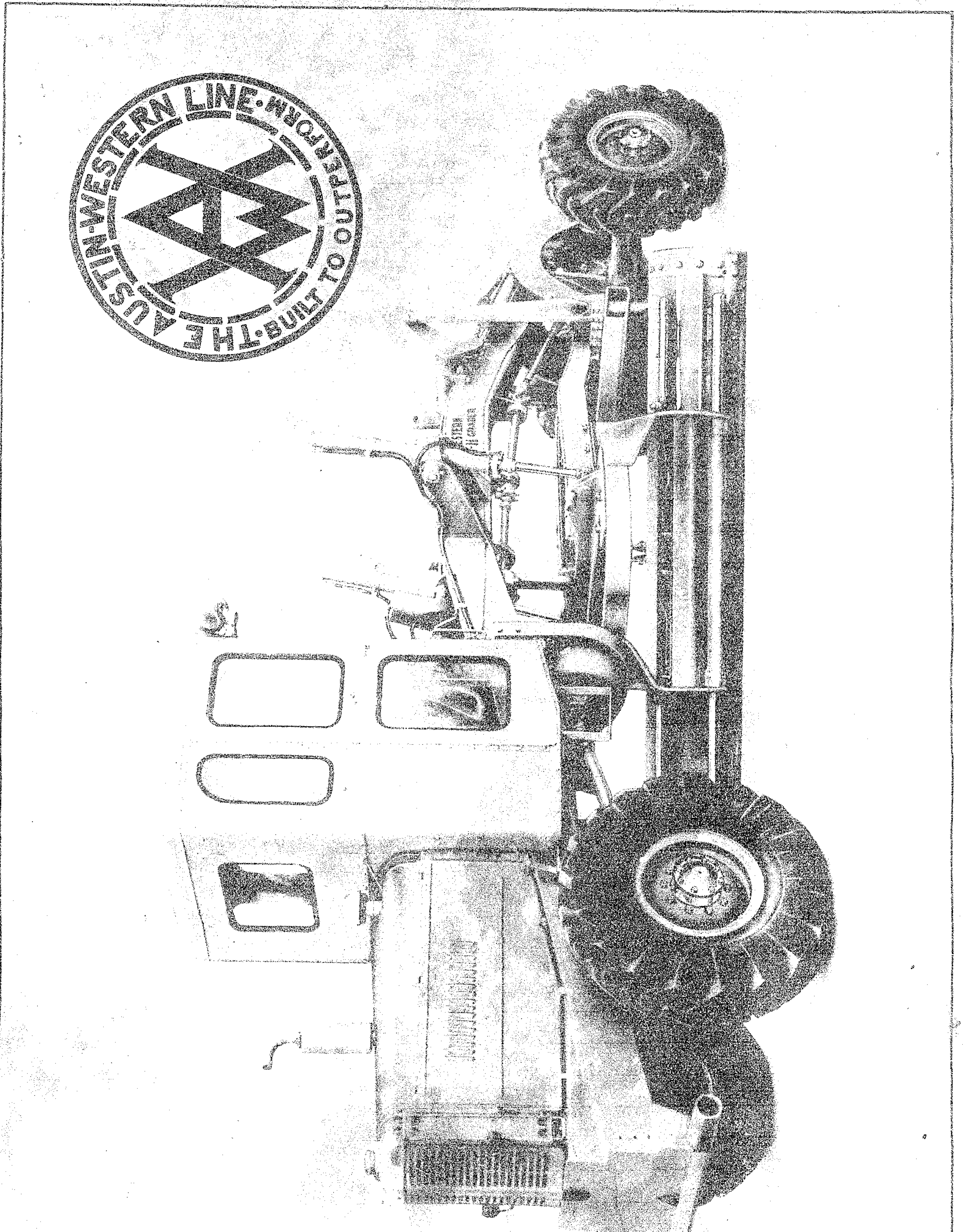


471.1

INDEX

NOTE: HOW TO USE THIS INSTRUCTION MANUAL

This manual No. 471-D is composed of six sections as follows:

Section 1. General Instructions to Operator. (Includes lubrication of basic grader only. See page 52 or 52A and 52B, for diesel engine lubrication.) (See separate manual No. 472-A for gas engine.)

Section 2. Earth Road Construction.

Section 3. Power Grader Attachments. (Includes lubrication, use of, and maintenance of all attachments.)

