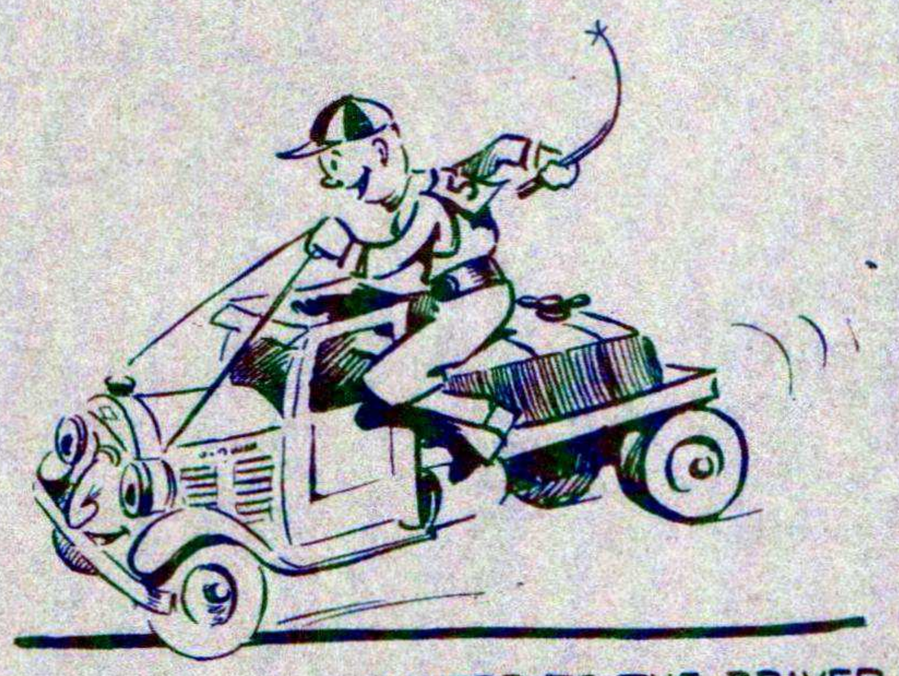
Commercial Compounds —

Commercial anti-freeze mixtures are compounded from ethylene glycol, propanol and other similar substances. These solutions will give adequate protection provided that the manufacturers' instructions are closely followed.

While these are more expensive than the anti-freezes already mentioned, they have the advantage of a higher boiling point, and hence are not so easily lost by evaporation. Generally speaking, these compounds are non-corrosive and will not injure the finish on the vehicle.

Anti-Freeze Table —

Freezing Point ° F.	Parts Alcohol	Parts Water
30 above zero	5	95
20 above zero	15	85
10 above zero	25	75
zero	30	70
10 below zero	35	65
20 below zero	40	60
30 below zero	45	55
40 below zero	55	45



A WORD TO THE DRIVER

DON'TS FOR DRIVERS

DON'T clash gears in transmission. Learn to shift smoothly by synchronizing engine speed with truck speed.

DON'T slip clutch in starting load. Select proper gear and the start will be smooth and easy.

DON'T permit the load to drive the engine at excessive speeds in descending steep grades. That knocks out motor bearings.

DON'T ride with foot on clutch pedal.

DON'T spin wheels on icy streets or wet roads. That ruins differential parts.

DON'T use service brake excessively on long hills. Use the compression of the motor as a brake.

DON'T race a cold motor. Let it idle till oil is warm and showing proper pressure on gauge before working at speed.

DON'T drive at unreasonably high speeds.

DON'T use choke any more than is necessary. That wastes fuel and causes crank case dilution and rapid cylinder wall wear.

DON'T run engine in a closed garage. Death without warning comes from the carbon monoxide gas in exhaust fumes.

DON'T put boiling water in cooling-system to thaw a frozen radiator.

DON'T continue driving if heat indicator shows excessive temperature. Stop and determine cause.

DON'T put cold water in an overheated motor.

DON'T run truck with under-inflated tires. When tires have less than proper pressure they damage more easily and may cause poor steering.

DON'T drive on street car tracks. Doing so is cause of much uneven wear of the tire tread.

DON'T omit to clean air cleaner regularly. Dust allowed to get into motor leads to wear and breakage of piston rings and to very rapid wear of cylinder walls.

DON'T operate motor too cold. That causes misfiring, crankcase dilution, sludge and rapid wear of piston rings and cylinder walls, and etching of polished parts such as piston pins, crankshaft journals and pins, camshaft journals and cams, or valve lifter mushrooms. Right operating temperature is 160° to 180°.

DON'T drive fast over rough spots and avoid bumps wherever possible. To do so makes for tire damage and puts undue strain on springs and steering gear.

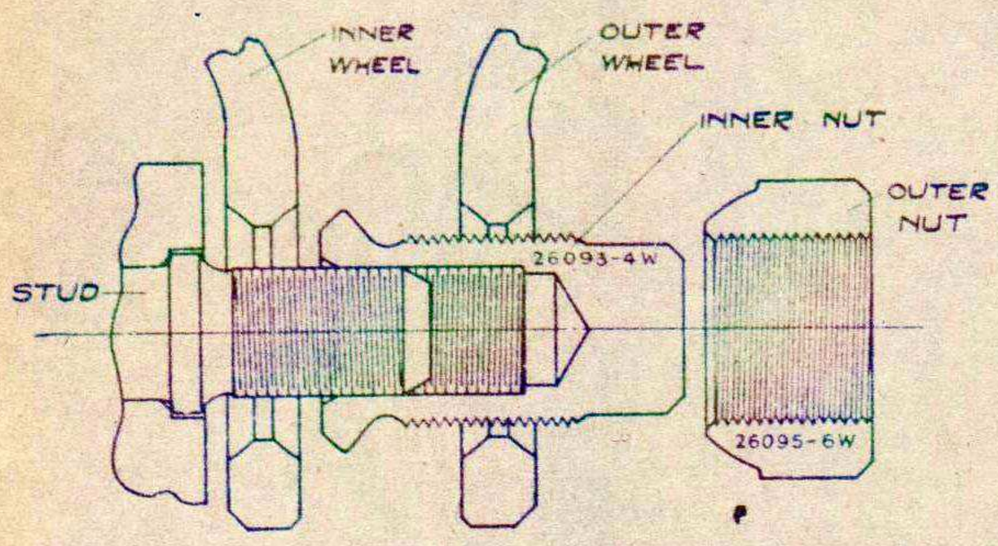
WHEELS

The wheels used on this vehicle are the tapered disc type made of cold rolled steel.

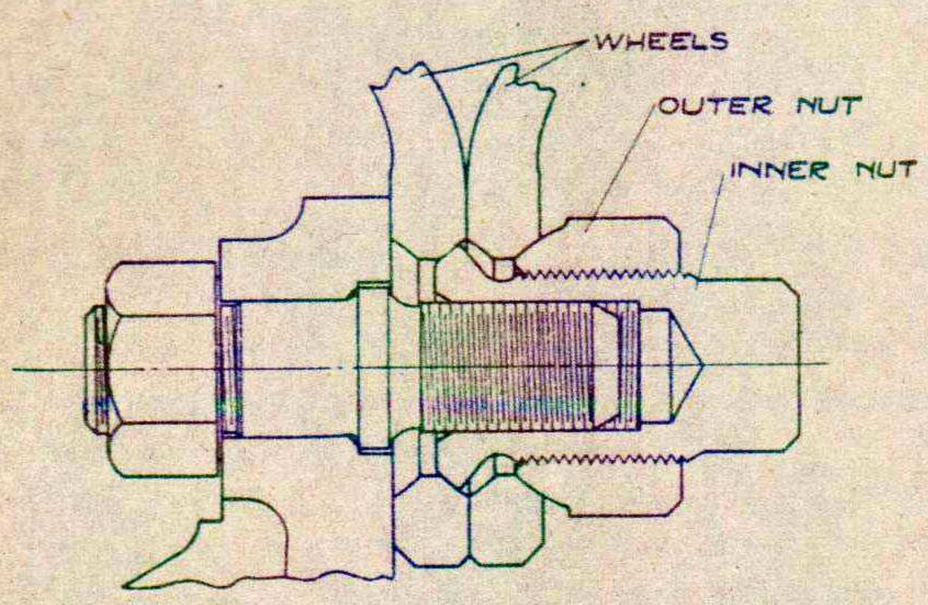
WHEEL BOLTS —

All studs and cap nuts are plainly marked "R" and "L" designating right and left hand threads used to offset any tendency of the cap nuts to work loose.

Those marked "R" must be used on the right side of the chassis, while those marked "L" must be used on the left side.



The dual wheels are locked with double cap nuts. The inner dual is individually held by a sleeve-like inner cap nut. The inner dual must be mounted and tightened down before the outer wheel is put on. The outer dual slips over the inner cap nuts and is locked in place with the outer nuts. The wheels do not pilot at the hub center; the entire load is distributed over the cap nuts and studs.



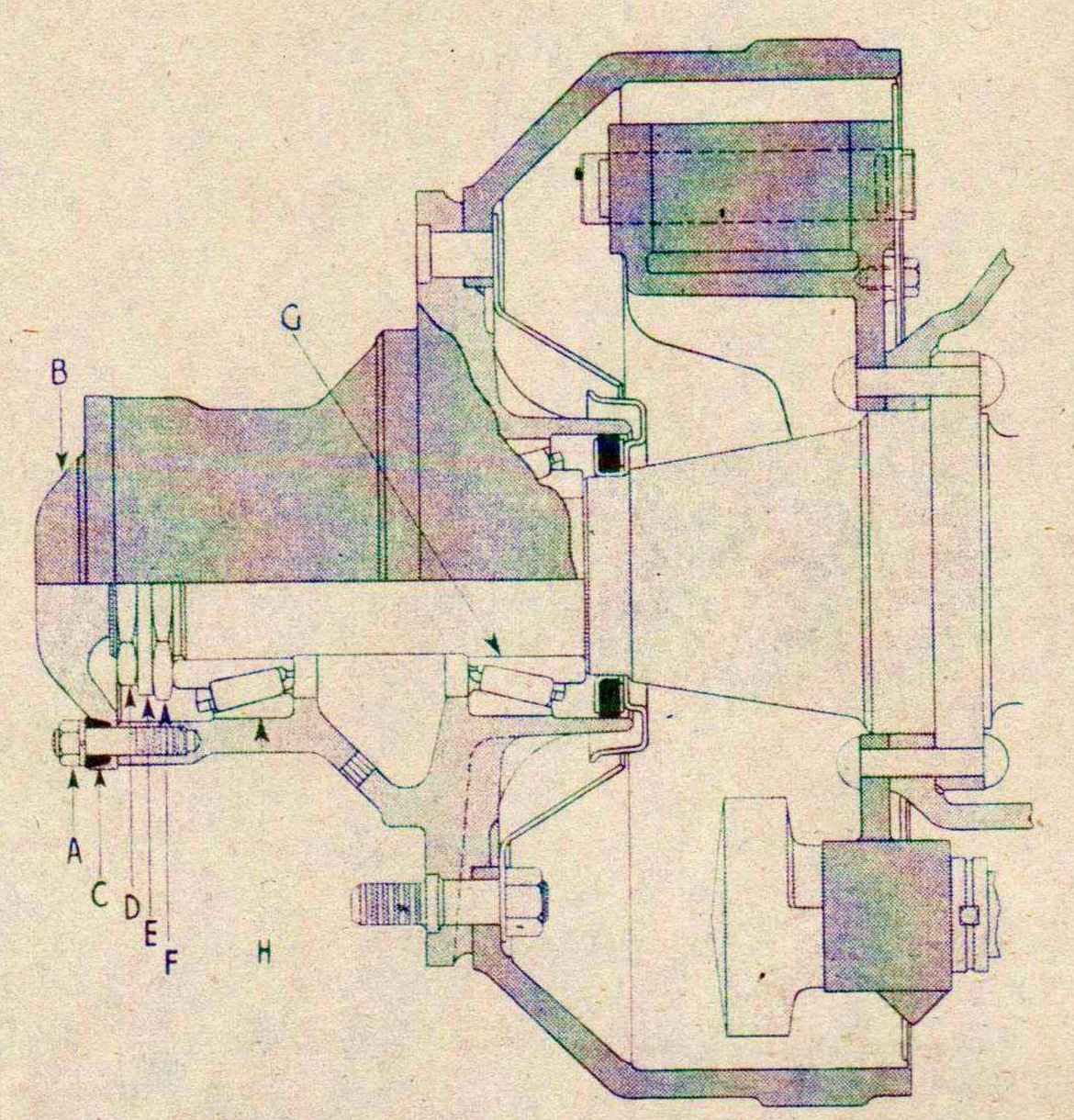
Cap nuts should be tightened with the wheels off the ground. The outer nuts must be backed off at least two full turns to facilitate tightening the inner cap nuts, which must not be neglected. The cap nuts should be tightened in a criss-cross fashion and not around the wheel.

It is good practice to make frequent checks for tightness in the studs and cap screws. Always clean the wheels before reassembling, especially at the countersunk holes and bolt on flanges.

Mount the dual wheels with the inner valve stem in a different circumferential position than the outer to permit easy inflation of the tires.

WHEEL BEARINGS —

A full floating axle is used in both the front and rear driving units. The hubs are rotated on a double



set of opposed tapered roller bearings supported on the axle tubes. The wheel bearings are adjustable for wear, and if they are to give long and satisfactory service they must be properly adjusted and lubricated.

Note — While the front drive axle is different than that used in the rear, the same instructions may be used for all of the wheels, save that it is only necessary to remove a stub, rather than a full shaft, from the front assembly.

Removing Wheels —

1. First remove the stud nuts (A) around the axle shaft drive plate (B).

2. Remove the axle shaft. Split taper dowel locks (C) are located between the studs and the drive plate, and care must be exercised that these are not lost.

3. Raise the wheels from the floor with a jack under the housing and wipe the grease from the end of the housing tubes and lock nuts.

4. Remove outer lock nut (D), locking washer (E) and adjusting nut (F).

5. Place a greased board under the wheel and lower the wheel until it is resting lightly on the board. (The wheel is too heavy to be conveniently lifted off the axle tube and so it is best to slide off on a grease board.)

6. Remove outer bearing (H). Be careful not to drop it on the floor as this may bend or damage the cage.

7. Now slip the wheel off along the greased board.

8. It is now possible to remove the inner bearing and oil seal.

9. Using a good stiff brush and kerosene or suitable solvent, thoroughly scrub the old grease from the bearings, hubs and tubes.

10. Inspect the bearings for pitting and use new parts if necessary, never use bearings showing wear.

Reassembly and Adjustment — After all parts have been thoroughly cleaned and dried, proceed as follows:

1. The grease seal should be carefully inspected and replaced if necessary. Seals should be changed from time to time to prevent leakage from wear.

2. Replace the inner bearing on the tube, covering it well with the proper grease. Be sure that the grease is clean, that is, free from grit or solid matter; see that the paddle is clean. (Use a No. 3 cup grease only).

3. Repack the space in the hub between the two cups which fit over the bearings with clean grease, ½ to ⅔ full.

4. Slide the wheel back on the axle tube.

5. Hold the wheel in place and press the outer bearing firmly into the hub.

6. Screw up the inner adjusting nut, turning it with the wheel rotating until it binds.

7. Back off the nut enough to allow free rotation of the wheel without end play.

8. Test your adjustment with a bar used as a lever between the tire and the floor. Hold a finger on the outer bearing cage while working the bar up and down so that it will be possible to detect any excessive play or looseness. If the wheel rotates freely and there is a barely perceptible shake, the adjustment is correct. Proper adjustment is from .003″ to .005″ loose.

9. Replace the locking washer and nut, screwing the nut up tight. Test the adjustment again.

10. Cover the end of the axle tube and lock nuts with grease and replace the axle shaft.

11. Tighten studs thoroughly, being sure that the tapered dowels are in place.

Cautions — Don't jam the lock nuts so tight that the wheels will bind. Don't allow the lock nuts to be so loose that you can feel the end play in the bearings by shaking the wheel. Carefully follow the lubrication instructions found in this manual.

TIRES —

Inflation maintenance is the most important element of tire care. The tire is designed and manufactured to give good service on a prescribed amount of air pressure and it is the operator's responsibility to keep the tires at that pressure.

Note — Check tire pressures at least once a week. Maintain pressure at 65 pounds per square inch for all tires.

Changing a Tire — To change a tire proceed as follows:

1. If the tire is not flat, deflate completely.

2. With tire tools, pry loose end of clamp ring over the edge of the wheel and work the ring loose.

3. Remove rim clamp ring assembly.

4. Lift tire from wheel.

5. Slip new tire over wheel, guiding the valve stem into the slot provided. Be sure that valve is facing in the right direction and that the tread is oriented correctly. (See arrow on tire.)

6. Place clamp ring assembly in position and work snap ring over edge of wheel.

7. Inflate to 65 pounds pressure.

Tire Inflation — An air hose is supplied with each vehicle so that it is possible to inflate the tires from the air pressure reservoirs of the braking system. The air pressure gauge should read close to 100 pounds pressure before this is attempted.

Lift the left hand hood and remove the cap nut from the front of the inflation fitting. Attach the air hose coupling to this connection and open the supply valve. The tires may now be inflated in the usual manner to 65 pounds pressure.

Run engine long enough to replenish air supply before driving the truck.

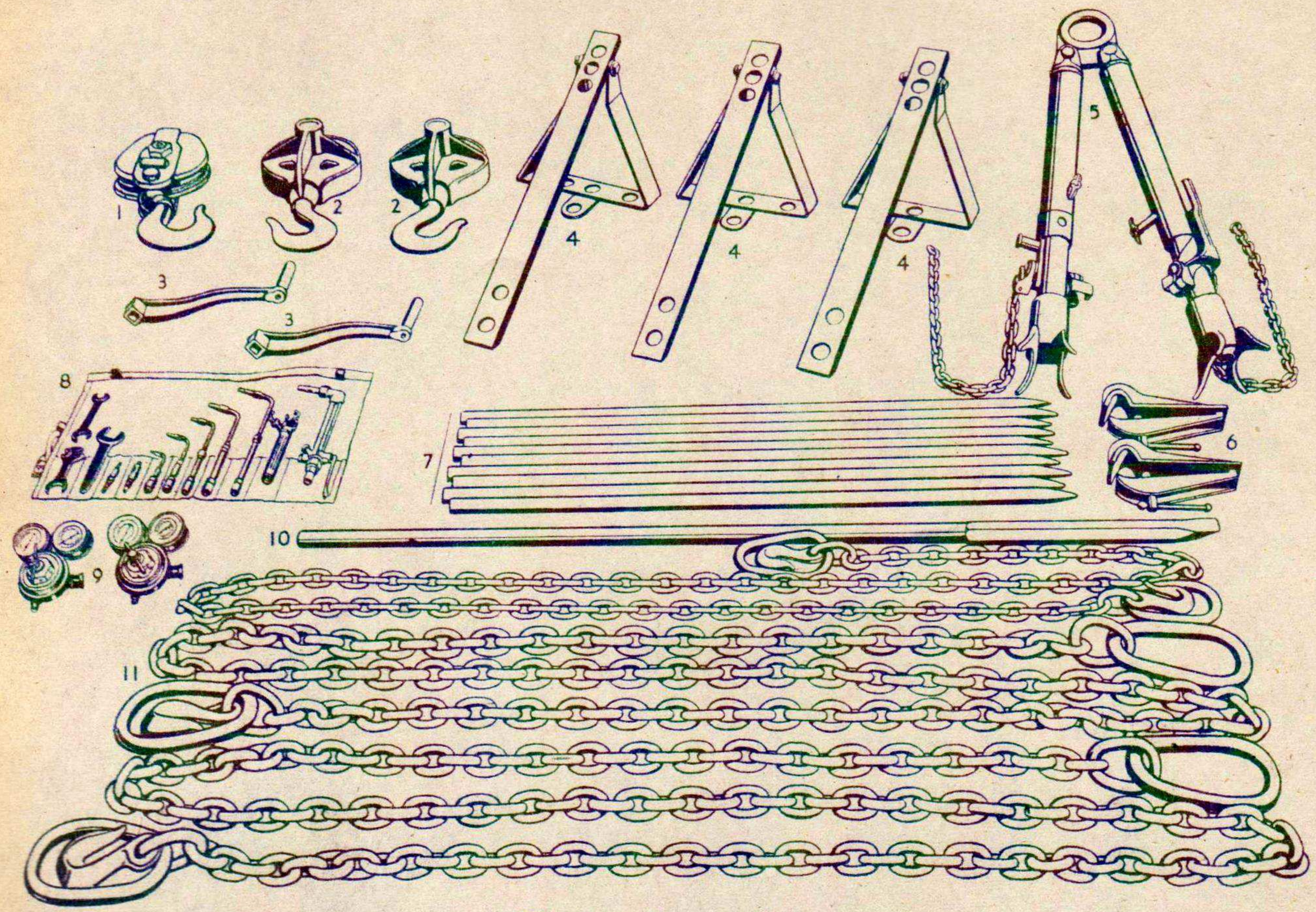
Improper Inflation is probably the most frequent cause of rapid tire wear and yet is the easiest to avoid. Underinflation permits abnormal flexing of the side walls which causes the tread to be wiped away. It has been found that an average tire will lose 30% of its life when run 6 lbs. under inflated.

Balloon tires are designed to give proper deflection and road contact at a specified inflation pressure. If these are changed from normal by overinflation, underinflation or overload, satisfactory service cannot be obtained.

Temperature — Road surfaces are generally warmer than air temperature and in very hot weather will reach temperatures around 130°F. The rate of tire wear increases with the temperature; in fact, wear is five times faster at 100°F. than at 40°F. Summer driving will give only 50% as much tire mileage as winter.

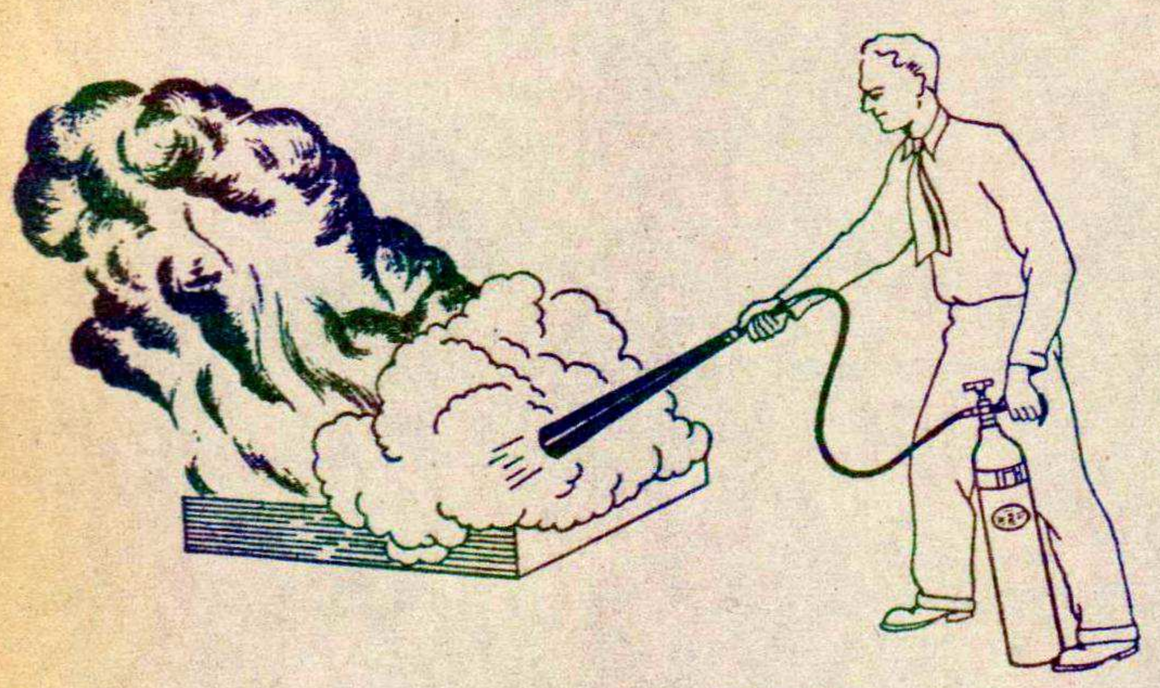
Misalignment — If the wheels do not run parallel they will scuff the tread from the tires. A tire only ½″ out of line will scuff 87 feet in every mile.

Wheel Balance — Pitting, cupping, rippling, etc. at one location on the tire circumference is caused by an out of balance condition. Balance wheels carefully using wheel balance equipment or follow instructions on page 1-10.



Wrecker Accessories

1. Western snatch block.....1081	5. V tow bar VB-45	9. Oxygen Regulator 8506
2. Snatch blocks 3850A	6. Steering gear clamps.....1552A	9. Acetylene Regulator 8502
3. Hand operating cranks 1018A	7. Anchor stakes 1173	10. Crow bar DX5837
4. Ground anchors 1172A	8. Welding kit	11. Grab chains (Large) DX5839
		11. Grab chain (Small) DX5840



USE OF FIRE EXTINGUISHER —

The wrecker truck (Model 969B) is equipped with a large carbon dioxide fire extinguisher mounted on the right running board. The extinguisher is held in place by a snap clamp and is easily removed in emergencies.