Section 4. Diesel Engines (UD-14A and UD-16). (Includes lubrication and maintenance of the diesel engines.) (See separate manual No. 472-A for gas engine.)

Section 5. Electrical.

Section 6. Power Grader. (Includes maintenance, dismantling, and assembly of all basic grader parts.)

INDEX

1. *INSPECTION BEFORE UNLOADING GRADER.*

a. *General.*

Before unloading the grader check it thoroly for damage during shipment.

Inspect the tires carefully, also the glass and the cab, if so equipped.

The tool packing list should be checked carefully, and any shortage or damage should be immediately reported to an authorized agent of the transportation company involved. In case of damage or pilferage, you have a right to demand that your copy of the transportation document be noted by the transportation company, showing whatever shortage or damage is involved.

Any damage or pilferage should be immediately reported to the nearest Austin-Western Distributor, and they will assist you in procuring the repairs required and advise you in regard to procedure that should be followed in further handling the claim papers.

b. *Before Starting Diesel Engine.*
(See separate Manual #472-A for Gas Engine)

Check oil level in the crankcase, air cleaner and diesel fuel pump. (See pages 52 to 52D inclusive.)

Fill fuel tank. (On IHC diesel engines the one gallon tank mounted on lower cab panel is for gasoline starting only.) (See page 58A, paragraph 60C., for diesel fuel specifications.)

See tag wired to hood near radiator indicating water is drained from cooling system. Also see data on card regarding oil placed in the crankcase of engine before it left the factory. Find and install water drain plug wired to engine, and fill complete system with clean water (or anti-freeze). (See page 69.)

Open fuel valve under diesel fuel and gas tanks.

Lubricate engine. (See lubrication chart, pages 52 to 52D inclusive.)

Remove the spark plugs and put about one teaspoonful of crankcase oil into each cylinder. Replace the spark plugs and crank the engine to distribute oil over the cylinder walls. This assures positive lubrication of cylinders and pistons immediately after starting and reduces the possibility of scoring.

c. *Hydraulic System.*

Consult hydraulic section on page 121 (paragraph 136.-b.) for oil specifications.

Check oil level in oil reservoir. Fill to oil level shown on page 121 (paragraph 136.-c.(3)).

Wipe all dust, gum and grime from exposed ends of all hydraulic piston rods. Do not relubricate piston rods.

d. *Unloading Motor Grader.*

Remove blocks from front, sides and rear of all wheels. Pull spikes from car floor.

Start engine. (See engine starting instructions, page 49.)

Test brakes before moving off car. Move grader slowly off car in low gear.

Wash all grime and dust laden grease from all exposed machined parts, such as, hydraulic ram piston rods, back of all wheel trunnion sockets and circle.

The piston rods and trunnion sockets need not be relubricated. Use a handful of high pressure grease and apply lubricant to the inside bore of the circle, also the under side of same. Do not lubricate the top side of the circle.

Lubricate balance of grader with grease gun provided. (See page 10 for points to be lubricated and lubricant specifications.)

Test brakes. Fill master cylinder with fluid. (See page 12.)

Check tire pressures. Do not over or under inflate tires. (See decalcomania on main frame, also page 119.)

Check clutch pedal clearance. (See pages 79, 82 and 82A for all adjustments, including clutch brake.)

POWER GRADER SPECIFICATIONS

NOTE: Throughout this manual the use of the terms "Left" and "Right" must be understood to avoid confusion when following instructions. "Left" and "Right" indicate the left and right sides of the grader when standing back of and facing the radiator.

GOVERNED SPEED - FULL THROTTLE - NO LOAD

UD-14A Engine (Modification 66A).. 1540 R.P.M. UD-16 Engine..... 1980 ± 20 R.P.M.
UD-14A Engine (Modification 66B).. 1705 R.P.M.

TRAVELING SPEEDS

* (With Standard 14.00 x 20 Tires - 14 Ply)

	UD-14A (Modification 66A) and D-471 Engines	UD-14A Engine (Modification 66B)	UD-16 Engine
1st	1.72 M.P.H.	1.96 M.P.H.	2.21 M.P.H.
2nd	2.79 M.P.H.	3.19 M.P.H.	3.59 M.P.H.
3rd	4.08 M.P.H.	4.66 M.P.H.	5.25 M.P.H.
4th	5.74 M.P.H.	6.56 M.P.H.	7.39 M.P.H.
5th	9.32 M.P.H.	10.66 M.P.H.	12.00 M.P.H.
6th	14.98 M.P.H.	17.13 M.P.H.	19.28 M.P.H.
Low Reverse	1.75 M.P.H.	2.00 M.P.H.	2.25 M.P.H.
High Reverse	5.84 M.P.H.	6.68 M.P.H.	7.52 M.P.H.