To use the extinguisher proceed as follows:

1. Carry extinguisher to fire and then open valve. Do not open valve before carrying extinguisher to fire. Carry it in one hand and hold the nozzle at the hose end of the handle with the other. (see illustration.)

2. Direct discharge close to fire. Do not stand at a distance as effectiveness will then be lost.

3. Direct discharge first at the edge nearest the operator, or if on a vertical surface, at bottom of fire.

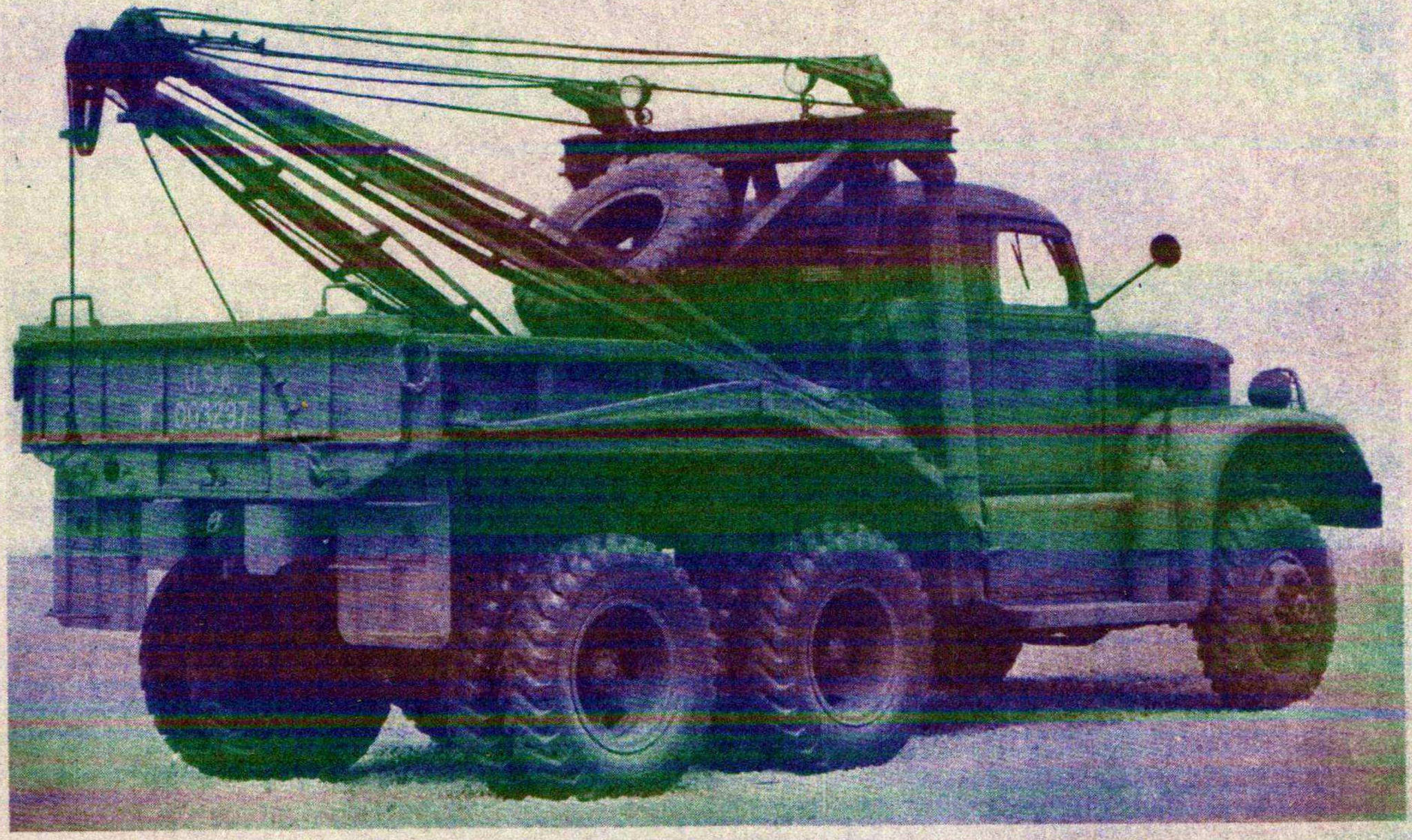
4. Slowly and deliberately advance the discharge as flame is extinguished. Do not haphazardly direct discharge over various sections of fire. Put out one portion of fire completely before attacking other parts.

5. Continue discharge after flames are out to coat hot material with carbon dioxide snow.

6. Recharge extinguisher as soon as possible.

WRECKER EQUIPMENT

The wrecker equipment installed in Model 969B is ten ton capacity (5 tons with single line or 10 tons when using snatch block). The equipment includes two telescoping brace legs, two swivel booms and power winches mounted on a structural frame carried on chassis side rails, with necessary cables, anchors, blocks, tow-bars, etc.



Model 969B — Wrecker

Winches—The separately operated power winches each carry 200 feet of cable, and derive their power from a chain driven transmission, which obtains its power from the truck engine through a power take off on the transfer case. The winches can be operated simultaneously or individually.

Accessories — The wrecker equipment includes snatch blocks, anchors, tow bars, steering gear clamps, chains, a crow bar and welding equipment. The latter includes two gas tanks, 75 feet of hose and the necessary jets and nozzles. An air compressor for tire inflation, a fire extinguisher (carbon dioxide type) and two spot lights are furnished.

Rigging for Operation — In use the wrecker should be placed alongside the object to be moved, and at a suitable distance from it to admit of freedom in use of the equipment and to permit the load being drawn to a position in which it can be further handled. The brace leg on the load side should be lowered into position towards the load, and generally at full extension of the attaching chain.

The boom on the loadside is now swung out towards the load and the cable hooked to the chain previously attached to the load.

If the load is heavy or circumstances require pulling at low speed, a snatch block should be used, the cable hook being anchored to the loop or eye on the top of wrecker frame. In the event of load being exceptionally heavy it is desirable to swing out boom on opposite side of wrecker and attach cable to suitable anchor.

For loads under five ton pull, frequently the simplest method is to pull from the rear of the wrecker with the booms locked together and with a snatch block in the line. In this method, truck brakes are set but the brace legs are not rigged. Pulling from the rear is generally used when the object lifted can be towed on its wheels.

Brace Legs — The two brace legs are tubular steel telescoping in design, the upper and outer portion being pinned to a swivel mounted on the end of the wrecker frame. The lower or sliding member is equipped with a steel foot, to which a chain is attached. This chain, with a grab hook at the free end, serves to limit movement of the brace leg when in use, and to prevent kicking out under load. In traveling position the brace leg is secured in a bracket welded to base of wrecker frame. The sliding portion is secured in its nested position by a spring pin near

the bottom of the outer tube which passes through a corresponding hole in the inner or sliding tube.

To place the brace leg in position for operation, operator should lift it by the handle on the foot clear of carrying bracket and draw spring pin allowing sliding portion to move out. Swing brace leg in direction of load and carry out towards the load as far as is necessary, dropping brace leg foot to the ground and locking pin in upper-half so that the inner portion cannot slide and the two sections become a single stiff-leg. Tie the chain to loop in the base of the wrecker frame.

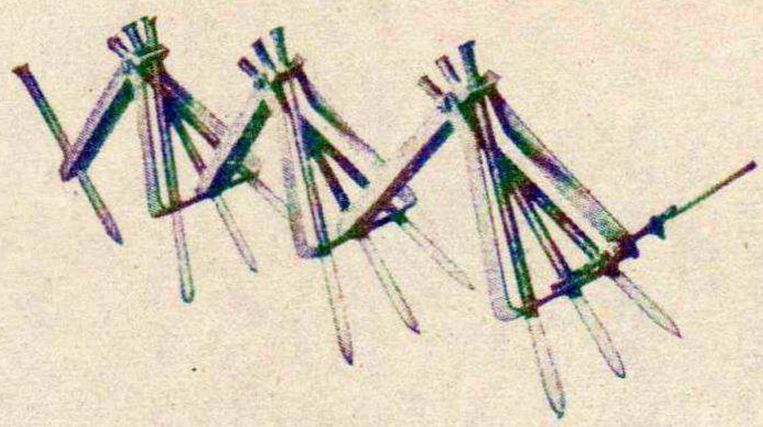
The brace leg on the load side only of the wrecker should be used, as if the one on the far side from the load is also lowered, the strain of the pull on the vehicle will tip it towards the load and the brace leg on far side will tend to slip in towards the wrecker so that when strain of pull is slacked, the wrecker would not return to its normal position but would be cocked up by the brace legs.

After operation is complete, raise brace leg and replace in holding bracket before moving vehicle.

Installation of Working Tackle—To release cable, winch drum is thrown out of gear by means of a handle controlling a sliding pinion which meshes with the bull gear. A back lash brake prevents cable unwinding when there is no pull on the line. When cable is released it may be slacked sufficiently to unhook from loops in back of wrecker body so that it will be free for work at back of truck or to swing with the boom when the latter is unlocked for rigging in position for work at an alongside position.

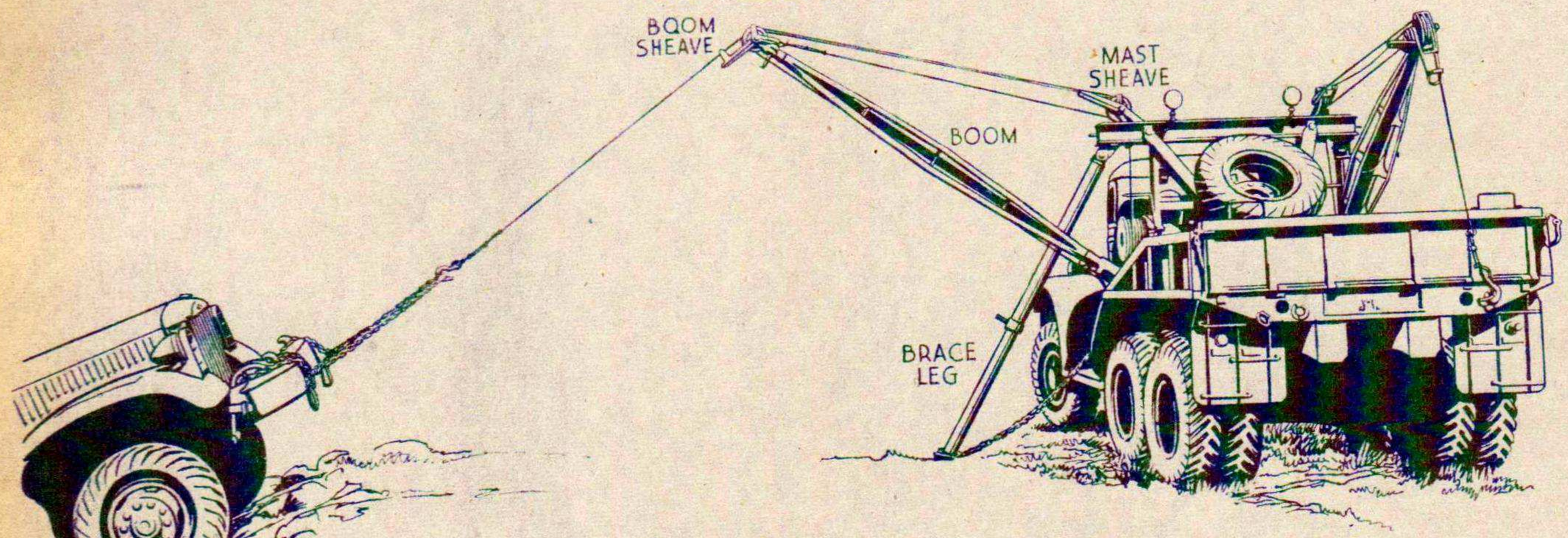
The cable may now be carried towards the object to be hauled or lifted, the character of the pull determining the most suitable hook-up, — the straight hook with single line; double line with snatch block; a light pull from the rear or a heavy side pull with anchor lines out. Mud, obstructions in line of haul or a sharp incline may indicate the desirability of using a high boom for its lifting effect. The booms are raised or lowered by the use of a hand crank winch mounted in drum housing at base of boom.

If the object to be hauled or lifted is not equipped with some means of attaching cable or block hook directly to it, then a sling should be made of the grab-chains so that cable or block-hooks can be attached. **Under no circumstances should cable be wound around the load. To do so distorts the lay of the wires forming the cable, and dirt and moisture can get into the core causing rapid deterioration from corrosion and friction.**



Anchors — Natural anchors — trees, etc. — are desirable if available, and of suitable strength. In absence of such natural anchors, the ground anchors furnished with the wrecker will be suitable in most cases. They are triangular in shape with a rest which at installation should form about a right angle with the triangle of the anchor frame. The illustration shows method of installation. Anchors should be used chain fashion; never use a single anchor.

OPERATION



Single Line Hook-up

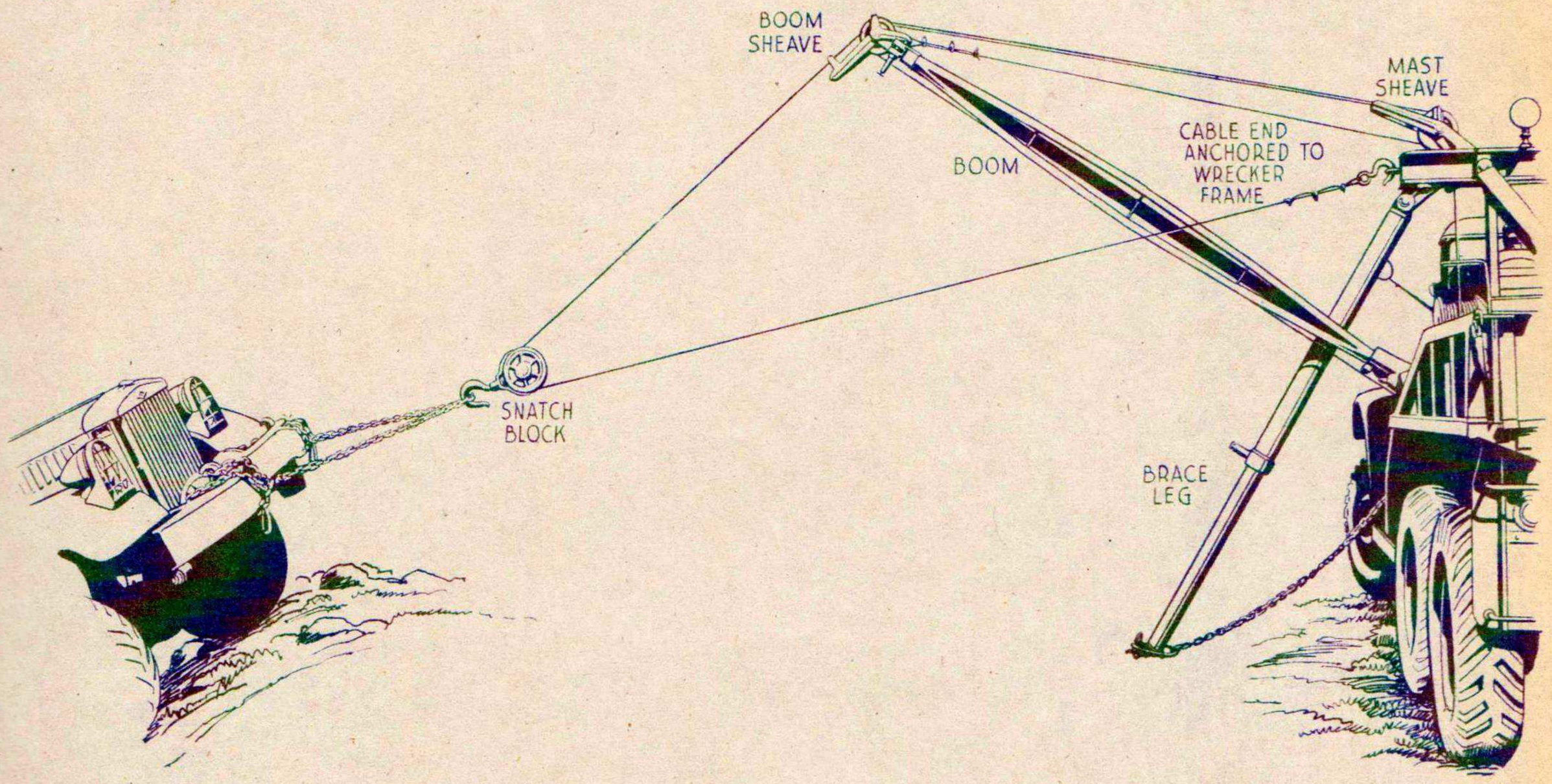
Operation — Successful wrecking operations depend on early and proper organization; on prompt moving of equipment and accessories to the points where they are needed; on exercise of control to coordinate the wrecking activities and to eliminate injury to personnel or damage to equipment.

The wrecker foreman, or person designated to give signals or issue commands, must place himself where he can see the object being raised and the wrecker operator. The tendency on the part of others present

to give advice, issue orders or make signals should be prohibited.*

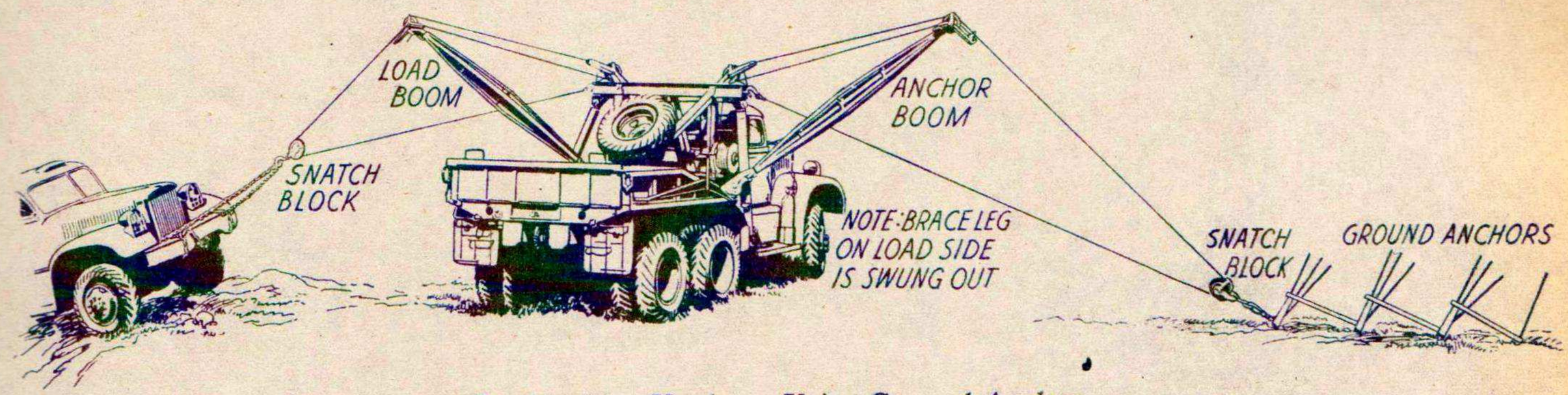
Having determined by examination of ground and load what type of rigging is most suitable, and the proper location of the wrecker unit, the machine is spotted in its position, brace leg set up and cable run out.

Illustration on preceding page shows simple one line hook-up from the side, one brace leg and one boom out with hook in cable attached to sling attached to load. Other boom shown in traveling position.



Double Line Hook-up

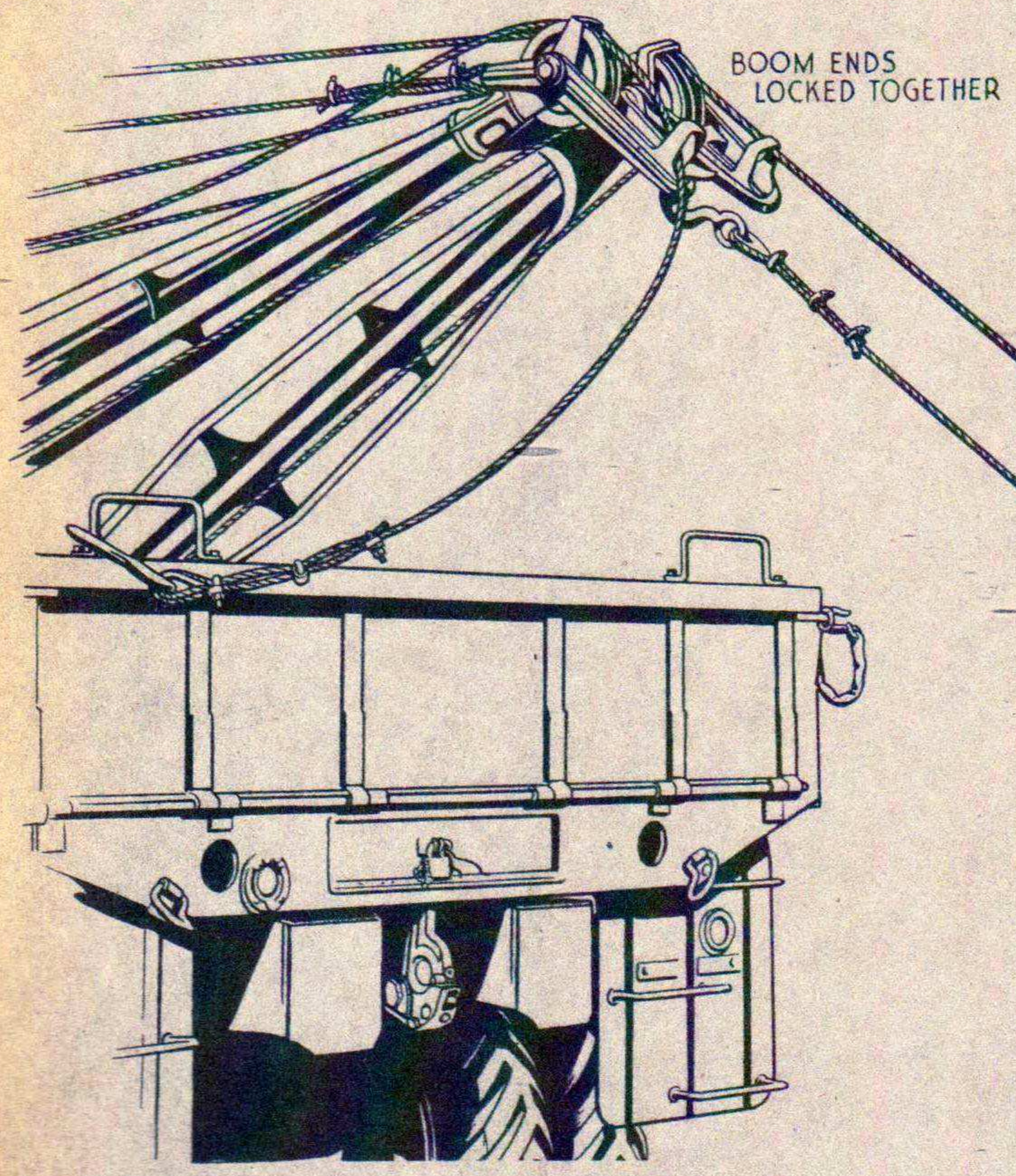
Illustration shows double line hookup from the side, using snatch block, over which pulling cable is returned to wrecker and hooked to the loop in top of wrecker frame. **Never hook cable on double line operation to the guide loop on end of boom.** To do so does not accomplish one object of double line equipment which is to divide the load between boom and frame.



Double Line Hook-up, Using Ground Anchors

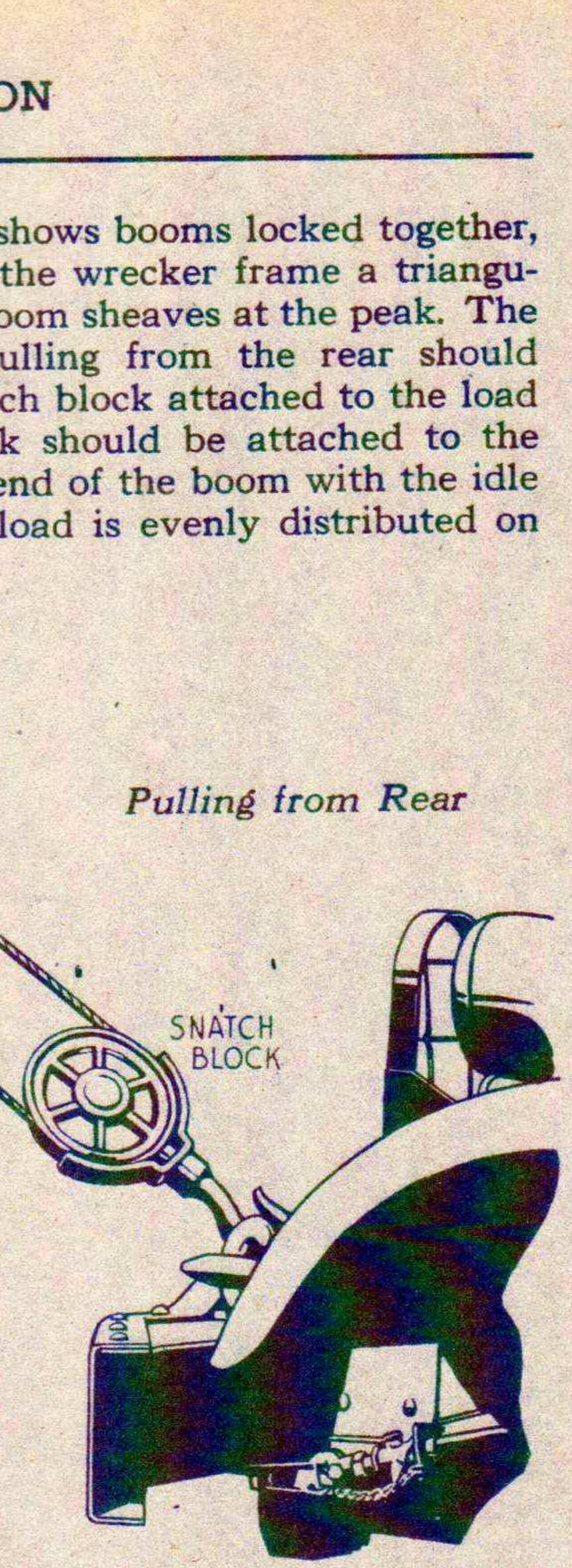
Illustration shows hook-up with double line on load side and on anchor side, both booms out, and in line with each other. Brace leg out on load side only. Snatch blocks should be used in both load and anchor lines, as pulling and anchor lines must be of equal strength at all times. Anchors and load should be in line with booms so that pull is directly through the wrecker frame.

*See War Department Training Regulations 185-5 dated July 31, 1924, and Field Manual 525-10, Motor Transport, Chapter 4, Pages 101-131.



The illustration shows booms locked together, thus forming with the wrecker frame a triangular truss with the boom sheaves at the peak. The cable in use in pulling from the rear should always have a snatch block attached to the load and the cable hook should be attached to the guide loop on the end of the boom with the idle cable, so that the load is evenly distributed on the two booms.

Pulling from Rear



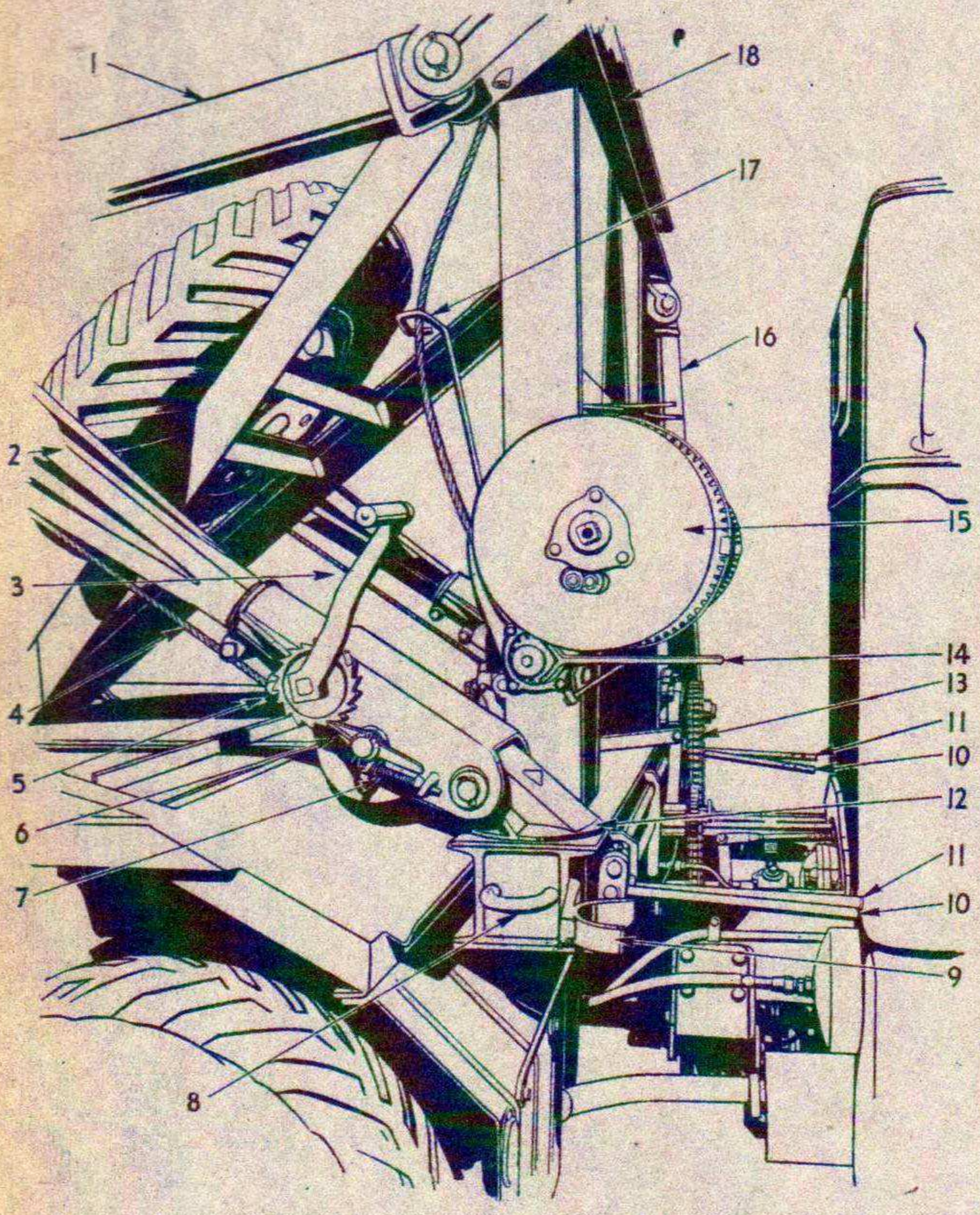
In hauling from the rear extreme side pull should be avoided as to pull much out of a line to the rear might result in cable riding off the sheave pulley and also excessively strain the boom connections. A maximum pull of five tons from rear should be the limit, as to exceed this might render the wrecker vehicle unstable.

The illustration at the left identifies mechanism previously referred to. The cable backlash brake loop is shown in brake applied position. Tension on the cable straightens it and by pulling the loop into a vertical position, releases the brake through an eccentric.

To free cable drum when running cut the cable, the pinion shift lever is pushed in, and pulled out when it is desired to again engage the drum with the power mechanism.

The booms are raised or lowered manually by the hand operating crank on the end of the ratchet wheel shaft. The same crank may be used on the cable drum when tightening cable for traveling.

The power operation of the winding (cable) drums can be controlled from either side, there being two



Wrecker Controls

1. Brace leg.
2. Boom.
3. Hand operating crank.
4. Boom drum cable.
5. Boom drum ratchet.
6. Boom drum pawl.
7. Pawl spring.
8. Brace leg chain loop.
9. Brace leg rest.
10. R.H. Winch controls.
11. L.H. Winch controls.
12. Boom heel swivel.
13. Roller chain.
14. Pinion shift handle.
15. Service drum.
16. Brace leg.
17. Backlash brake loop.
18. Wrecker frame.

handles on each side. The outer handles control the near drums while the inner handles control the drums on the far side of the wrecker. The inner handles are also equipped with a sleeve which can be twisted to accelerate or decelerate the engine, similar to the throttle control on a motorcycle.

To Apply Power to Wrecker Equipment, engine must be in operation, see Starting Engine, page 0-5. Then proceed as follows:

1. Shift transfer case lever into neutral (see page 0-7).

2. Shift transmission into direct speed, as normal operations can be carried out in this gear. All the speeds in the transmission may be used in wrecker operation **except overdrive and reverse.**

3. Engage transfer case power take-off by pulling up the lever at the lower left of the control levers in cab, to engaged position as shown in illustration.

4. The chain drive connecting the power-take-off with the wrecker transmission mainshaft is now in operation. To apply power to the cable drums for pulling or lowering the load operator should stand on side nearest load. The control handles are held in neutral by a heavy spring so that as soon as pressure is released they return to neutral, stopping movement of drum and cable, the load being held by self locking brake on worm shaft. To raise load, bear down on handle. To lower load, raise up on handle. **Be sure that these shifts are made complete** to prevent faulty engagement of the transmission. Speed of haul can be controlled by sleeve throttle control as previously described.

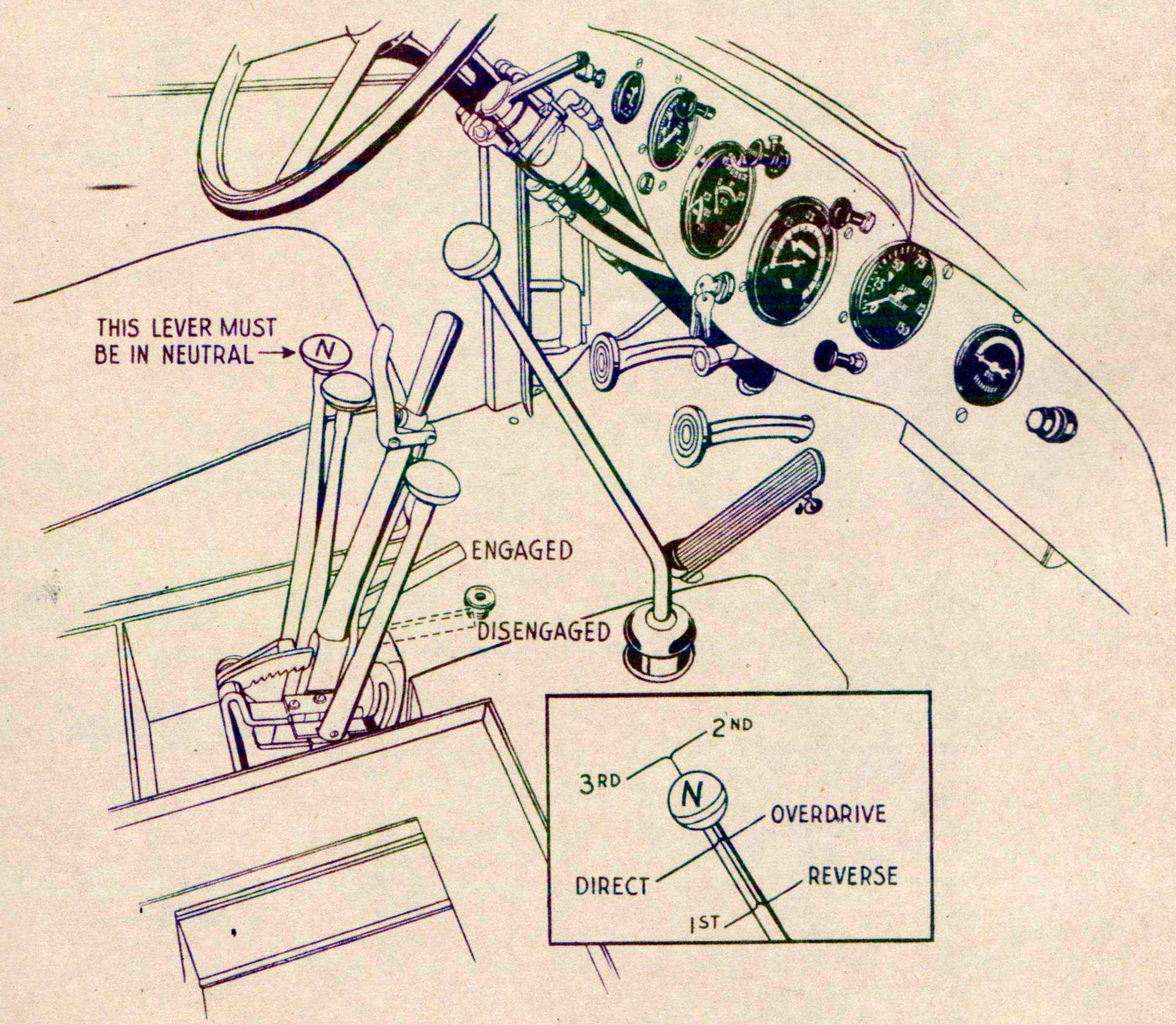
Cautions — Never run engine over **1800 RPM** when operating wrecker. Never race the engine, especially when wrecker is operating without a load or with a very light load.

Always use moderate speeds when pulling heavy loads until the load starts to move.

When pulling over rough ground where possible use crow bars to ease load over rocks or other obstructions.

Whenever possible to turn a wreck on its wheels this should be done as early in the operation as possible.

Watch the cables to see they do not chafe on sharp edges.



Wrecker Cab Controls

Keep cable free of kinks.

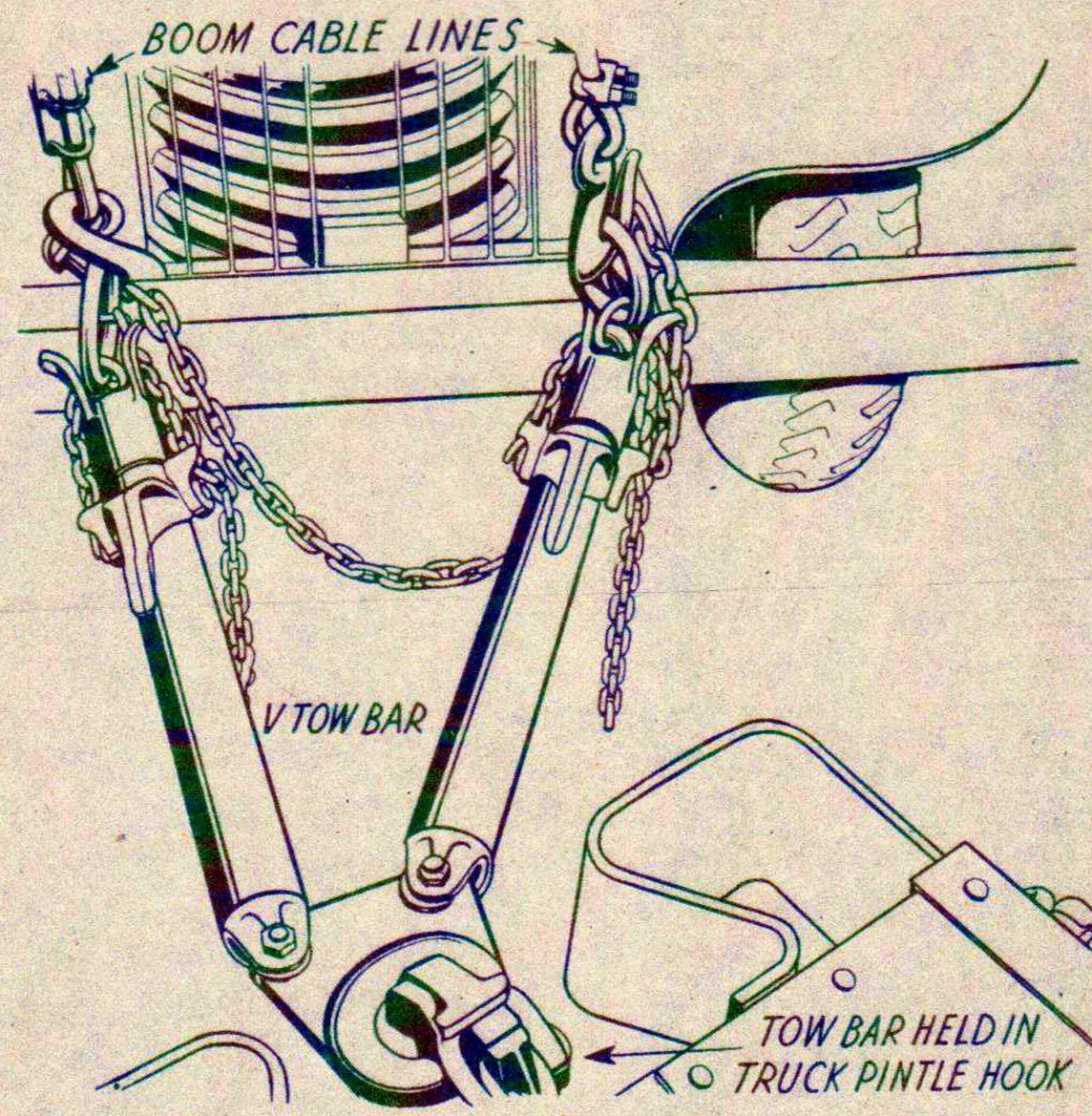
Anchor lines must always be at least as strong as a service or hauling line.

Cables should always be wound tight on drums. Wherever possible wind them up under load.

Towing — When vehicle to be towed is lifted in position for towing, which should always be with both lines, the V tow bar is hooked into the pintle hook of the wrecker. The tow bar legs are adjustable and should be extended so that the feet touch the part of the load to which they are to be attached by the tow bar chain. The chain should be wrapped around the bumper, spring horn, or tow hooks and brought back to the toggle catch on the tow bar, and the lever for tightening them should then be closed against the bar.

Care should be taken to have sufficient space between towing and the towed vehicles to admit of free movement on turns.

Towing with rear of towed vehicle in front is handled in the same manner, but in this case steering gear clamps should be used to lock the steering mechanism. These clamps attach to the tie rod, one on each side of a front spring, so that they will strike the sides of the spring and prevent movement of the tie rod.



Tow Bar Hook-up

WRECKER AIR COMPRESSOR UNIT

The belt driven wrecker air compressor equipment includes a driving motor, an air compressor, an air reservoir, an automatic switch, a check valve, a safety valve and a pressure gauge.

The automatic switch stops the motor when the tank pressure reaches 150 lbs. The check valve prevents air in the tank from flowing back when the compressor stops.

Operating Suggestions —

1. Belt Tension — The belt should be kept in proper adjustment at all times. When adjusting belts be sure pulleys are properly lined up.

Belts should be just tight enough to prevent slippage. Heating of motor pulley indicates slipping.

2. Draining Condensation — Open the screen chamber drain and check valve drain every day while the compressor is running to blow out moisture which has condensed in the pipe and tubing.

3. Compressor Filter — The intake filter is intended to keep dirt from being drawn into the compressor. If it becomes too dirty the compressor will pump slowly. To remedy this condition, remove filter and wash in gasoline and then dip in oil before replacing.

4. Keep the Motor and Compressor Clean — See that no dirt or water enter when adding oil or gasoline. Always wipe off the gasoline cap and oil filler plugs, as well as around them before refilling.

5. Use a Good Grade of Regular Gasoline — Be sure that the vent hole in the gasoline tank cap is not clogged up as air must enter the tank to allow fuel to flow to the carburetor. Test by blowing through top of cap.

6. Clean the Gasoline Filter Bowl and Screen — Be sure gasket is not torn. If a gummy varnish-like substance is found, alcohol or acetone will dissolve it.

7. Exhaust Tubing — Water is condensed in the exhaust after it cools off. For this reason, after stopping motor place exhaust tube so that water cannot drain into exhaust port of motor to corrode the mechanical parts.

8. Drain moisture from air tank at least once a week and preferably every day.

Starting Air Compressor Unit —

1. See that both the compressor and the engine are properly lubricated and that there is gasoline in the gas tank.

2. Open hand unloader to relieve the back pressure on the compressor to assist in starting.

3. Choke engine and pull quickly on starter lever 3 or 4 times to prime the engine.

4. After motor is primed open choke about halfway and again pull on starter lever to start motor. After motor is started close check valve drain to pump air into reservoir tank.

5. As the motor warms up, adjust the choke until the motor operates smoothly. Use the choke in the same way that the choke on an automobile is used.

6. To start the motor shortly after having stopped it by choking and while it is still warm, pull the starter lever 3 or 4 times without choking. If it does not start, prime as explained above. A warm motor does not require as much priming as a cold one.

7. If the motor fails to start after a reasonable number of trials, do not make any adjustments until after studying the instructions on page 15-11.

WRECKER LUBRICATION

The wrecker equipment should be checked and lubricated regularly each time the vehicle is lubricated.

Transmission Case — The transmission is checked and filled by removing the cover and is drained through the drain plug in the bottom of the case. Keep the unit filled to about half way on the worms. Use a good quality engine oil, S.A.E. 50 in summer and S.A.E. 30 in winter. Keep lubricant at proper level and renew seasonally.

Idler Shaft — A pressure fitting is located on the tube which supports the idler shaft. Lubricate every 1000 miles using an N.L.G.I. No. 1 grease in winter and an N.L.G.I. No. 2 in summer.

Pinion Shaft Bearings — Pressure fittings are provided on the tubes which carry the pinion shafts from the transmission. Use an N.L.G.I. No. 2 grease in summer and N.L.G.I. No. 1 in winter. Lubricate every 1000 miles.

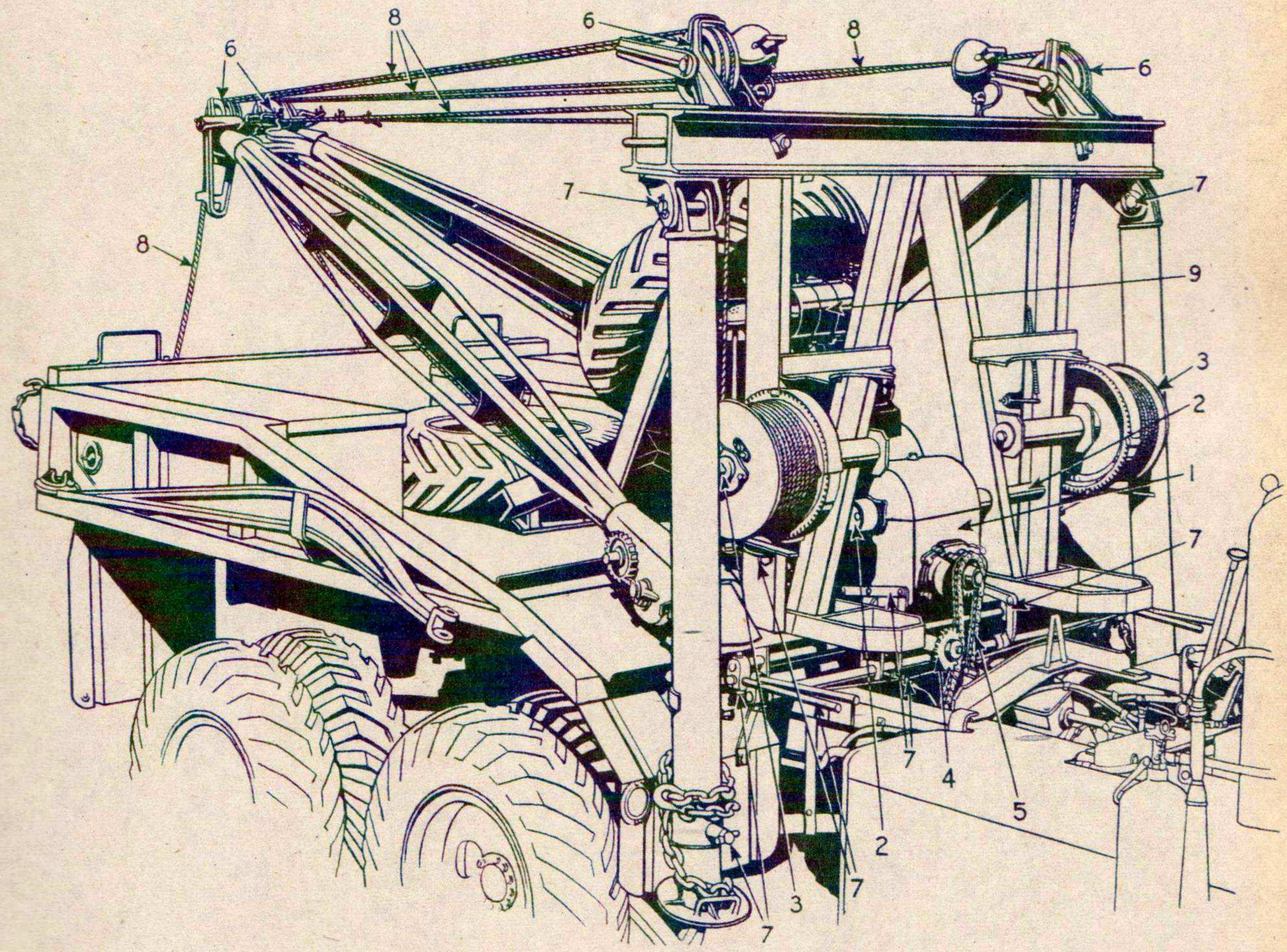
Drum Bearings — A pressure fitting is located in the end of each drum shaft. These are accessible through the holes in the square castings on the face of each drum. Force lubricant through these fittings until the drum bearings are thoroughly lubricated. Use an N.L.G.I. No. 1 grease in winter and an N.L.G.I. No. 2 in summer. Lubricate every 1000 miles.