* (With Special 16.00 x 20 Tires - 14 Ply)

1st	1.82 M.P.H.	2.08 M.P.H.	2.34 M.P.H.
2nd	2.94 M.P.H.	3.36 M.P.H.	3.79 M.P.H.
3rd	4.30 M.P.H.	4.92 M.P.H.	5.54 M.P.H.
4th	6.07 M.P.H.	6.94 M.P.H.	7.81 M.P.H.
5th	9.85 M.P.H.	11.26 M.P.H.	12.68 M.P.H.
6th	15.82 M.P.H.	18.09 M.P.H.	20.36 M.P.H.
Low Reverse	1.85 M.P.H.	2.11 M.P.H.	2.38 M.P.H.
High Reverse	6.17 M.P.H.	7.05 M.P.H.	7.94 M.P.H.

NOTE: * Traveling speeds in gear shift charts on pages 15 and 84, and text on pages 15 and 86, are for machines (with UD-14A, modification No. 66A, or D-471 engines) using standard tires only.

GEAR LUBRICANT CAPACITIES (U.S. Measure Approximate)

Front Axle..... 15 quarts
Rear Axle..... 13½ quarts
Transfer Case (Machines H-100 to H-1838 inclusive)..... 28 quarts
Transmission (Machines H-100 to H-1838 inclusive)..... 4 quarts

NOTE: On Machines H-1840 and up the transfer case filler plug is to be used for determining oil level in both the transfer case and transmission case, due to both oil compartments being interconnected. 32 quarts of oil will be required for initial filling.

ENGINE OIL PRESSURE

UD-14A Engine..... 45 pounds UD-16 Engine..... 45 pounds

ENGINE OIL CAPACITIES (U.S. Measure Approximate)

UD-14A Engine	16 quarts	UD-16 Engine	18 quarts
UD-14A Fuel Injection Pump	½ pint	UD-16 Fuel Injection Pump	7/8 pint
UD-14A Air Cleaner Oil Cup	5½ pints	UD-16 Air Cleaner Oil Cup	5½ pints

COOLING SYSTEM CAPACITY (U.S. Measure Approximate)

UD-14A Engine..... 14 gallons UD-16 Engine..... 17 gallons

FUEL TANK CAPACITIES (U.S. Measure Approximate)

UD-14A Engine-Diesel Fuel	58 gallons	UD-16 Engine-Diesel Fuel	58 gallons
UD-14A Engine-Gasoline (for starting)	1 gallon	UD-16 Engine-Gasoline (for starting)	1 gallon

EXTREME PRESSURE LUBRICANTS (APPROVED LIST)
(For Use in Front and Rear Axle Housings, Transfer Case and Transmission)

We recommend that the owner use the lubricant shipped with the machine in the gear housings and when a seasonal change becomes necessary, the housing should be thoroughly drained, flushed and refilled.

We suggest that the owner, rather than add to the original oil, drain out and refill with an approved EXTREME PRESSURE LUBRICANT obtainable in his locality. We prefer this rather than mixing two unknown brands.