Sheaves — Snatch block sheaves and other pulleys equipped with high pressure fittings should be lubricated every 1000 miles, using an N.L.G.I. No. 1 grease in winter and an N.L.G.I. No. 2 grease in summer.

Roller Chain — The roller chain should be lubricated with a light low colloidal graphite grease with each chassis lubrication.

Miscellaneous — Miscellaneous controls, linkages, etc. should be oiled every 1000 miles with a squirt can. Use a medium engine oil.

Wrecker Air Compressor — Maintain the oil level in the compressor base just below the upper mark on the bayonet oil gauge. Use S.A.E. 30 oil and fill at oil cup on side opposite flywheel.



Lubrication Diagram — See Chart on next page.

Check lubricant level each day the compressor is operated. This *must* be done as the crankcase capacity is necessarily limited by the size of the unit. Drain old oil every 3 months and refill with fresh lubricant.

Engine — Fill the crankcase with a high grade oil not heavier than S.A.E. 20. **A heavier oil must not be used.**

To fill remove blue filler plug and fill oil reservoir by slowly pouring in oil at the filler opening. Be sure that oil reservoir is full to point of overflowing before replacing filler cap. The reservoir holds 1 pint.

Check lubricant level each day unit is operated. This *must* be done as the crankcase capacity is necessarily limited by the size of the unit. Drain old lubricant and refill with fresh oil after every 25 hours of operation. Flushing with kerosene is not recommended.

Cable Maintenance — Wire rope should not be wound on to the drum too rapidly or without load because the rope may kink. An unloaded rope should be fed onto the drum by hand. Never bend a wire rope through sharp angles or tie knots in it except for emergency repairs. If tractors or other vehicles with metal traction devices are allowed to run over the wire rope they will flatten it, expose the core and allow water to enter, which decreases the strength of the rope by rusting the internal strands.

About once each month all the cables should be pulled out their entire length and thoroughly lubricated with engine crankcase oil or other heavy viscous oil to prevent rust. This should be done on a clean surface free from grit, etc.

Allow the oil to soak into the core of the rope and then wipe off the excess. If rust is noticed or if conditions seem to indicate the need of oil, it may be necessary to oil the cables more frequently than at the regular inspection or lubrication periods.

On these occasions as well as at all other times possible, the cables should be checked for cuts, kinks and other defects.

If the cables are not kept tightly wound on the drums, they will cut down through the loosely wound layers and cause serious damage to the cable. The cables should never be allowed to run off the sheaves or drums.

WRECKER LUBRICATION CHART

Ref. No.	Description	Type Fitting	No. of Fittings	COMMERCIAL LUBRICANT (Manufacturer's Specification)			Mileage	SERVICE LUBRICANT			
								British W.D. for U.K.		D.N.D. Canada	
				Lubricant	Grade			Specified	Alternative		
					Summer	Winter				Summer	Winter
1.	Wrecker Transmission	Cover	1	Engine Oil	S.A.E. 50	S.A.E. 30	5000 to 10000 ①	M-220	M-160	140	100
2.	Pinion Shaft Bearings	Zerk	2	Fibre Grease	No. 2	No. 1	1000	Grease G. S.	—	632	602
3.	Drum Bearings	Zerk	2	Fibre Grease	No. 2	No. 1	1000	Grease G. S.	—	632	602
4.	Idler Shaft Bearing	Zerk	1	Fibre Grease	No. 2	No. 1	1000	Grease G. S.	—	632	602
5.	Roller Chain	—	—	Light Low Colloidal Graphite Grease	—	—	1000	C. S. 1268	Grease G. S.	400	400
6.	Sheaves	Zerk	—	Fibre Grease	No. 2	No. 1	1000	Grease G. S.	—	632	602
7.	Controls Linkage, etc.	—	—	Engine Oil	S.A.E. 50	S.A.E. 50	1000 ②	M-220	M-160	140	100
8.	Cables	—	—	Engine Oil	S.A.E. 50	S.A.E. 50	1000 ③	M-220	M-160	140	100
9.	Wrecker Air Compressor	—	—	Engine Oil	S.A.E. 30	S.A.E. 30	3000 ④	M-160	M-120	65	45
9.	Compressor Driving Engine	—	—	Engine Oil	S.A.E. 20	S.A.E. 20	3000 ④	M-120	M-120X	51	45

NOTE — See Page O-14 for Grease Specifications.

① — Check oil level each 1000 miles.
② — Lubricate with oil can at each engine oil change.
③ — Wire rope should be wiped with oil at frequent intervals.
④ — Check each day unit is operated.

TROUBLES — CAUSES AND CORRECTIONS

Neglect and abuse are responsible for a very large percentage of the troubles experienced with motor trucks. Satisfactory and economical service results from proper maintenance care. If the vehicle is cared for as recommended in the manual, no serious expense is likely to be incurred for some time.

Minor difficulties sometimes arise which may be easily remedied. Many of the lesser repairs and adjustments can be made at the road side. Serious troubles call for expert attention and should not be dealt with by anyone not familiar with modern repair methods.

Most troubles are noticeable with the vehicle in motion and it is the mark of an alert driver that he notices anything unusual in the working of the truck. The instruments in the cab will assist the driver in this diagnosis, and with experience, any change in the rhythm of the vehicle will be noticed, and the cause should be determined.

Study the usual symptoms of the more common troubles as represented here, and think them over to their root before attempting any adjustments.

BRAKING SYSTEM —

I. Brakes Dragging —

1. Weak brake retracting spring.	1. Replace Spring.
2. Lining adjusted too close to drum.	2. Correct Adjustment. (.015" at Heel.)
3. Loose wheel bearings.	3. Take Up with Adjusting Nut.
4. Leaky Air Valve.	4. Clean and Grind in.

II. Vehicle Pulling to One Side —

1. Oil on brake lining.	1. Clean and Roughen or Replace Lining.
2. Brakes not properly equalized.	2. Adjust Brakes.
3. Tires not evenly inflated.	3. Inflate All Tires to 65 Lbs. Pressure.
4. Loose spring clip.	4. Tighten "U" Bolts.

III. Slow Air Pressure Build Up —

1. Leaking air line connections.	1. Coat with White Lead and Tighten.
2. Leaking brake or compressor discharge valve.	2. Clean and Grind in Defective Valve.
3. Clogged air strainer (Air Compressor).	3. Clean in Gasoline.
4. Worn piston and rings (Air Compressor).	4. Overhaul.
5. Carbon in discharge line.	5. Clean Thoroughly.
6. No clearance on unloader valves.	6. Adjust to .010"—.015".
7. Loose drive belt.	7 Tighten Adjustment.

IV. Quick Loss Reservoir Pressure when Engine is Stopped —

1. Leaking tubing or connections.	1. Tighten or Replace as Required.
2. Leaking valves.	2. Clean and Grind in Valves.
3. Leaking governor.	3. Clean and Grind in Valves.
4. Leaking compressor discharge valves.	4. Clean and Grind in Valves.

V. Inefficient Brakes —

1. Low reservoir pressure.	1. Check Compressor, Governor and Safety Valve for Operation and Air Equipment for Leaks.
2. Excessive push rod travel in air chambers.	2. Adjust Slack Adjuster to give ¾" to 1½" travel.
3. Lining and drums in poor condition.	3. Replace Lining and Turn Drums.
4. Brake chamber diaphragm leaking.	4. Replace Diaphragm.

VI. Slow Brake Application —

1. Low brake line pressure (Valve to chambers).	1. Adjust Pressure Through Valve.
2. Restriction in line.	2. Clean Lines.
3. Excessive push rod travel.	3. Adjust Slack Adjuster to give ¾" to 1½" travel.
4. Leaking diaphragm (Brake valve or chambers).	4. Replace Diaphragm.
5. Brake lining or drum condition.	5. Replace Lining or Recondition Drum.

VII. Slow Brake Release —

1. Binding cam or camshaft.	1. Lubricate and Align Properly.
2. Excessive push rod travel.	2. Adjust Slack Adjuster to give ¾" to 1½" travel
3. Restriction in line.	3. Clean Lines.
4. Improperly seated valves.	4. Clean and Grind In.
5. Brake valve lever not returning fully to stop.	5. Adjust Operating Rod.

TROUBLES — CAUSES AND CORRECTIONS

CLUTCH —

I. Slipping —

1. Improper adjustment. — 1. Adjust to Give 1⅛" from Face of Flywheel Ring to Face of Release Sleeve.
2. Oily facings. — 2. Clean and Correct Cause. Check Bellhousing Oil Seal. Do not Overlubricate Pilot or Throwout Bearing. Replace Facing if Necessary.
3. Weak clutch spring. — 3. Replace Spring.
4. Worn clutch facings. — 4. Reface Clutch Disc.
5. Sticking release sleeve. — 5. Check Pull Back Spring.

II. Rattling —

1. Loose release fork. — 1. Tighten Fork.
2. Weak pull back springs. — 2. Replace Spring.
3. Improper pedal adjustment. — 3. Adjust Pedal.

III. Chattering —

1. Broken dampener springs. — 1. Replace Clutch Disc.
2. Oily facings. — 2. Clean or Replace.
3. Sticking release sleeve. — 3. Check Pull Back Spring.

COOLING SYSTEM —

I. Overheating —

1. Lack of water. — 1. Fill Radiator.
2. Fan belt loose. — 2. Adjust Belt for 1" Deflection.
3. Cooling system clogged. — 3. Clean and Flush System.
4. Water pump not functioning. — 4. Check Drive Shaft, Impeller and Lines.
5. Thermostat sticking closed. — 5. Correct or Replace.
6. Lime coated cylinders. — 6. Clean and Flush System.
7. Dirt or insects in radiator air passages. — 7. Blow Out with Compressed Air.
8. Rotted hoses. — 8. Replace.

(See also under Engine).

II. Overcooling —

1. Thermostat sticks open. (Extremely low temperatures may necessitate use of winter front or radiator cover). — 1. Correct or Replace. Check installation of thermostat, see page 0-34.

III. Loss of Cooling Water —

1. Water pump packing defective. — 1. Replace.
2. Leaks in radiator core. — 2. Repair.
3. Defective hose connections. — 3. Tighten or Replace.
4. Radiator tubes clogged so that water builds up in top tank and is lost through overflow pipe. — 4. Clean System. If Condition Not Corrected, Remove Top Tank and Rod Out Tubes.
5. Cracked cylinder head or block. — 5. Replace.
6. Loose core plugs (freeze plugs) in the block. — 6. Replace Plugs.

ELECTRICAL SYSTEM —

I. Starting Motor —

1. Slow starter speed.
   - a. Loose or dirty connections. — a. Clean and Tighten.
   - b. Worn brushes. — b. Replace Brushes.
   - c. Dirty or worn armature. — c. Clean or Replace.
   - d. Armature rubbing field coils. — d. Replace Bushings.
   - e. Low battery voltage. — e. Check Generator and Regulator.
2. Inoperative starter.
   - a. Battery down. — a. Charge Battery.
   - b. Poor connections. — b. Clean and Tighten.
   - c. Burned commutator bars. — c. Recut Commutator.
   - d. Open or short circuits in field or armature. — d. Eliminate Defective Condition.

TROUBLES—CAUSES AND CORRECTIONS

e. Defective starter switch (Foot or solonoid).	e. Check Contacts.
f. Burned circuit breaker.	f. Replace.

II. Generator —

1. No output.	
a. Burned commutator bars.	a. Recut Commutator.
b. Worn or sticking brushes.	b. Replace or Clean.
c. Open circuits in field or armature.	c. Replace.
d. Short circuits in field or armature.	d. Replace.
2. Low or unsteady output.	
a. Low brush tension.	a. Adjust or Replace Brush Springs.
b. Brushes sticking.	b. Clean Brushes.
c. Rough, dirty or greasy commutator bars.	c. Clean Commutator Bars.
d. High mica on commutator.	d. Undercut Mica.
e. Commutator out of round.	e. Recut Commutator.
f. Burned commutator bars.	f. Recut Commutator.
3. Noisy generator.	
a. Loose mounting.	a. Tighten Mounting Bolts.
b. Worn or loose gear.	b. Tighten or Replace Gear.
c. Worn bearings.	c. Replace Bearings.
4. Excessive output.	
a. Generator field grounded.	a. Examine for External Ground.
b. Regulator defective.	b. Check or Replace Regulator.

III. Distributor —

1. Poor ignition.	
a. Distributor points burned or corroded.	a. Clean or Replace Points.
b. Distributor points too wide.	b. Clean and Adjust to .020" Gap.
c. Cracked distributor cap.	c. Replace Cap.
d. Defective coil.	d. Replace Coil.
e. Defective condenser.	e. Replace Condenser.
f. Spark plug gap wide or points corroded.	f. Clean and Set Gap to .027".
g. Spark plug porcelain cracked.	g. Replace Plug.
h. Ignition timing incorrect.	h. Adjust Timing.
i. Loose terminals and connections.	i. Tighten and Clean.

IV. Battery —

1. Discharged battery.	
a. Short circuits.	a. Locate Shorts and Correct.
b. Connections loose or dirty.	b. Clean and Tighten.
c. Voltage regulator out of order.	c. Adjust or Replace.
d. Generator not charging.	d. Check Regulator.
2. Battery overheating.	
a. Voltage regulator out of order.	a. Adjust or Replace.
b. High charging rate.	b. Check Regulator.

ENGINE —

I. Lack of Power —

1. Poor compression.	
a. Valves or seats worn.	a. Grind Valves.
b. Piston rings weak, broken, stuck, or worn.	b. Replace and Correct Cause of Sticking.
c. Tappets sticking or set too close.	c. Clean Guides or Set Clearance at .006" for Intake and .010" for Exhaust.
d. Leaky spark plugs.	d. Tighten Plugs in Head.
e. Cylinder head loose or gasket leaking.	e. Tighten Head or Replace Gasket.
f. Worn pistons, rings, or cylinders.	f. Replace Worn Parts or Rebore Cylinders.
2. Poor carburetion.	
a. Dirty carburetor.	a. Clean Carburetor.
b. Valves leaking.	b. Grind Valves.
c. Intake manifold leaking.	c. Tighten Manifold Nuts. Check Gasket.

TROUBLES—CAUSES AND CORRECTIONS

d. Water or sediment in fuel tank.	d. Clean Fuel Tank.
e. Air cleaner clogged. (See also Fuel System)	e. Clean Mesh in Gasoline.
3. Poor ignition.	
a. Defective or incorrectly gapped spark plugs.	a. Replace or Set Gaps to .027".
b. Worn or pitted distributor points.	b. Replace or Clean Points.
c. Improper distributor timing.	c. Correct Timing.
d. Defective coil.	d. Replace Coil.
e. Defective condenser.	e. Replace Condenser.
4. Exhaust restriction.	4. Check Muffler and Tail Pipe.
II. Engine Knocking —	
1. Loose main bearings.	1. Adjust or Replace as Required.
2. Loose rod bearings.	2. Adjust or Replace as Required.
3. Loose piston pins.	3. Replace Pins.
4. Worn pistons and cylinders.	4. Replace or Rebore.
5. Excessive tappet clearance.	5. Set to .006" and .010".
6. Tight pistons.	6. Hone Cylindres.
7. Loose flywheel.	7. Tighten in Place.
8. Too much camshaft end play.	8. Adjust with Screw in Gear Cover.
9. Too much idler gear shaft end play.	9. Adjust with Screw in Gear Cover.
10. Bent connecting rod.	10. Check and Correct or Replace.
III. Explosion in Muffler —	
1. Ignition too late.	1. Retime Ignition.
2. Weak spark.	2. Check Distributor, Coil and Condenser.
3. Exhaust valves holding open.	3. Clean Guides and Check Tappet Adjustment.
4. Exhaust valves warped.	4. Replace Valves.
IV. Explosion in Carburetor or Intake Manifold —	
1. Gasoline mixture too lean.	1. Clean carburetor. Check fuel level adjustment (top of float to be 2⅛" out of cover.)
2. Intake valves or tappets sticking.	2. Clean valve stems, tappets and guides. Replace parts as required.
3. Intake valve springs weak.	3. Replace springs.
4. Intake tappets set too close.	4. Adjust to .006".
5. Intake manifold leaking.	5. Tighten manifold nuts.
V. Hard Starting —	
1. Weak battery.	1. Charge battery. Determine and correct cause of discharge.
2. Defective distributor.	
a. Worn or pitted breaker points.	a. Clean or replace points.
b. Oil or water soaked.	b. Clean thoroughly.
c. Coil broken or soaked.	c. Replace coil.
3. Spark plugs cracked, fouled, or gapped incorrectly.	3. Replace or clean and set to .027".
4. Defective wiring.	4. Replace worn or broken parts.
5. Improper timing.	5. Correct timing.
6. Water in fuel supply.	6. Clean tank, lines, filter and carburetor.
7. Valve tappets improperly adjusted.	7. Adjust to .006" and .010".
VI. Missing —	
1. Spark plugs fouled or cracked.	1. Clean or replace plugs.
2. Spark plug gaps set too wide.	2. Set gaps at .027".
3. Short circuit in ignition system.	3. Locate short and correct.
4. Breaker points sticking.	4. Clean and set at .020". Replace worn or broken parts as required.
5. Cylinder head gasket leaking.	5. Tighten head or replace gasket.
6. Valves sticking, warped or broken.	6. Clean or replace valves.
7. Valve tappets improperly adjusted.	7. Set at .006" and .010".

TROUBLES—CAUSES AND CORRECTIONS

VII. Excessive Smoke from Exhaust —

1. Too much oil in crankcase.	1. Fill only to 4/4 mark on bayonet gauge. (16 quart capacity.)
2. Carburetor float sticking or leaking.	2. Adjust or replace fuel valve needle or seat.
3. Worn pistons, rings or cylinders.	3. Overhaul.

VIII. Excessive Oil Consumption —

1. Worn piston rings.	1. Install new rings.
2. Crankcase gasket loose.	2. Tighten or replace.
3. Front gear case loose.	3. Tighten.
4. Poor grade oil.	4. Use a good quality oil as recommended in Lubrication Section.
5. Cylinder walls worn.	5. Overhaul.
6. Main or rod bearings loose.	6. Adjust or replace bearings.
7. Ring gaps too great or lined up.	7. Install new rings. If ring gaps are lined up, the condition will correct itself.
8. Rings poorly seated.	8. Replace rings.
9. Overheating.	9. Correct cause of heating.
10. Oil ring slots clogged with carbon.	10. Clean rings of carbon. Replace if necessary.

IX. Overheating —

1. Ineffective cooling.	
a. Lack of water.	a. Fill radiator.
b. Fan belt loose.	b. Tighten fan belt (1″ deflection.)
c. Cooling system clogged.	c. Clean and flush.
d. Water pump not functioning.	d. Check shaft, impeller and tubing.
e. Thermostat sticking closed.	e. Replace thermostat.
f. Lime coated cylinders.	f. Clean and flush cooling system.
g. Dirt or insects in radiator air passages.	g. Blow out with compressed air.
h. Radiator hoses rotted.	h. Replace hoses.
2. Lack of oil or oil badly diluted.	2. Add or change oil.
3. Carburetor choke valve partly closed.	3. Adjust controls.
4. Lean mixture.	4. Clean carburetor and check float level.
5. Improper valve timing.	5. Correct timing.
6. Driving with spark too far retarded.	6. Advance Spark.
7. Brakes dragging.	7. Determine cause and correct. (See under Braking System.)
8. Exhaust line restricted.	8. Check muffler and tail pipe.

X. Excessive Cylinder Wall Wear —

1. Dirty air cleaner allowing dust to reach the combustion chamber.	1. Clean air cleaner mesh and sump.
2. Rich fuel mixture.	2. Replace worn jets.
3. Lack of oil or dirty oil.	3. Add or change oil.
4. Motor runs too cool.	4. Check thermostat. Warm up engine before starting.
5. Piston rings stuck or broken.	5. Clean or replace rings.

XI. Valves Sticking —

1. Improper valve clearance.	1. Set at .006″ and .010″.
2. Valve springs broken.	2. Replace springs.
3. Valve stems scored or dirty.	3. Replace or clean valves.
4. Gummy deposits from inferior fuels or oils.	4. Clean. Use better grade fuel or oil.
5. Lack of clearance between stem and guide.	5. Ream guides for proper clearance.
6. Weak valve springs.	6. Replace springs.

XII. Bearing Failures —

1. Overspeeding engine.	1. Continuous operation at maximum speed or close to it is to be avoided. Check governor at 2300 R.P.M. Exercise caution when going down grade
2. Bearings loose, sprung or improperly fitted.	2. Adjust mains .0025″-.003″ and rods .0015″-.002″ Sprung inserts should be replaced.

TROUBLES—CAUSES AND CORRECTIONS

3. Low oil pressure or lack of oil.	3. Add oil or check oil pump. Adjust pump to deliver 5-10 lbs. pressure idling and at least 25 at running speed. Fit bearings properly.
4. Crank journal rough or out of round.	4. Grind or replace shaft.
5. Restricted oil passages.	5. Clean oil passages and lines.
6. Improper oil.	6. Use correct oil (see Lubrication).
7. Bent connecting rod.	7. Replace rod.

XIII. Burned Valves —

1. Tappets set too close.	1. Set at .006" and .010".
2. Improper valve timing.	2. Time properly (see Valve Timing).
3. Excessive carbon.	3. Clean carbon.
4. Weak valve springs.	4. Replace springs.
5. Valves sticking.	5. Clean stems and guides. Replace parts as required.
6. Lean mixture.	6. Clean carburetor. Check float adjustment.
7. Low grade fuel.	7. Use good quality fuel.

XIV. Clicking, Spark Knock or "Ping"—

1. Excessive carbon deposits.	1. Clean carbon from engine.
2. Hot spot in cylinder head. (Carbon formation).	2. Clean carbon from engine.
3. Low grade fuel.	3. Use good grade fuel.
4. Improper valve timing.	4. Check valve timing (see Valve Timing).
5. Ignition timing incorrect.	5. Correct timing (see Ignition Timing).
6. Carburetion incorrect.	6. Check carburetor (see Fuel System).
7. Spark plug gaps too wide.	7. Set gaps at .027".

XV. Low Oil Pressure —

1. Excessive bearing clearances.	1. Adjust main bearing to .0025"-.003" and rods to .0015"-.002".
2. Oil pump worn.	2. Overhaul oil pump.
3. Oil pump screen clogged.	3. Clean screen.
4. Improper oil.	4. Use correct oil (see Lubrication).
5. Pressure regulating plunger worn or clogged. (Check oil pressure gauge for accuracy).	5. Adjust correctly. (Oil pressure at 5-10 lbs. idling and at least 25 lbs. at running speed.)

FUEL SYSTEM —

I. Excessive Fuel Consumption —

1. Carburetor worn.	1. Check carburetor (see Fuel System).
2. Fuel leaks.	2. Check tank, lines, etc.
3. Sticking controls.	3. Oil controls and eliminate binding.
4. Excessive idling or use of choke.	4. Shut engine off.
5. Dirty air cleaner.	5. Clean air cleaner.
6. Overloading.	6. Stay within 8,000 lbs. chassis and 11,000 lbs. trailed loads.
7. Engine running too hot.	7. See overheating. (Check timing).
8. Brakes dragging or tires underinflated.	8. Adjust brakes or inflate tires to 65 lbs. pressure.
9. Engine in poor condition and adjustment.	9. Overhaul.

II. Fuel Pressure Low —

1. Air leaks in system.	1. Tighten connections.
2. Fuel pump diaphragm out of order.	2. Replace diaphragm.

III. Lack of Fuel at Carburetor —

1. Empty fuel tank.	1. Fill tank with fuel.
2. Bent or kinked tubing.	2. Straighten or replace tubing.
3. Stopped up filtering screens.	3. Clean filter mesh. When replacing element in fuel filter, finger tightness is sufficient.
4. Fuel leaks.	4. Check tank, lines, etc.
5. Broken fuel pump diaphragm.	5. Replace diaphragm.
6. Sticking fuel valve in carburetor.	6. Replace fuel valve and seat (No. 55).
7. Loose fuel pump cover plate screw.	7. Tighten and replace gasket if necessary.

TROUBLES—CAUSES AND CORRECTIONS

IV. Fast Idling —

1. Sticking controls. — 1. Oil controls and eliminate binding.
2. Improper adjustment of idling screw. — 2. Adjust screw for even idling.

STEERING AND WHEEL ALIGNMENT—

I. Hard Steering —

1. Lack of lubrication. — 1. Add lubricant (see Lubrication).
2. Tight adjustment in steering gear. — 2. Adjust for slight drag only.
3. Worn parts in steering gear. — 3. Replace worn parts.
4. Front axle shifted. — 4. Tighten "U" bolts.
5. Reverse camber. — 5. Replace worn or bent axle parts.
6. Excessive caster. — 6. Check for broken spring leaves.
7. Excessive toe-in. — 7. Set at 1/8" ± 1/16".