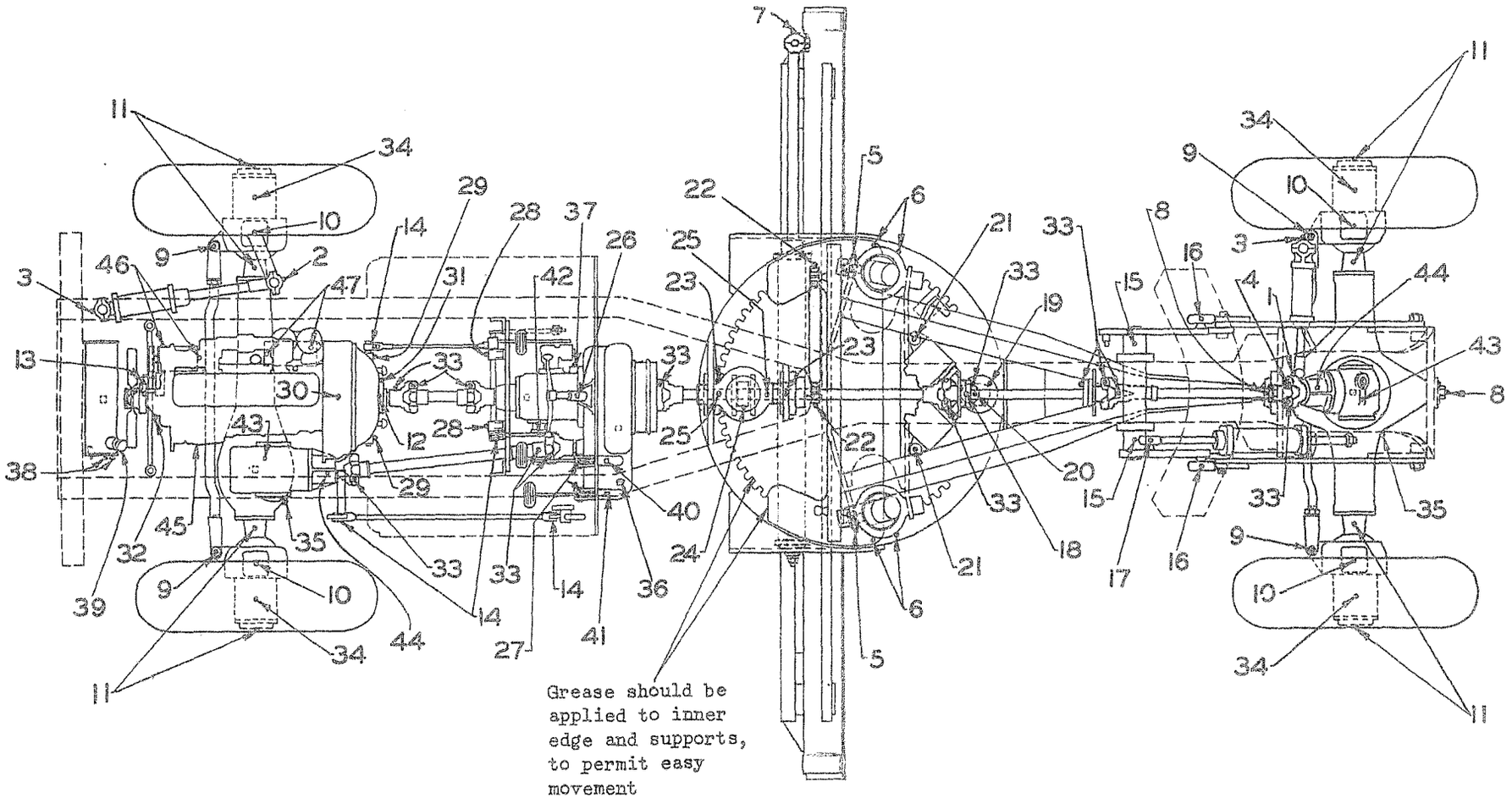
In flushing out the gear housings, use a regular flushing oil in preference to kerosene, gasoline, or other thin fuels.

We recommend the following brands of EXTREME PRESSURE LUBRICANTS for summer and winter use in Austin-Western Graders where the LUBRICATION CHART specifies its use.

In case these lubricants are not available in your territory, secure SAE-90 or SAE-140 equivalent grades of stable inactive types. The following are of the stable or inactive types of EXTREME PRESSURE LUBRICANTS and contain either combined sulphur, chlorine, phosphorous, leaded soaps or combinations.