II. Tramp or Shimmy —

1. Tires out of balance. — 1. Balance tires with wheel balance weights.
2. Worn steering knuckle bearings, tie rod bushings, etc. — 2. Replace worn parts.
3. Drag link or tie rod loose. — 3. Adjust correctly (see Steering Gear Section).
4. Improper caster. — 4. Should be 4°-6°. Check for broken spring leaves.
5. Insufficient toe-in. — 5. Set at 1/8" ± 1/16".
6. Front axle shifted. — 6. Tighten "U" bolts.
7. Bent axle center. — 7. Replace bent parts.
8. Underinflation of tires. — 8. Inflate all tires to 65 pounds pressure.
9. Loose spring shackle pins. — 9. Tighten spring shackle pins.

III. Road Shock —

1. Steering linkage tight. — 1. Adjust linkage correctly (see Steering Gear).

IV. Wandering —

1. Steering linkage loose. — 1. Adjust linkage correctly (see Steering Gear).
2. Reverse camber. — 2. Replace worn or bent axle parts.
3. Improper caster. — 3. Check for broken spring leaves.
4. Bent axle center. — 4. Replace bent parts.

TRANSMISSION —

I. Slipping Out of Gear —

1. Partial engagement of gears. — 1. Adjust forks for full engagement. "Step-worn" gears must be replaced.
2. Poppets not holding. — 2.
   a. Weakened poppet springs. — a. Use new springs.
   b. Worn poppet balls or seats. — b. Replace balls or rails.
3. Worn shifting forks. — 3. Replace forks. (Correct cause of wear).
4. Transmission out of alignment. — 4. Support transmission on jack, loosen clutch housing bolts, move transmission around and bolt in place.

II. Noise in Transmission —

1. Gears worn. — 1. Replace worn gears.
2. Worn bearings. — 2. Replace bearings.

NOTE — Transmission noises are deceptive and other chassis noises often seem to come from the transmission. Before any mechanical work is attempted, be sure the noise really is a transmission noise.

PERIODIC INSPECTION CHART

	Inspection	Daily	1000 Miles or Monthly	6000 Miles or Semi-Annually	10000 Miles or Yearly
Axle — Front	Check Wheel alignment			√	
	Check steering arms and linkage		√		
	Check tie rod bushings for excessive wear			√	
	Check steering knuckle bearing play and take up if necessary			√	
	Tighten driving flange nuts		√		
	Inspect axle for oil leaks. Replace seals as necessary		√		
	Check pinion and cross shaft bearings for end play			√	
	Tighten nuts on pinion cage			√	
	Tighten nuts holding carrier housing			√	
	Check lubricant level and clean breather		√		
	Drain, flush and renew lubricant			√	
Axles — Rear	Tighten axle shaft flange nuts		√		
	Inspect axles for oil leaks. Replace seals as necessary		√		
	Check pinion and cross shaft bearings for end play			√	
	Tighten nuts on pinion cage			√	
	Check lubricant level and clean breather		√		
	Drain, flush and renew lubricant			√	
Brakes	Bleed air reservoirs	√			
	Check hand brake and adjust if necessary			√	
	Inspect brake linings			√	
	Clean air compressor air strainer		√		
	Complete inspection on air compressor				√
	Overhaul of air compressor				√
	Check governor for leakage			√	
	Check safety valve for leaks				√
	Calibrate air pressure gauge				√
	Check brake application valve for leakage			√	
	Check hand brake valve for leakage			√	
	Check brake chambers for leakage			√	
	Check low pressure indicator for leakage			√	
	Check quick release valve, relay valve, stop light switch, and air lines for leaks			√	
Cab and Body	Check and tighten cab mountings		√		
	Check and tighten body mountings				√
Clutch	Check pedal operation for proper clutch release. If necessary adjust as described in clutch section			√	
	Inspect facings. Replace if necessary			√	

Periodic Inspection Chart *(Continued)*

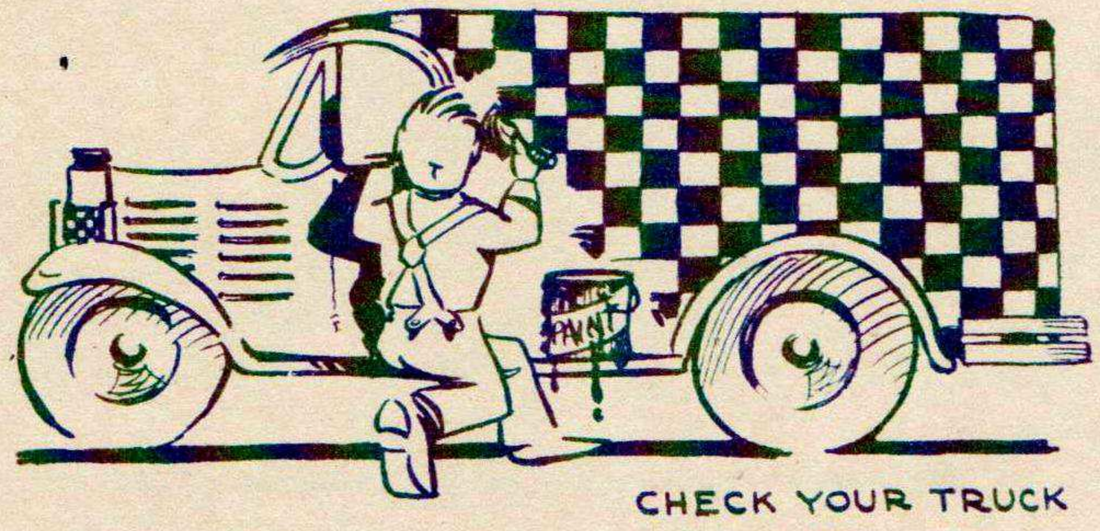
	Inspection	Daily	1000 Miles or Monthly	6000 Miles or Semi-Annually	10000 Miles or Yearly
Cooling System	Check radiator and add water if needed	√			
	In cold weather, see that anti-freeze is of sufficient concentration to provide adequate protection	√			
	Inspect water pump shaft for leaks, and tighten packing if necessary	√			
	Check fan belt tension		√		
	Inspect hose connections and radiator for leaks		√		
	Clean radiator (inside and outside)			√	
	Clean and flush the system			√	
	Check thermostat and water temperature indicator	(Maintain 160° to 180°)		√	
Electrical System	Check wiring system			√	
	a. Inspect electrical connections. They must be tight and clean			√	
	b. Inspect wiring system for chafed or broken wires, loose holding clips or worn rubber grommets			√	
	Check starting motor			√	
	a. Check mounting bolts for tightness			√	
	b. Inspect commutator. Clean if necessary			√	
	c. Check starter operation. Replace parts as necessary			√	
	Inspect generator			√	
	a. Inspect commutator bars and clean if necessary			√	
	b. Inspect brushes			√	
	c. Check ammeter			√	
	d. Check regulator			√	
	Check battery		√		
	a. Check specific gravity and add distilled water as needed		√		
	b. Clean terminals		√		
	c. Clean and tighten connections		√		
	d. Check charging rate		√		
	Check distributor		√		
	a. Clean and set distributor points		√		
	b. Inspect cap, rotor and wires		√		
	c. Check timing		√		
	d. Check condenser		√		
	Clean and set spark plugs		√		
	Replace spark plugs				√
	Check Lights	√			

Periodic Inspection Chart *(Continued)*

	Inspection	Daily	1000 Miles or Monthly	6000 Miles or Semi-Annually	10000 Miles or Yearly
Engine	Tighten cylinder head and manifold nuts			√	
	Check oiling system		√		
	Inspect oil pan for leakage		√		
	Wash breather cap in gasoline		√		
	Clean oil pan and check lubricant passages			√	
	Check tappet adjustment			√	
	Inspect crankshaft bearings			√	
	Check compression			√	
	Check lubricant	√			
	Renew lubricant		√		
Fuel System	Inspect air cleaner. (In extremely dusty areas, inspect daily)		√		
	Drain sediment from fuel pump and fuel filter		√		
	Clean strainers of fuel pump, fuel filter and carburetor		√		
	Check fuel system for leaks		√		
	Tighten flange bolts of the carburetor, governor, fuel pump and fuel filter			√	
	Check fuel pump. Replace parts if necessary			√	
	Clean carburetor and check float level			√	
	Drain fuel tank to flush out sediment			√	
Propeller Shafts	Tighten flange bolts		√		
	Check slip joints for backlash. Replace worn parts			√	
	Disassemble joints and inspect for wear			√	
Springs	Check to see that spring clips are tight		√		
	Inspect for broken leaves			√	
	Check rocker beam lubricant		√		
	Check shock absorber fluid		√		
Steering Gear	Check steering wheel play			√	
	Check steering linkage for looseness			√	
	Check wheel alignment			√	
	Renew lubricant			√	
Transmission and Transfer Case	Check for oil leaks. Replace oil seals as required		√		
	Tighten housing bolts			√	
	Inspect bearings and replace as necessary				√
	Check gears for wear				√
	Renew lubricant			√	

Periodic Inspection Chart *(Continued)*

	Inspection	Daily	1000 Miles or Monthly	6000 Miles or Semi-Annually	10000 Miles or Yearly
Wheels	Check tire pressure	√			
	Tighten wheel stud nuts		√		
	Check wheel bearings			√	
	Lubricate wheel bearings			√	
Winch	Check worm shaft brake adjustment	WHEN DRUM SLIPS IN NEUTRAL			
	Check power take-off, propeller shaft, etc.				√
	Renew lubricant			√	
Wrecker	Check wire rope for kinks, cuts, etc.		√		
	Oil wire rope		√		
	Check drive chain idler adjustment		√		
	Tighten cable eye "U" bolts.		√		
	Tighten welding tank "U" bolts.		√		
	Lubricate		√		



CHECK YOUR TRUCK

Seasonal Inspections

Spring

1. Clean and flush radiator.
2. Check radiator hoses.
3. In hot weather remove the thermostat or the rubber gasket seating the thermostat.
4. Check water pump packing.
5. Fan belt adjustment must be maintained in hot weather.
6. Change to summer lubricants.
7. Clean carburetor. Adjust carburetor controls. Check float level.
8. Check ignition system.
9. Inspect brakes.
10. Clean crankcase and oil pan.
11. Check air cleaner.
12. Use bug screen when necessary.

Fall

1. Clean and flush radiator.
2. Check radiator hoses.
3. Check water pump packing.
4. Replace thermostat. Check thermostat installation and operation and heat indicator.
5. KEEP ENGINE WARM, 160° to 180°. Use a radiator curtain or cover when necessary.
6. Check ignition system.
7. Change to winter lubricants.
8. Clean carburetor. Adjust carburetor controls. Check float level.
9. Inspect brakes.
10. Install antifreeze solution when required.
11. Check battery.
12. Replace brake chamber and valve diaphragms.

MEMORANDA

SECTION TWO

SHOP MANUAL

In offering the suggestions and methods which follow, the difficulty of imparting technical instruction by the printed word is recognized. It is not pretended that other methods, developed by experience to be practical, should not be used. Nor is it assumed that without practical experience or personal instruction that this booklet will develop the mechanical ability necessary to the operations described. Rather it is offered in the hope that it will be found of assistance in some measure to all who may have occasion to use it.

FRONT AXLE

The front axle is a driving unit type with a conventional double reduction differential bolted to the rear of the housing. The front wheels are driven through constant velocity universal joints and steering knuckles.

FRONT AXLE UNIVERSAL JOINT —

These joints are built to a high degree of precision and should be treated and serviced with the same care as are ball bearings. Freedom from grit or other harmful substances, as well as proper lubrication, is very important.

Disassembly:

1. Remove snap ring BB5129 holding the cage with splined end BB5116, (or steering knuckle shaft) in the drive flange BB5113.

2. Remove the stud nuts holding the drive flange to the hub and remove the drive flange assembly, using puller screws in the tapped holes in the flange.

3. Remove the lock nut, locking washer, adjusting nut and outer wheel bearing, and remove the wheel and hub as described in the section on wheel bearings (page 0-36). Remove inner wheel bearing.

4. Disconnect brake chamber push rod from slack adjuster lever at the clevis pin.

5. Remove the nuts holding the steering knuckle and bushing BB5144 and brake plate oil slinger BB5244 to the steering knuckle flange BB15108 or BB15109 and remove these parts from the studs.

6. Remove the spring, oil seal felt and bushing from the cage with splined end (steering knuckle shaft).

NOTE. The universal drive joint and axle shaft may now be pulled from the housing. If it is not necessary to disassemble the flanges, steering knuckle or trunnion housing, omit steps 7, 8, 9, 10, 11, 12, 13 and 14.

7. Disconnect support bolt and remove the brake chamber from the steering knuckle flange assembly and swing it out of the way. It is not necessary to disconnect the air line.

8. Remove the pin from the tie rod yoke and swing the tie rod clear.

9. Remove the cap screws holding the brake dust shield halves in place and take off the shields.

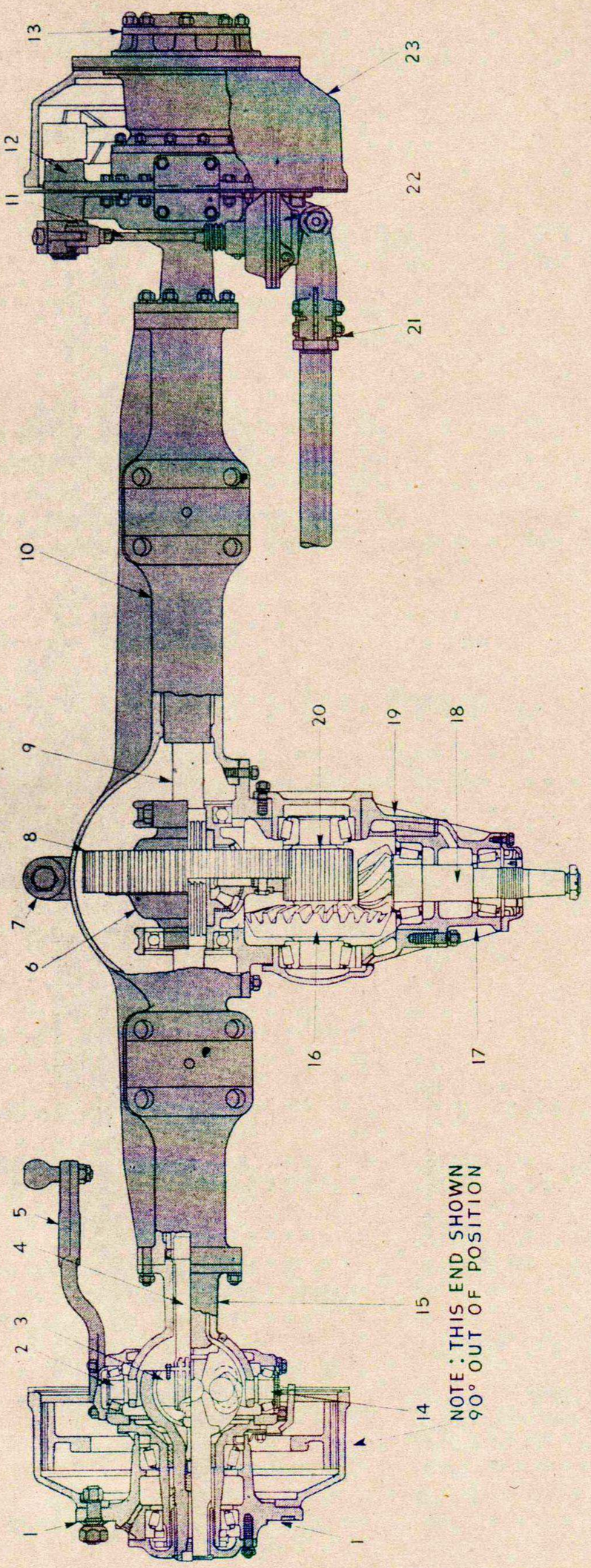
10. Remove nuts from studs holding the steering knuckle flange assembly together.

11. Remove the cap screws holding the steering knuckle bearing covers at the top and bottom of the flange assembly. The upper cover is an integral part of the steering arm BB5184 which can be swung clear without disconnecting from the drag link.

12. Split the flange halves and lift out the steering knuckle bearing cups.

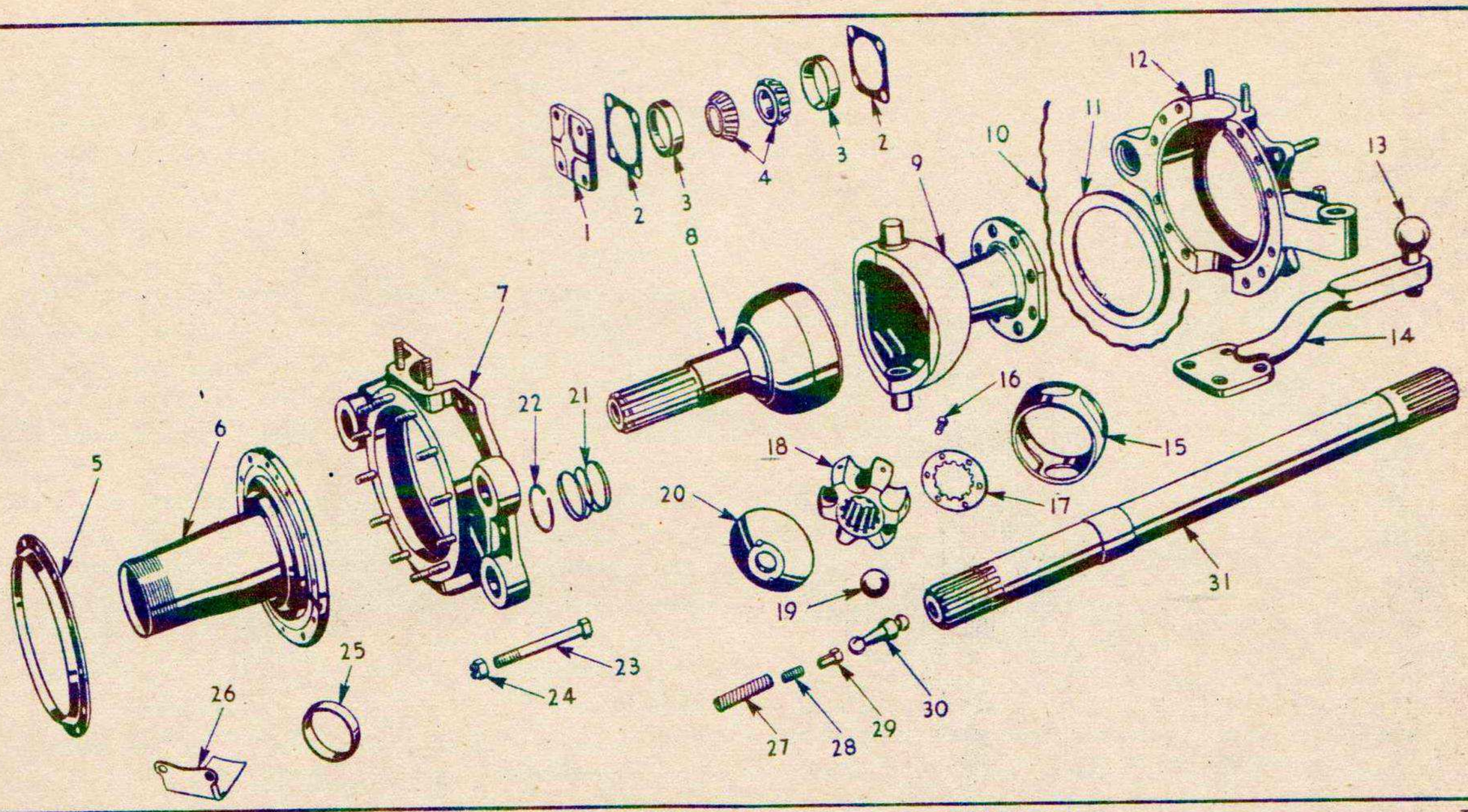
13. Remove the bearing cones from housing trunnion socket BB15112.

14. Remove the stud nuts holding the housing trunnion socket to the main axle housing BB5102 and remove the socket.



Front Axle Assembly

1. Hub.
2. Steering knuckle bearing.
3. Universal joint.
4. Axle shaft.
5. Steering arm.
6. Differential case.
7. Oil filter plug.
8. Spur gear.
9. Axle shaft.
10. Axle housing.
11. Brake chamber push rod.
12. Brake camshaft.
13. Drive flange.
14. Steering knuckle bearing.
15. Trunnion socket housing.
16. Bevel gear.
17. Pinion cage.
18. Bevel pinion.
19. Differential carrier housing.
20. Cross shaft.
21. Tie rod.
22. Brake chamber.
23. Drum.



DESCRIPTION	PART No.
1. Steering Knuckle Bearing Cap — lower	BB5161
2. Bearing Cap Shim	BB5164
3. Steering Knuckle Bearing Cup	BB5159
4. Steering Knuckle Bearing Cone	BB5158
5. Oil Slinger	BB5244
6. Steering Knuckle and Bushing	BB5144
7. Flange Assembly, L.H. (not serviced separately)	BB15109
8. Cage with Splined End	BB5116
9. Housing Trunnion Socket	BB15112
10. Trunnion Socket Felt Spring	BB5157
11. Trunnion Socket Felt	BB5156
12. Flange Assembly, L.H. (not serviced separately)	BB15109
13. Ball	BB5185
14. Steering Arm	BB5184
15. Cage (inner)	BB5124
16. Shaft Retainer Screw	BB5128

DESCRIPTION	PART No.
17. Shaft Retainer	BB5127
18. Inner Race	BB5126
19. Ball	BB5125
20. Pilot	BB5123
21. Spring	BB5131
22. Snap Ring	BB5129
23. Screw	BB15111
24. Nut	BB5170
25. Axle Shaft Oil Seal	6257C
26. Front Wheel Hub Oil Drain	BB15105
27. Pilot Pin Spring	BB5122
28. Buffer Spring	BB5120
29. Plunger	BB5121
30. Pilot Pin	BB5118
31. Axle Shaft, L.H. (short)	BB5111

15. Remove the screw holding the shaft retainer BB5127 to the inner ball race BB5126. Turn the retainer to mesh with the axle shaft splines and remove the shaft and retainer.

16. Remove the pilot pin BB5118 through the inner race splines.

17. Tilt inner race to double angle of cage (Figure 1) until one ball can be removed. Roll inner race and cage to a corresponding position for removal of the adjacent ball. Proceed until all six balls are removed.

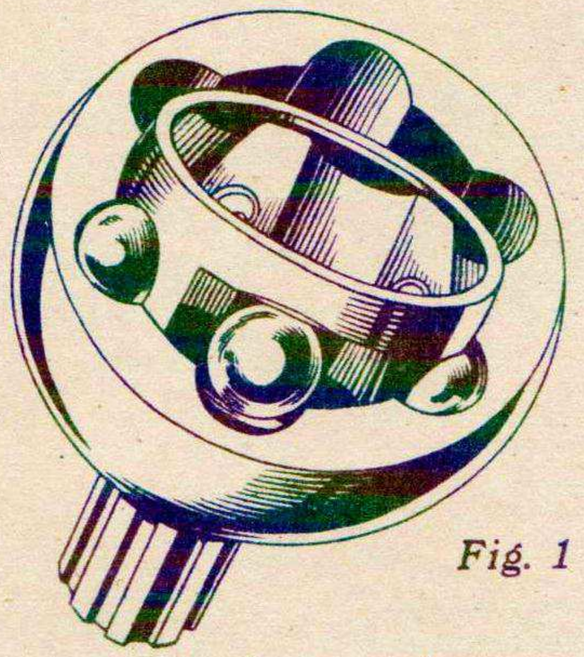


Fig. 1

18. Roll cage upside down and remove the pilot. (Figure 2).

19. Place cage and inner race at right angles with outer race so that rectangular cage openings mesh with opposite teeth of outer race BB5116 (Figure 3). Withdraw cage and inner race assembly.

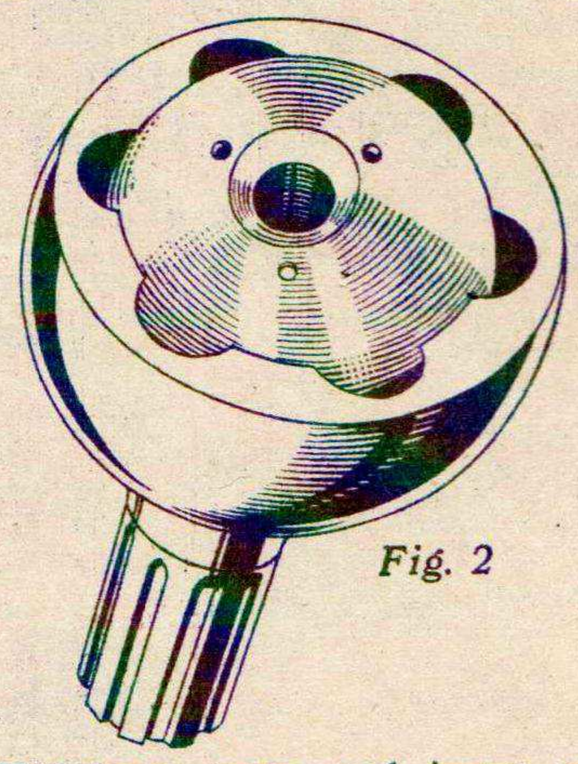


Fig. 2

20. Turn inner race within cage until one tooth projects through rectangular opening of cage (Figure 4). Roll the inner race out of cage.

21. Remove the pilot spring BB5122 and plunger assembly BB5120 and BB5121 from stem bore.

After the disassembly is complete, wash all parts thoroughly in kerosene. Inspect the bearings for pits and scores. Examine the balls and races from the universal joints. If a race is badly scored, replace the entire universal assembly. If the balls are cracked or have flat spots, they must be replaced.

Reassembly—Lightly lubricate all moving parts before reassembling.

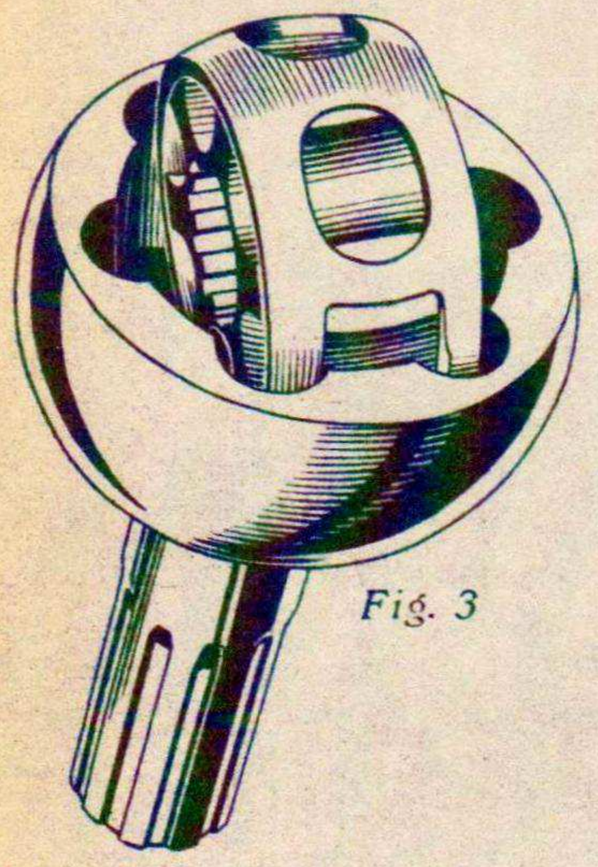


Fig. 3

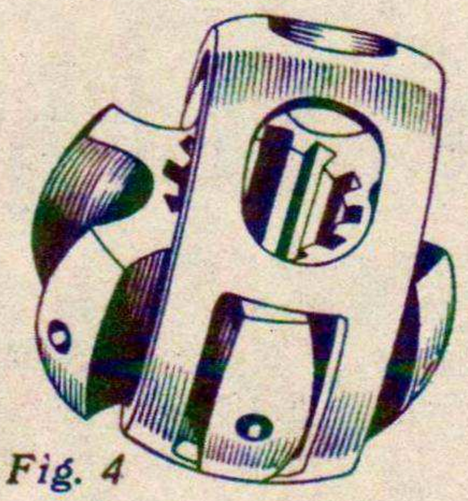


Fig. 4

1. Secure outer race in an upright position, large opening facing upward. Fill stem bore with lubricant and insert spring and plunger assembly, plunger on top.

2. Put inner race into cage by inserting one inner race tooth into rectangular opening of cage and roll inner race into place. (Figure 4). Try for a free fit.

3. Insert cage and inner race into outer race. Position rectangular openings of cage so as to clear opposite teeth of the outer race. (Figure 3). Drop cage into place and turn into position, making sure that parts turn freely.

4. Insert pilot face down (Figure 2). Tapped holes of inner race should be on opposite side of pilot. Roll all internal parts until the pilot is at the bottom of the outer race. Tapped holes in inner race should now face outward.

5. Tilt inner race and cage so that one ball can be inserted through cage opening into groove. (Figure 1). The inner race should be inclined at twice the cage angle. Roll all parts to a corresponding position for the next ball, and so on until all balls are assembled.

6. Add some lubricant through the splined hole of the inner race into pilot cavity and insert pilot pin, small end down, until it strikes spring plunger.

7. Press the pilot seat into the recess in the axle shaft, up to its shoulder. Insert the splined shaft into the inner race. This should be done with a steady, downward, vertical motion to insure proper engagement of pilot pin and seat. If the pilot pin head does not readily engage the seat in the shaft, level the cage with outer race and rock shaft slightly. Do not apply excessive force.

8. Install retainer and screws. Lock the screws with a wire.

9. Test for free movement through entire operating range (37½° maximum).

10. Place the rear flange cover over the trunnion socket and tighten the stud nuts holding the socket to the main axle housing.

11. Insert the bearings (cups and cones) over the steering knuckle pins on the trunnion socket.

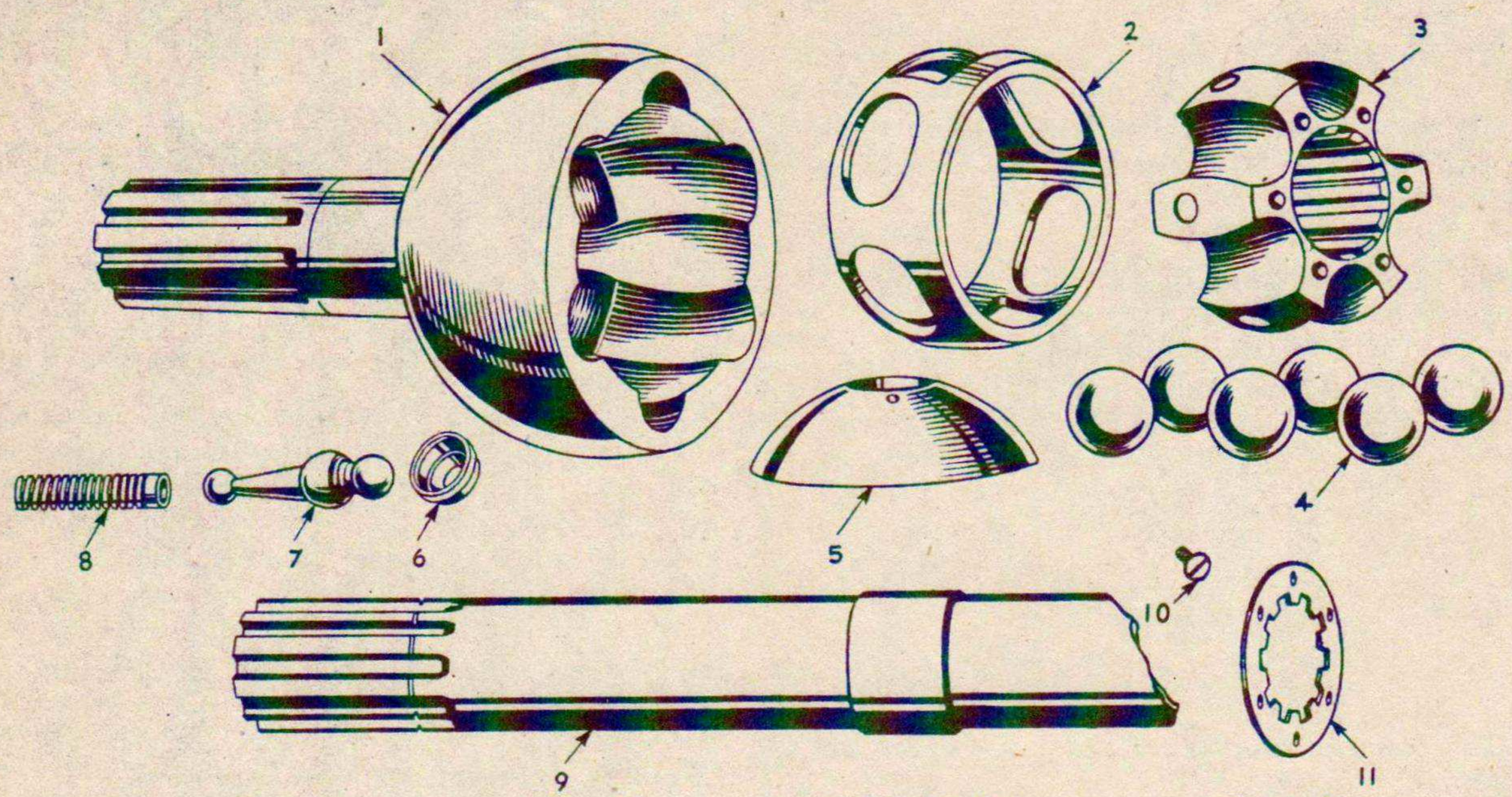
12. Slide the two halves of the flange assembly into place and bolt tightly together.

13. Be sure that the steering knuckle bearings are properly seated and install the bearing caps. Tighten the flange nuts evenly.

14. Reassemble the tie rod pin into the yoke and lock in place with a cotter pin.

15. Bolt the brake dust shield halves in place.

16. Bolt the brake chamber onto the flange assembly.



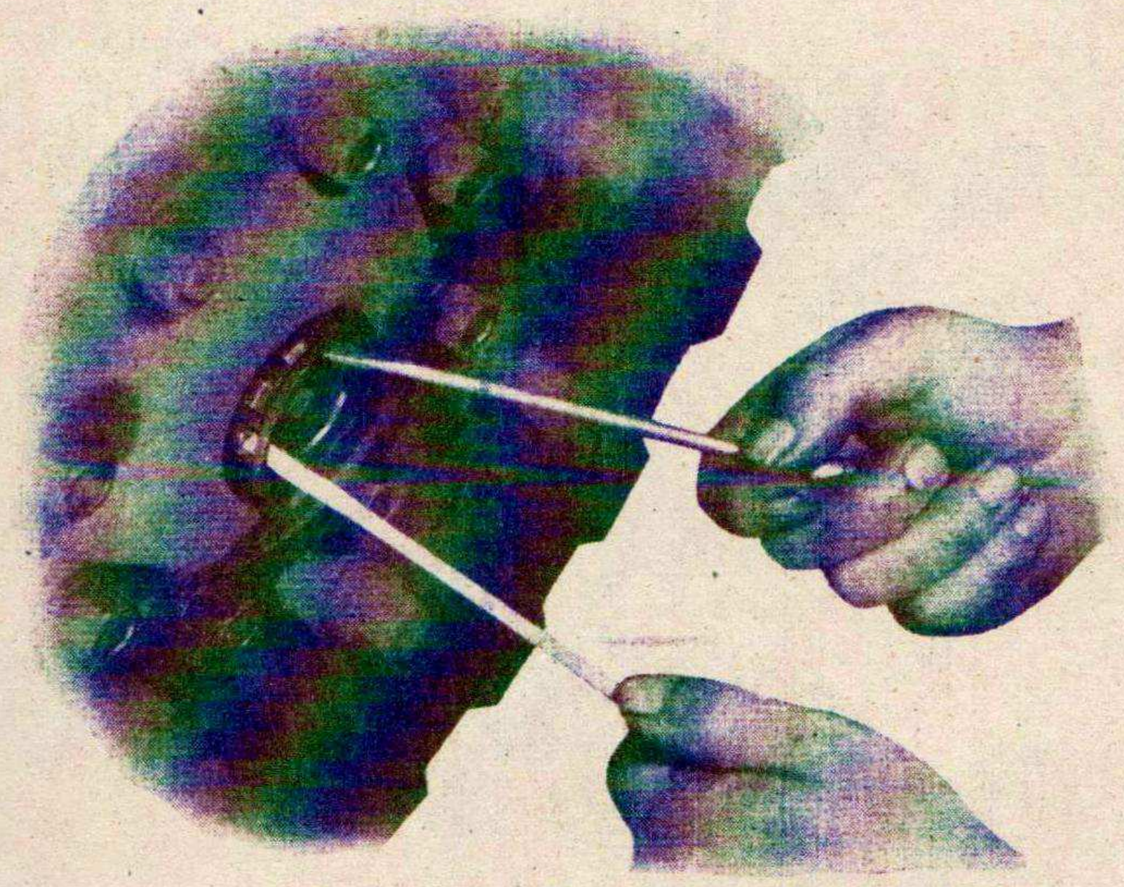
1 Cage with Splined End (Outer Race-Steering Knuckle Shaft BB5116)
2 Cage
3 Inner Race
4 Balls
5 Pilot
6 Pilot Pin Seat
7 Pilot Pin
8 Pilot Pin Spring
9 Axle Shaft
10 Shaft Retainer Screw
11 Shaft Retainer

17. Slide the axle shaft and joint assembly into the axle housing, meshing the shaft splines with those of the differential side gear.

18. Install the bushing, oil seal felt and spring on the steering knuckle shaft.

19. Assemble the brake plate, steering knuckle tube and the brake plate oil slinger to the flange assembly.

20. Connect push rod to brake camshaft lever with clevis and cotter pins.



Assembling Drive Flange Snap Ring

21. Install the hub assembly and adjust the wheel bearings as described on page 0-36.

22. Assemble the drive flange and snap ring to the axle.

ADJUSTMENT OF PINION SHAFT BEARINGS —

The pinion and its bearings are assembled in a housing known as the pinion cage. The cage is a separate unit and can be removed from the carrier housing for adjustment or disassembly.

To remove the pinion cage, remove the nuts (C) which hold it to the face of the carrier housing. The cage is then easily removed by using puller screws in the tapped holes of the flange. Remove the shim pack from the studs and keep all shims together so as not to alter the bevel gear adjustment.

To Remove Pinion and Bearings—To remove the pinion and bearings for inspection, cleaning or replacement, proceed as follows:

1. Remove the flange and bearing cap.
2. Loosen the Allen set screw in the jam nut.
3. Hold bevel pinion firmly and back off jam nut and remove lockwasher at (A).
4. Unscrew the wide adjusting nut at (A).
5. Place the assembly in an arbor press and apply pressure to the tapered end of the pinion shaft.
6. Press out of cage assembly.

The inner bearing near the gear end should be a tight fit on the bearing surface, while the outer bearing should be a tight sliding fit so that proper bearing adjustment can be made.

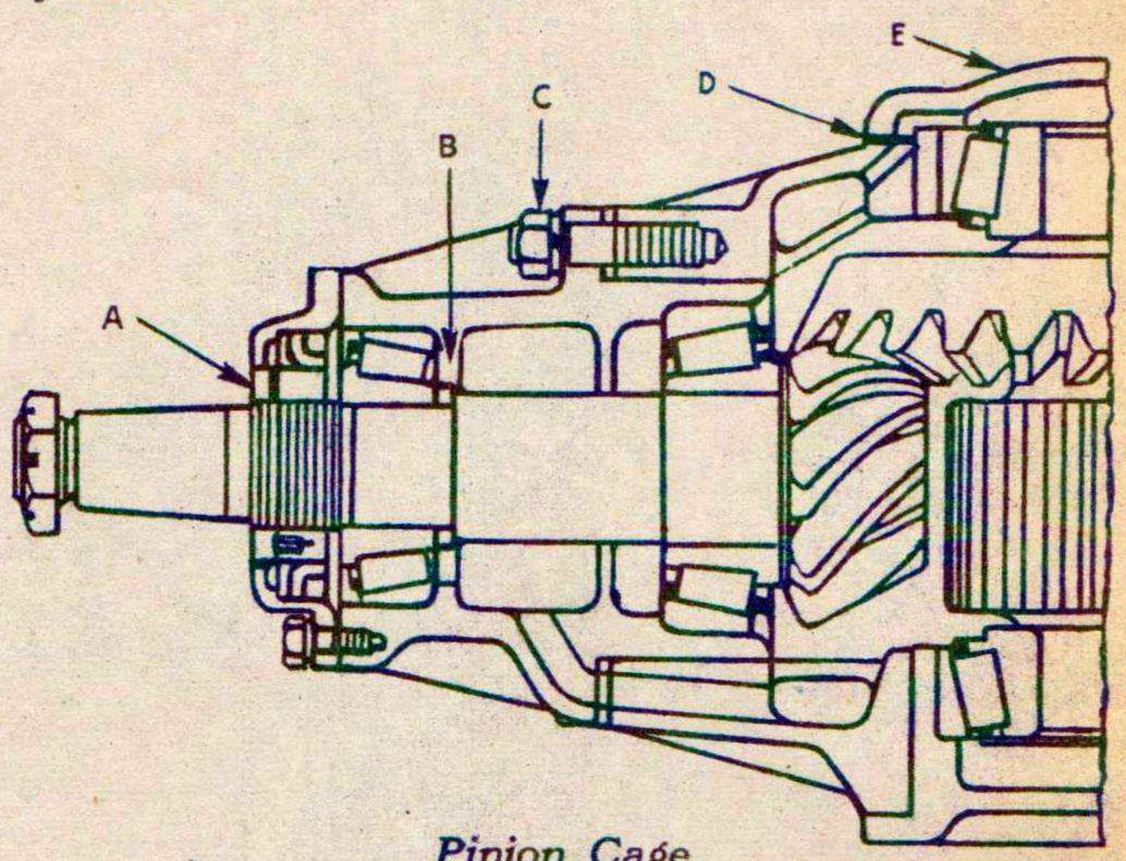
To Reassemble Pinion and Bearings —

1. Place the pinion in position and place pinion bearing shims on pinion against the pinion bearing spacer (B).

2. Place the pinion outer bearing on pinion shaft and press down tightly against the bearing cup.

3. Tighten adjusting nut against the bearing, drawing the assembly together.

Correct bearing adjustment is obtained by increasing or decreasing the thickness of the shim pack at the forward end of the bearing spacer. New bearings should be adjusted .000" to .002" tight so that a slight bearing drag is felt when rotating the pinion by hand.



Pinion Cage

When the proper bearing adjustment is obtained, place the lockwasher against the adjusting nut and with hammer and punch indent the washer into one of the holes in the adjusting nut. Back out the Allen set screw from jam nut and screw the latter up tight to the lock washer. Then run the set screw into the tapped hole in the jam nut and turn it up tight against the lockwasher, securing the adjustment. Recheck the bearing adjustment to make sure that it has not been altered by tightening the jam nut and set screw.

If it is necessary to change the pinion setting to obtain correct bevel gear tooth contact, add or remove shims between the pinion cage and carrier.

Cautions —

1. The oil seal assembly is self-contained and cannot be adjusted. When seals no longer hold oil replace with new part.

2. Make sure that the adjusting nut is smooth and true at the oil seal surface.

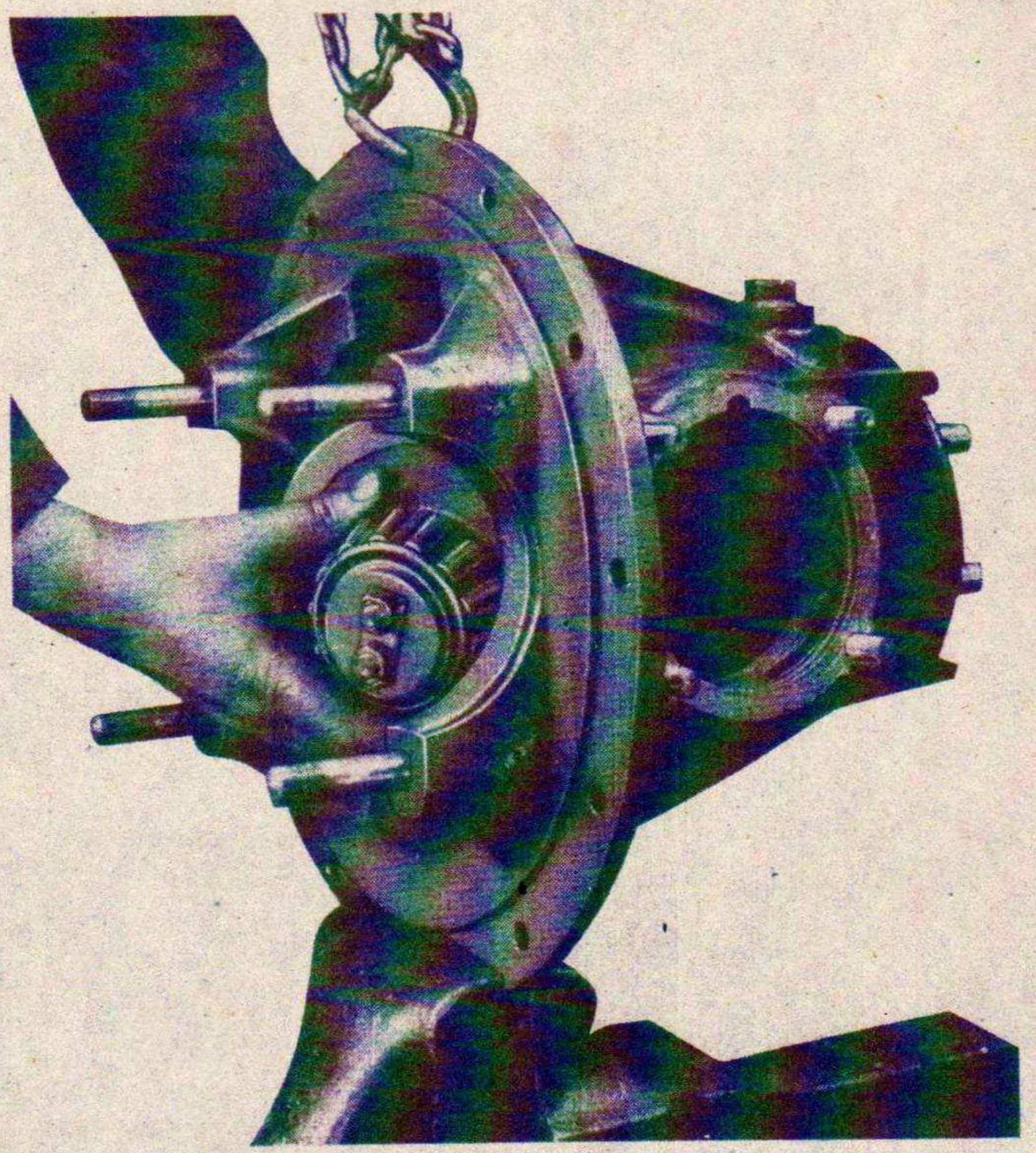
3. Be sure that the jam nut is securely locked.

4. Use a soft hammer for assembly and disassembly work.

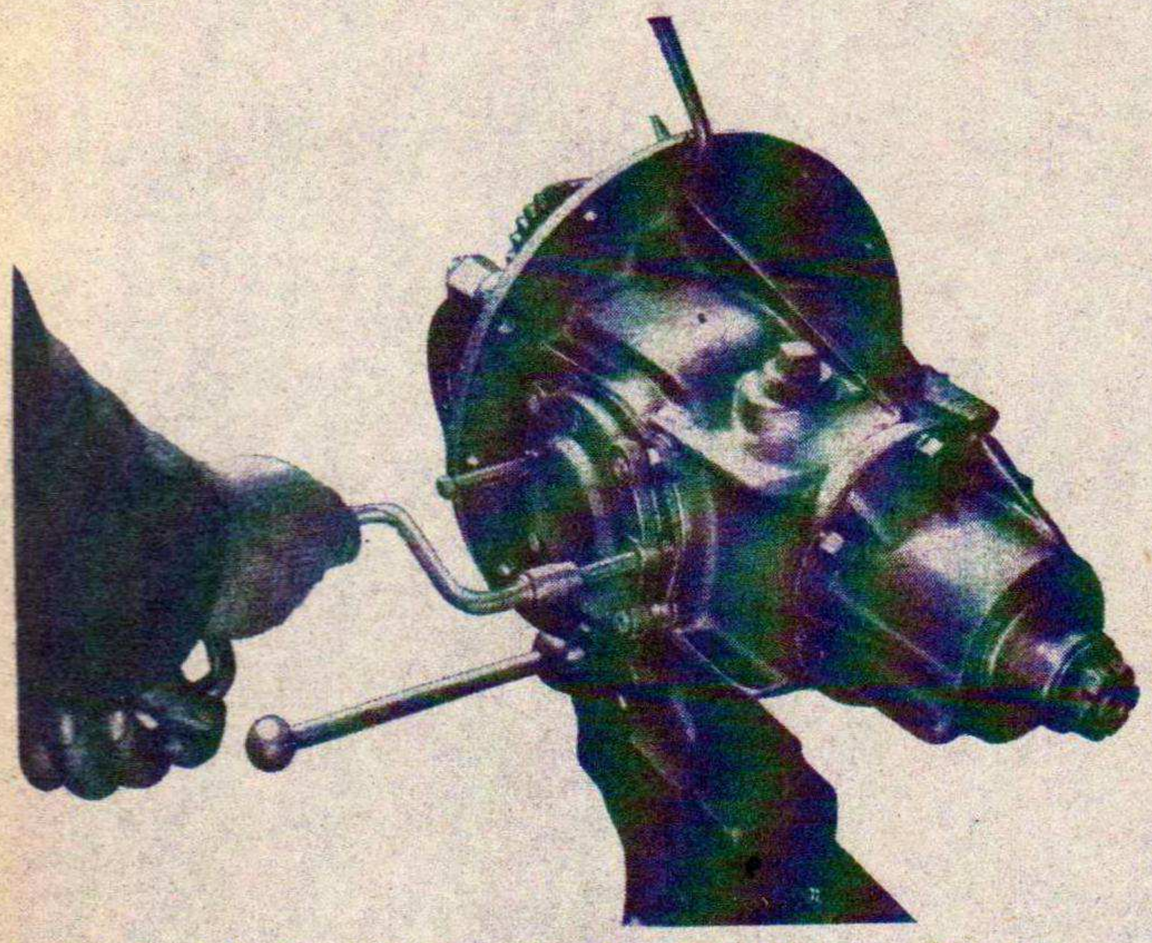
ADJUSTMENT OF CROSS SHAFT, DRIVE GEAR AND DIFFERENTIAL ASSEMBLY —

The cross shaft assembly consists of the spur pinion and shaft BB5223, bevel gear BB5226 and bearings, the pinion being an integral part of the shaft. The assembly is held in position by covers "E," which contain the bearing cups. The shaft bearings and bevel gear adjustments are made with shims "D," fitting between the cover flanges and the side faces of the carrier.

To Remove the Cross Shaft Assembly — To remove the cross shaft assembly from the carrier, the first step is to take out the large spur gear and differential assembly. Then remove the stud nuts and insert puller screws in the tapped holes in the bearing



Removing Cross Shaft



Using Puller Screws in Bearing Cover Flange

cover flanges. Turn the puller screws to lift the covers from their seats in the carrier. Be careful to keep the shims for each side separate so that the original bearing and gear adjustments are not changed.

After the covers have been removed, the shaft assembly can be taken from the carrier without further disassembly. The bevel gear is secured to a splined flange on the cross shaft by means of cap screws, the heads of which are drilled for a locking wire. After removing the cap screws, the bevel gear can be pressed from the splined flange.

If it is desirable to remove the bearings for inspection, use a puller suitable to fit behind the bearing cone. This method avoids the possibility of damaging the roller bearing cage.

To Reassemble — At reassembly, reverse the above operations. The cross shaft bearings are adjusted by adding or removing shims until the desired setting (.000" to .002") is obtained. Check the bevel gear tooth contact with the bevel pinion. The desired position of the bevel gear, with relation to its pinion, is obtained by transposing shims from under one side cap to the other, until correct tooth contact is obtained. Do not make the bevel gear adjustment until after the shaft bearings are correctly set. (See the section on the adjustment of bevel gearing).

Removing Shims to Adjust Cross Shaft Bearings

Finally place the spur gear and differential assembly, with the bearings assembled, into the support legs of the carrier, with the differential case bolt heads nearest the bevel gear. Place the bearing retainer rings in the grooves, assemble the support caps in place on the studs, screw stud nuts down securely and lock with cotter pins.

Cautions —

1. Make sure that the bearing cups are tight in the bearing seats and that the bearing cones fit the shafts and differential hubs tightly so as not to turn on bearing seats when in operation.

2. Be sure that the differential case bolts are drawn down tightly.

3. Be sure that all cap screws and nuts are properly locked.

4. Be sure that the entire assembly is thoroughly cleaned before placing it in the axle housing.

5. The housing bowl should be drained and carefully washed out with kerosene before the carrier assembly is replaced. DO NOT FAIL TO LUBRICATE.

DISASSEMBLY OF FRONT AXLE DIFFERENTIAL —

Removing Carrier Assembly —

1. Disconnect propeller shaft from the pinion shaft companion flange, and swing it clear.

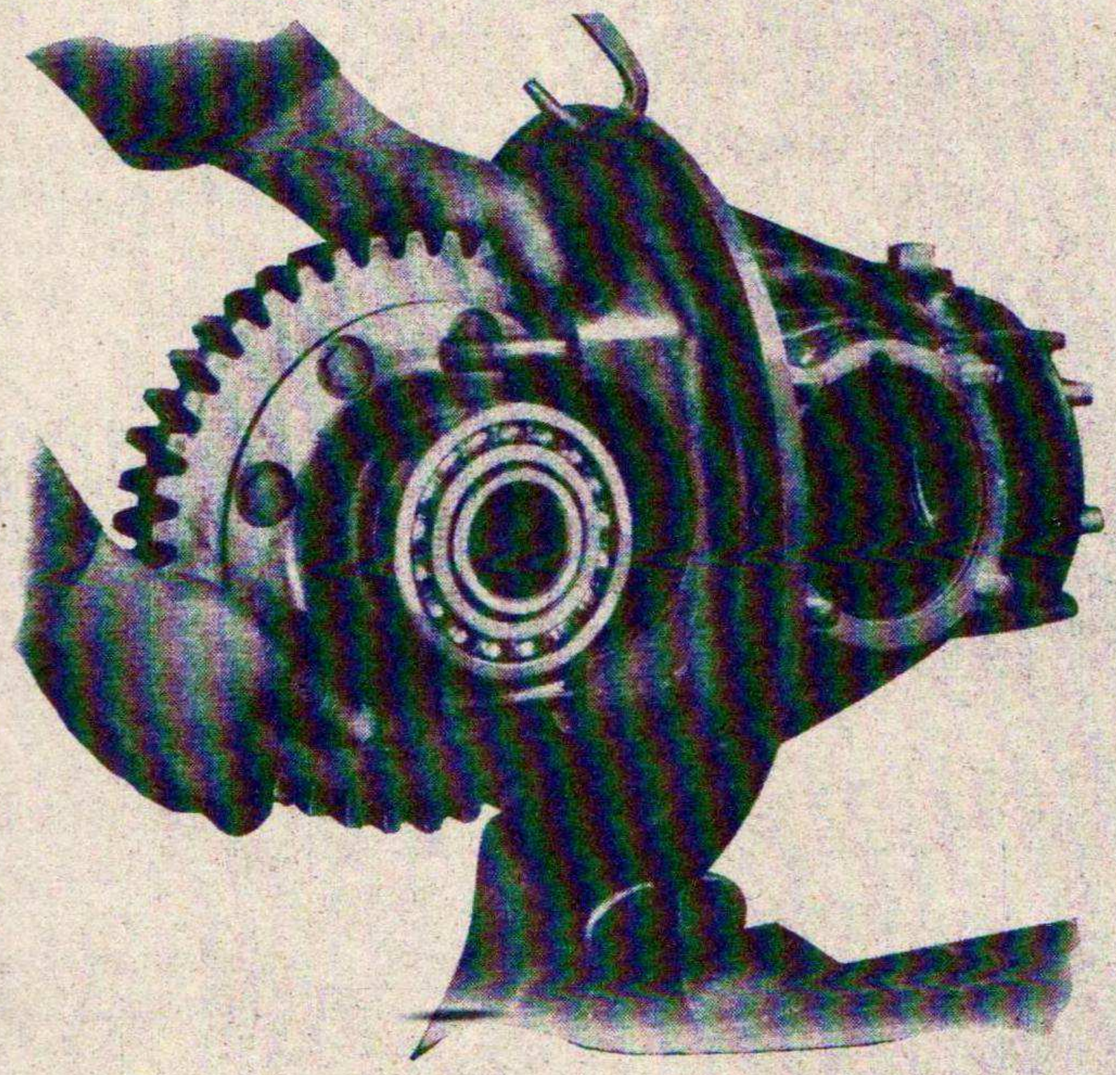
2. Raise the front of vehicle just enough to lift the weight off the wheels.

3. Disconnect the yoke at one end of the tie rod and swing the tie rod clear.

4. Remove the nuts holding the trunnion socket housing to the main axle housing, and slide each wheel and all attached parts out about 6 inches. (A greased board under each tire will make this easy.)

5. Remove the nuts holding the carrier housing to the axle housing and remove the carrier assembly.

Removing the Differential Assembly—The differential gears are held in the differential case which is bolted to the large spur gear. This assembly is mounted on bearings supported in the caps of the carrier housing.

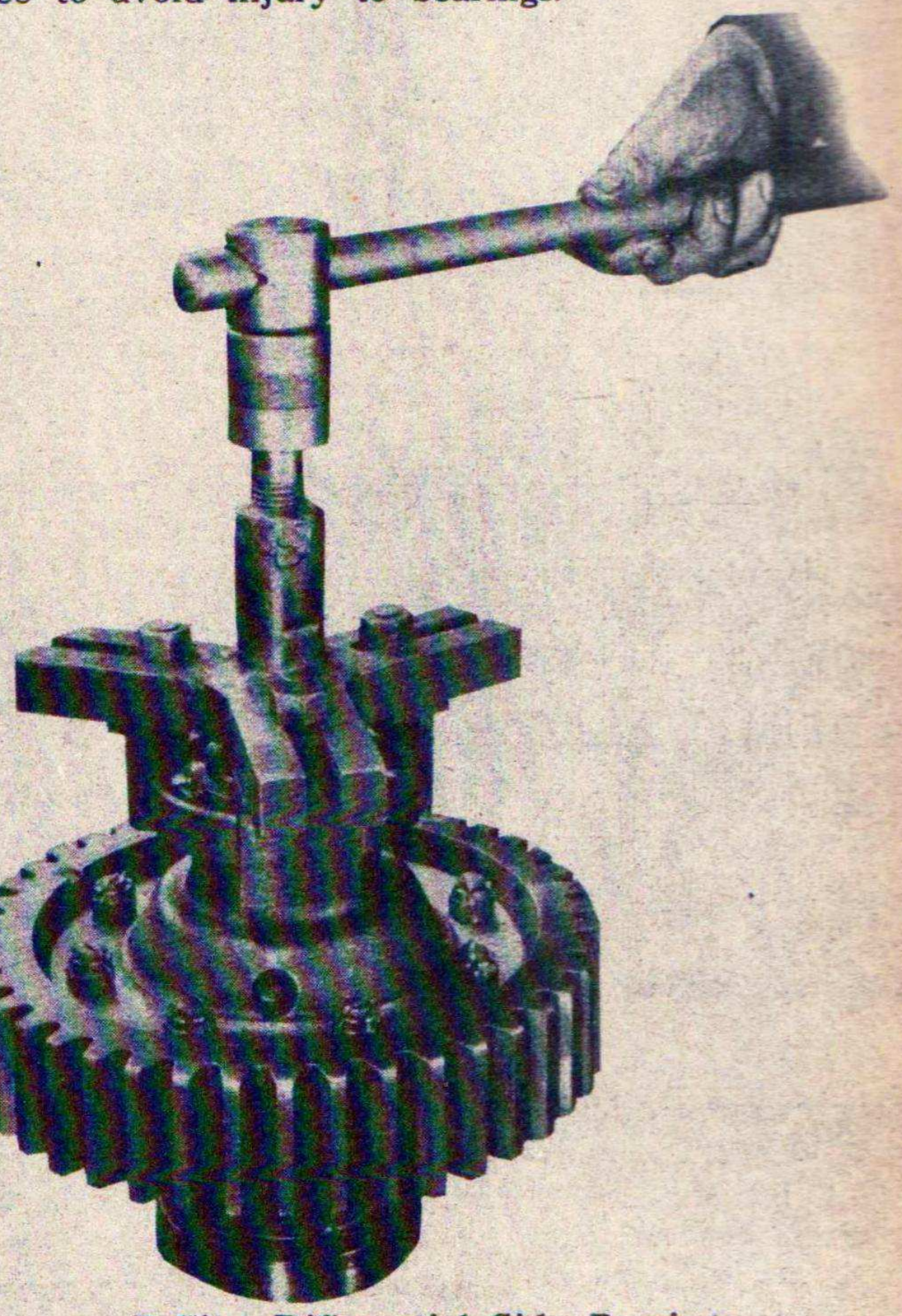


Removing Spur Gear and Differential Case

To remove the differential unit from the carrier assembly, remove the nuts holding the bearing caps to the carrier housing. The spur gear and differential assembly may then be lifted clear.

Disassembling Differential — It is good practice to mark the differential case halves in order to be sure that they are reassembled in their original relative positions.

1. Pull side bearings from the differential case. Use a suitable puller to apply pressure at the inner race to avoid injury to bearings.



Pulling Differential Side Bearings

2. Remove bolts holding the differential case halves together and to the spur gear.

3. Separate the halves of the case and remove the spider, differential pinion gears (4) and differential side gears (2) and thrust washers.

All parts should be thoroughly washed in kerosene or other suitable solvent. Examine the gears carefully and if any one of them has chipped, cracked or scored teeth, all six should be replaced, to avoid noise or wear which would result from mating worn with new parts.

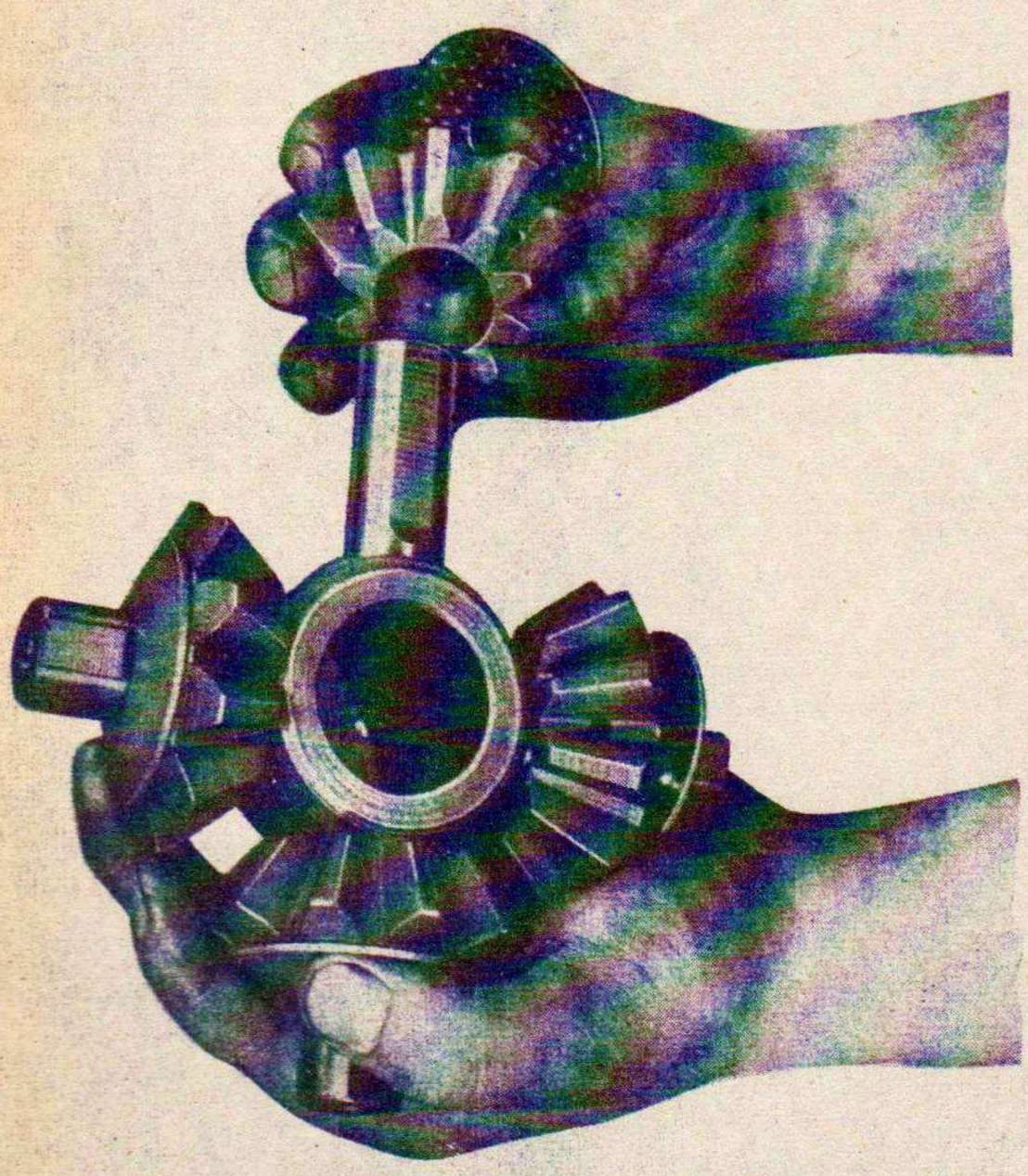
Examine the thrust surfaces on the differential case and gears and also inspect the thrust washers. Check the fit of the differential pinion gears on the spider. Worn or scored parts must be replaced.

Check the differential side bearings. These bearings are not adjustable for wear and must be replaced if side play can be detected.

Reassembly — Before reassemblihg this unit, lubricate the differential side gears and pinions.

1. Place one side gear and thrust washer assembly into one of the differential case halves.

2. Assemble the four pinion gears onto the spider and into the case, meshing the pinion teeth with those of the side gear already in place. Be sure that there are thrust washers between each gear and the case, on the spider arms.



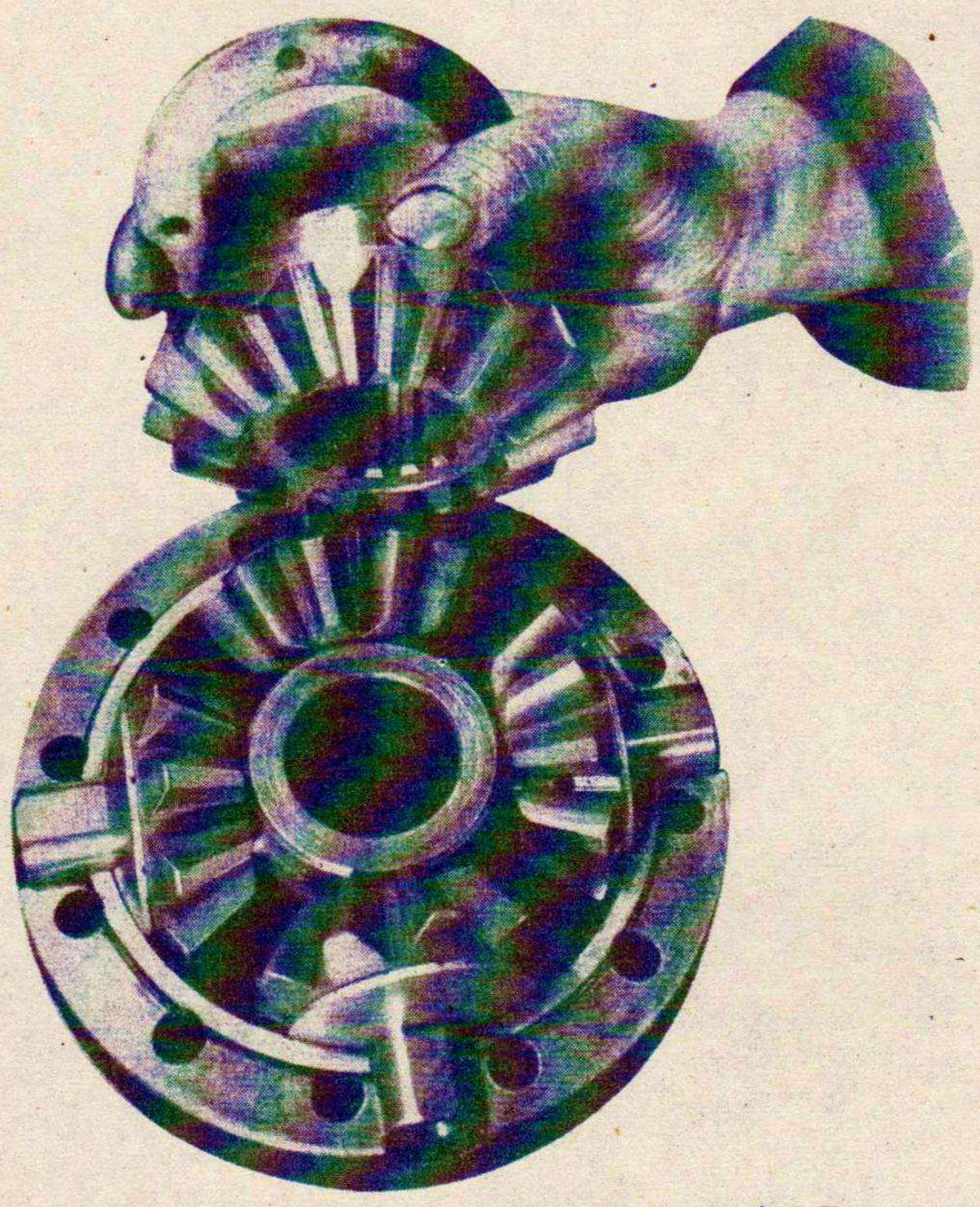
Assembling Pinion Gears to Spider

3. Place the other side gear and thrust washer assembly in position.

4. Place the spur gear and other differential case half in place and bolt the assembly together, locking the nuts with cotter pins.

5. Press the side bearings into place, applying pressure only at the inner race.

The differential assembly is installed in the carrier by lifting it into place and locking it there with the bearing caps and nuts. Lock with cotter pins. The carrier assembly may then be placed in and bolted to the banjo housing.



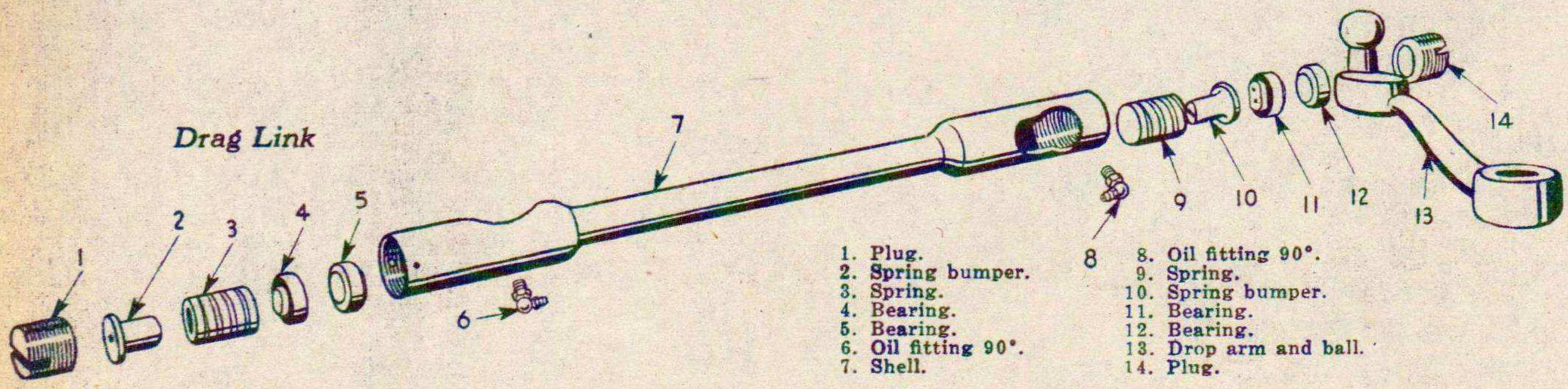
Assembling Side Gear into Differential Case

The wheels may then be slid in to mesh the axle shaft splines with those of the side gears. Replace the housing and socket stud nuts and connect the tie rod yoke. Lift the propeller shaft into place and bolt to the pinion shaft companion flange.

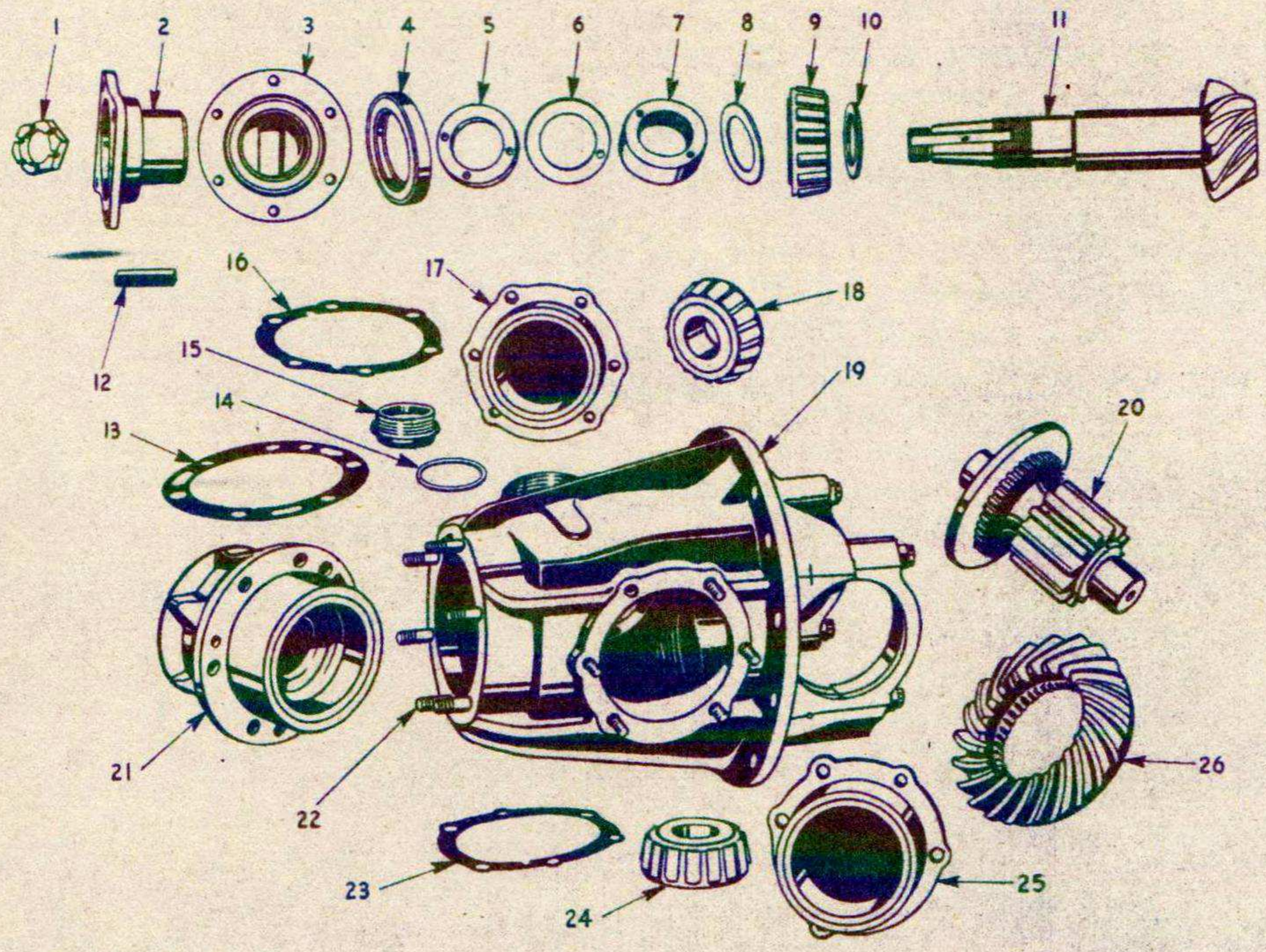
Oil Sealing—

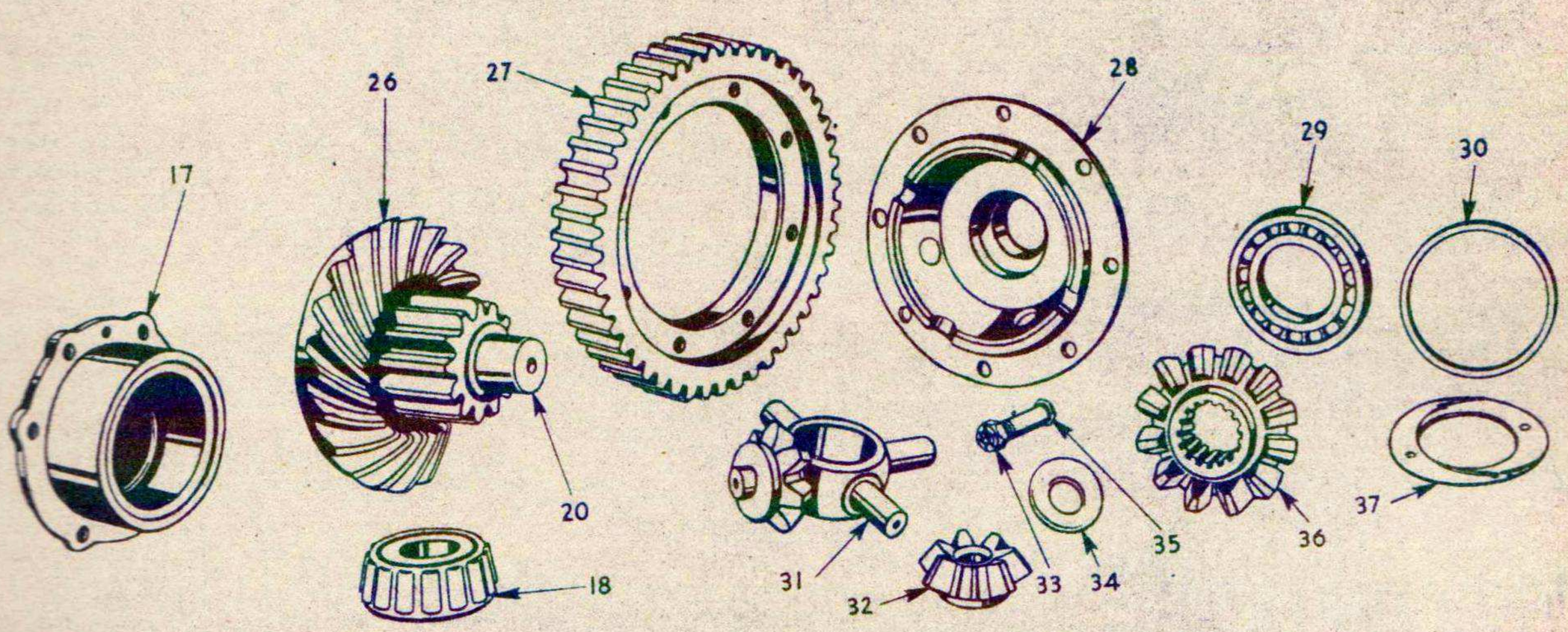
Spring loaded conventional oil retainers are installed in the front axle housing and are held in place by the trunnion socket housing. These seals are pressed into the housing. No adjustment is possible and when leather is worn through contact with the shaft replacement is necessary.

Drag Link



1. Plug.
2. Spring bumper.
3. Spring.
4. Bearing.
5. Bearing.
6. Oil fitting 90°.
7. Shell.
8. Oil fitting 90°.
9. Spring.
10. Spring bumper.
11. Bearing.
12. Bearing.
13. Drop arm and ball.
14. Plug.





Front Axle Differential Parts

DESCRIPTION	PART No.
1. Nut (companion flange)	26556F
2. Companion flange	DT2808
3. Cover assembly	56659F
4. Oil seal	BB5232
5. Jam nut	76635F
6. Lock	66654F
7. Adjusting nut	66635F
8. Spinner ring	BB5229
9. Bearing cone (forward)	26623F
10. Pinion shaft bearing shim	BB5233
11. Bevel pinion	BB5228
12. Key	26636F
13. Gasket (pinion shaft cage)	56644F
14. Gasket	BB5104
15. Inspection plug	6203C
16. Spur pinion cage gasket	56630F
17. Cage—(gear side)	76626F
18. Bearing cone (spur pinion)	56620F
19. Carrier and cap	BB15211

DESCRIPTION	PART No.
20. Spur pinion	BB5228
21. Cage and cup assy.	56640F
22. Stud (2-5/16" x 9/16")	BB5231
23. Spur pinion cage gasket	56630F
24. Bearing cone (spur pinion)	56620F
25. Cage (spur pinion)	76626F
26. Bevel gear	BB5226
27. Spur gear	76666J
28. Differential case (not serviced as separate halves)	BB5216
29. Differential bearing	BB5214
30. Retaining ring	36605F
31. Spider	16616F
32. Pinion gear	BB5220
33. Nut (9/16" S.A.E. Cast.)	X69
34. Pinion gear thrust washer	26617J
35. Bolt (differential case)	16613F
36. Side gear	BB5218
37. Side gear thrust washer	BB5219

STEERING AND WHEEL ALIGNMENT

Ease of steering, riding comfort and tire life are all dependent upon the front wheel alignment. In discussing wheel alignment it will be necessary to make use of such terms as caster, toe-in and steering angle, which are explained and illustrated in what follows.

These conditions should be checked regularly and especially after the front end has been subjected to heavy impact or severe strain. Precision equipment is necessary for accurate inspection and correction work.

The wheels of this vehicle have been given no camber (inclination from perpendicular), nor is any required.

CASTER —

Caster is the amount in degrees that the top of the front axle is tilted toward the rear of the vehicle. It is used because an axle so tilted will tend to hold the front wheels in a straight forward position while driving. With proper caster and with the axle, wheels and tires in proper condition the vehicle should run in a straight line on a level road with the steering wheel free. Caster also lends a tendency for the wheels to straighten out after a turn.

Caster must be alike on both ends of the axle. Any variation changes the relative toe-in of the two wheels, causing one to scuff or drag more than the other. In reality this variation causes a different degree of toe-in on each wheel resulting in rapid tire wear and shimmy. (See under Relative Toe-in).

There is no adjustment provided to change the caster angle, which is engineered into the spring seat on the axle housing. Any tendency toward zero or negative caster can usually be traced to broken springs, dislocated springs, loose "U" bolts or loose spring clips. Slight differences in caster between the two sides of the axle can usually be corrected with tapered shims between the axle housing and the spring.

TOE-IN —

Toe-in is measured as the distance that the front wheels are closer together at the front than at the rear, or it is the amount the wheels are "Pigeon-toed" at the front. Excessive toe-in will cause rapid tire wear, hard steering and wear on axle parts.

Toe-in should be checked at regular intervals and if found incorrect should be adjusted. Measurements are usually made from the tire centers or from the rim bead on the wheels, but always with the wheels pointed straight ahead. If an adjustment is necessary, the tie rod pin will have to be removed and the yoke given as many turns as are necessary to give proper toe-in.

RELATIVE TOE-IN —

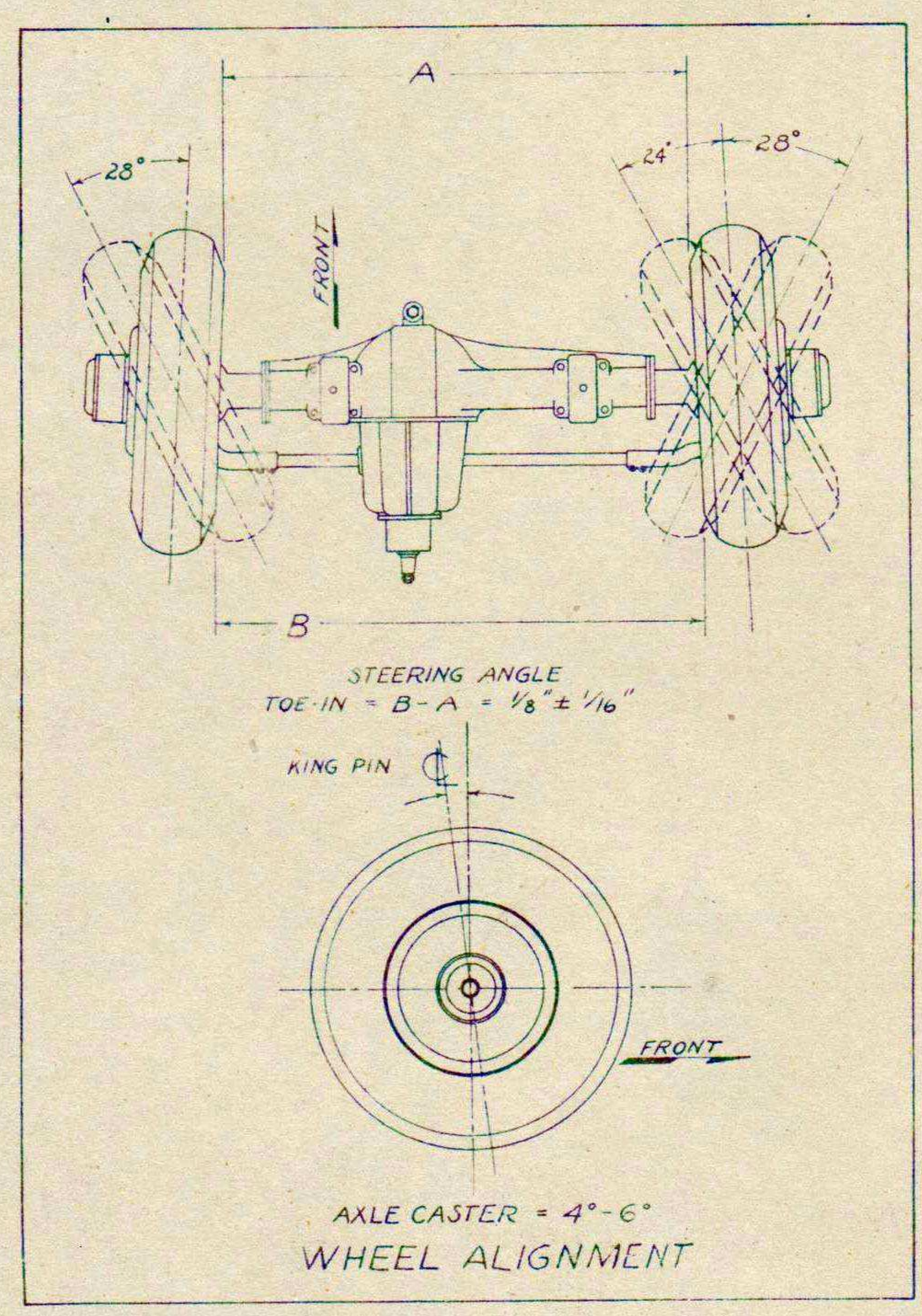
The narrowest point between front wheels having toe-in and caster is at a point at right angles from the tilted axle. A line drawn between the two wheels at these points will be slightly higher from the road than one drawn through the wheel centers.

If the caster should be decreased on one side, the narrowest point of toe-in is automatically brought down closer to the road, thereby causing this wheel to toe-in more. If the caster were increased on one side, the opposite effect would be achieved.

Too much caster makes a vehicle steer hard and causes shimmy. Insufficient caster or reverse caster will cause the front wheels to dive and wander, making it necessary that the vehicle be steered continually.

STEERING ANGLE —

The steering angle is controlled by stops at the rod arms which are set to give a maximum turning



angle of 28° for the inside wheel. When this condition is reached, the outside wheel has a turning angle of about 24°. These stops are welded in correct adjustment and it should not be necessary to make any changes. If the steering angle should come out of adjustment, it would be caused by worn or bent parts in the steering linkage, sprung axle housing or stops broken from axle.

SHIMMY —

Shimmy or front wheel tramp might be the result of wheel balance, wheel alignment (caster and toe-in), unevenly inflated tires, loose spring clips or loose

spring shackle bolts. Check these conditions after first noticing a shimmy and take the necessary steps to eliminate the trouble.

A high speed shimmy noticeable at speeds in excess of 25 m.p.h. is generally caused by faulty wheel balance. The wheels may be out of balance only a few ounces but this force is multiplied many times due to the speed at which they are rotating.

Balance wheels on a horizontal or vertical type balancer or proceed as follows:

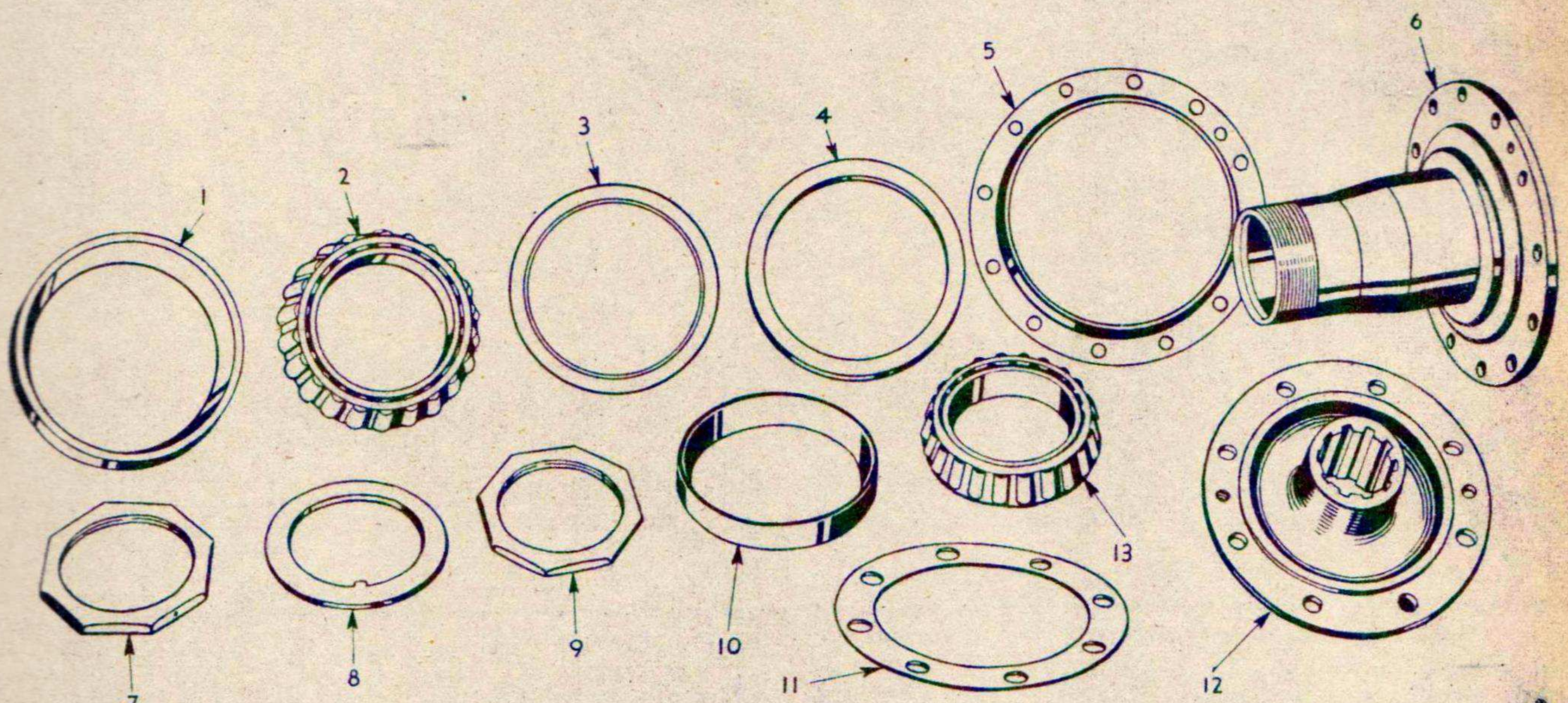
1. Lift the wheel from the floor with a jack under the front axle.
2. Remove the wheel and wheel bearings, wipe them clean of grease and reassemble with the dry bearings. (DO NOT REPLACE THE DRIVE FLANGE.) Adjust bearings for free rotation.
3. Spin the wheel to determine the light spot and mark it.
4. Install wheel balance weights on the rim bead to balance wheel so it will not stop in any one position repeatedly after spinning.
5. Remove wheel, lubricate bearings and reassemble.
6. Repeat with other front wheel.

SPECIFICATIONS — Alignment

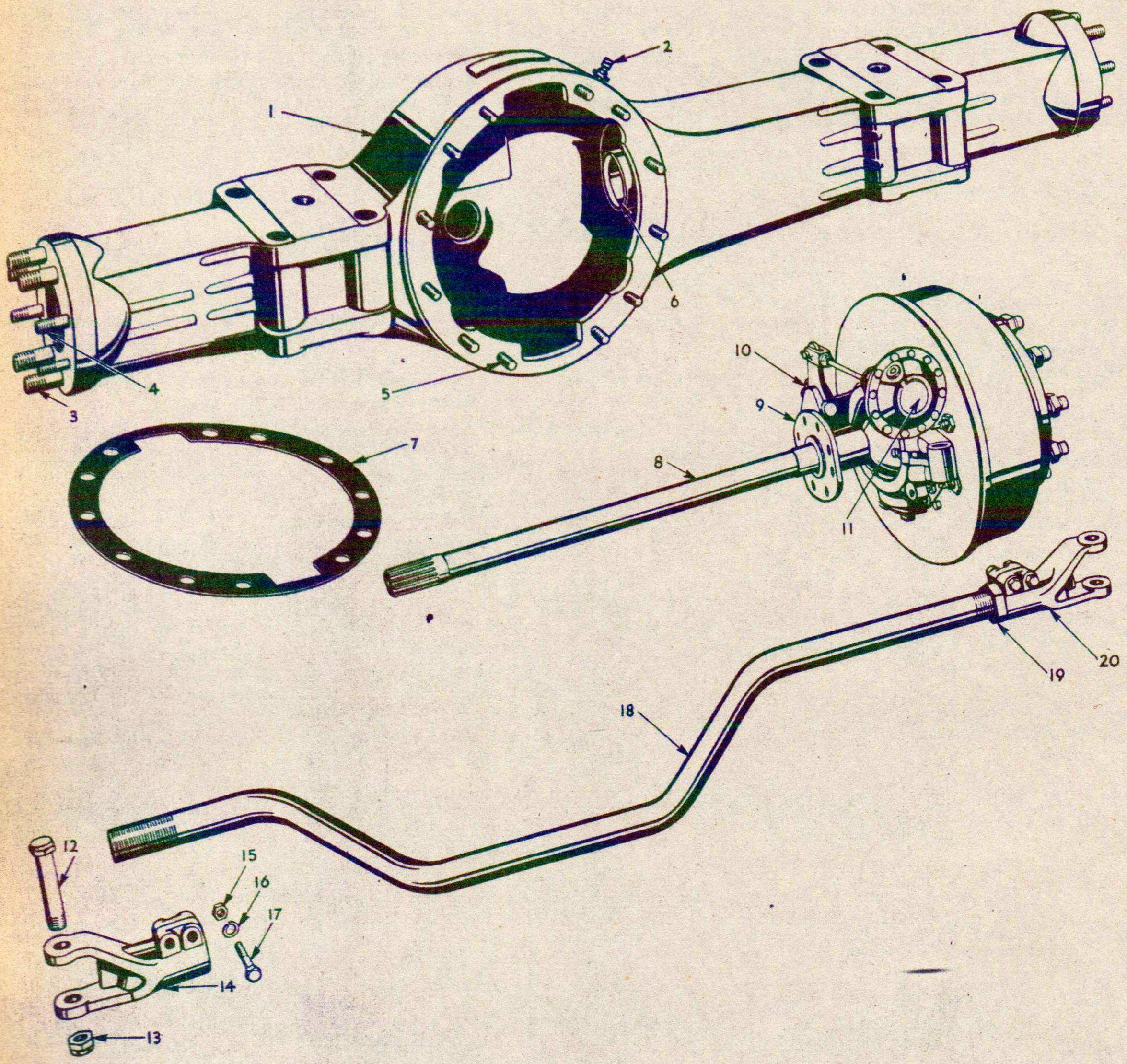
Caster Angle	4°-6°
Camber Angle	0°
Toe-In	1/8" + 1/16"
Steering angle	
Inside Wheel	28° Max.
Outside Wheel	24° Approx. as built into axle

SPECIFICATIONS — Front Axle

Make	Timken
Type	Double Reduction Drive
Model	F-2090-W-73
Gear Ratio	8.435 to 1
Pinion Shaft Bearings	
Make	Timken
Type	Opposed Tapered Roller
Numbers	
Forward Cone	527
Forward Cup	522
Rear Cone	621
Rear Cup	612
Cross Shaft Bearings	
Make	Timken
Type	Opposed Tapered Roller
Numbers	
Cones	615
Cups	612
Carrier Bearings	
Make	Timken
Type	Ball
Number	1214
Gear Backlash	.005"-.010"
Bearing Adjustment	.000"-.002" Tight
Universal Joint	Rzeppa
Lubricant	
Summer	SAE 140 Gear Oil
Winter	SAE 90 Gear Oil



DESCRIPTION	PART No.
1. Wheel bearing cup (493)	16606W
2. Wheel bearing cone (498)	16607W
3. Felt retainer	BB5141
4. Felt	BB5140
5. Oil slinger	BB5244
6. Steering knuckle and bushing	BB5144
7. Wheel bearing nut	BB5142
8. Wheel bearing lock	BB5143
9. Wheel bearing nut	BB5142
10. Wheel bearing cup (592A)	36888F
11. Drive flange gasket	BB5114
12. Drive flange	BB5113
13. Wheel bearing cone (594)	BB5139



Front Axle

DESCRIPTION	PART No.
1. Housing Assembly	BB15102
2. Breather	BB6003
3. Stud	BB5108
4. Stud	16619M
5. Stud	6631F
6. Housing Sleeve — Long	BB5106
7. Gasket	6647F
8. Axle Shaft — Long, R.H.	BB5112
9. Housing Trunnion Socket	BB15112
10. Slack Adjuster	BB15137
11. Brake Diaphragm — R.H.	BB15129
12. Tie Rod End Pin	BB5179
13. Nut	BB5180
14. Tie Rod End — L.H.	BB5176
15. Clamp Bolt Nut	X-38
16. Lock Washer	X-18
17. Clamp Bolt	BB5182
18. Tie Rod	BB15113
19. Tie Rod End Locknut	BB5178
20. Tie Rod End — R.H.	BB5177