APPROVED LIST OF EXTREME PRESSURE LUBRICANTS

EXTREME PRESSURE WINTER LUBRICANTS FOR TEMPERATURES BELOW 32°F.		EXTREME PRESSURE SUMMER LUBRICANTS FOR TEMPERATURES OF 32°F. AND ABOVE		
NAME	NO.	NAME	NO.	MANUFACTURER
Alemite	E.P.SAE-90	Alemite	E.P.SAE-140	Alemite Corp., Chicago, Ill.
Koolmotor Trans. Lub.	E.P.SAE-90	Koolmotor Trans. Lub.	E.P.SAE-140	Cities Service Oil Co., New York City, N.Y.
Universal Gear Lube	E.P.SAE-90	Universal Gear Lube	E.P.SAE-140	Continental Oil Co., Ponca City, Okla.
D-A Lubricant	E.P.SAE-90	D-A Lubricant	E.P.SAE-140	D-A Lubricant Co. Inc., Indianapolis, Ind.
Gulf Multi-Purpose Gear Lubricant	E.P.SAE-80	Gulf Multi-Purpose Gear Lubricant	E.P.SAE-140	Gulf Oil Corp., Pittsburgh, Penna.
Kendall E.P. Gear Lube	E.P.SAE-90	Kendall E.P. Gear Lube	E.P.SAE-140	Kendall Refining Co., Bradford, Penna.
Pennzoil #4191	E.P.SAE-90	Pennzoil #4191	E.P.SAE-140	Pennzoil Co., Oil City, Penna.
Phillips	E.P.SAE-90	Phillips	E.P.SAE-140	Phillips Petroleum Co., Kansas City, Mo.
Purelube	EE	Purelube	DD	Pure Oil Co., Chicago, Ill.
Shell Super Gear Lub.	E.P.SAE-90	Shell Super Gear Lub.	E.P.SAE-140	Shell Corp., New York City, N.Y.
All Purpose Gear Lub.	A.P.SAE-90	All Purpose Gear Lub.	A.P.SAE-140	Standard Oil - Indiana Chicago, Ill.
SohioLube	E.P.SAE-90	Sohiolube	E.P. SAE-140	Standard Oil - Ohio Cleveland, Ohio
Texaco New Univ Gear Lub or Texaco Meropa Lub.-3	E.P.SAE-90	Texaco New Univ Gear Lub or Texaco Meropa Lub.-6	E.P.SAE-140	Texas Co., New York City, N.Y.
Veedol Lub.	E.P.SAE-90	Veedol Lub.	E.P.SAE-140	Tidewater Oil Co., New York City, N.Y.
Red Line E.P. Gear Lub.	E.P.SAE-90	Red Line E.P. Gear Lub.	E.P.SAE-140	Union Oil Co. - Calif. Los. Angles, Calif.



Refer to Pages 11 and 12 for Lubrication Chart Key

Figure 1. Lubrication Chart

Key to Lubrication Chart - Refer to Figure 1

LUBRICATE DAILY (8 to 12 HOURS OF OPERATION)
Two strokes of lubricator at each grease fitting

Ref.	*Point of Lubrication:*	*Remark-*
1.	Ball - axle steer (front)	With pressure gun grease
2.	Ball - axle steer (rear)	With pressure gun grease
3.	Ball - steer ram base (front and rear axles)	With pressure gun grease
4.	Ball - draw bar	With pressure gun grease
5.	Ball - blade lift ram (on circle)	With pressure gun grease
6.	Ball - blade lift ram (upper and lower sockets)	With pressure gun grease
7.	Ball - side shift (on blade)	With pressure gun grease
8.	Pivot shaft - front and rear (front axle)	With pressure gun grease
9.	Tie rod ends - front and rear axles	With pressure gun grease
10.	Trunnion bearings - upper (front and rear axles)	With pressure gun grease
11.	Steering knuckles - front and rear axles	With pressure gun grease Grease level can be determined by removing pipe plug from lower side of each trunnion socket.
12.	Clutch - throw-out bearing	With pressure gun grease
13.	Pump - hydraulic (Grease fitting not used on 2nd type pump shown on page 124B).	With #2 Marfak grease or equal.
14.	Pins, rods, levers, parts with oil holes, etc.	Occasionally lubricate with a few drops of motor oil
18.	Bearing - pinion shaft (circle reverse hydraulic motor)	With pressure gun grease
19.	Bearing - pinion (circle reverse hydraulic motor)	With pressure gun grease

LUBRICATE WEEKLY (50 to 80 HOURS OF OPERATION)
Two strokes of lubricator at each grease fitting

15.	Bearings - scarifier lift	With pressure gun grease
16.	Ball - scarifier lift	With pressure gun grease
17.	Ball - scarifier ram	With pressure gun grease
20.	Bearing - crank pin (circle reverse hydraulic motor)	With pressure gun grease
21.	Bearings - pivot pin (circle reverse hydraulic motor)	With pressure gun grease
22.	Ball - high lift link (on lift arm and circle)	With pressure gun grease
23.	Bearings - high lift (front and rear)	With pressure gun grease
24.	Bearing - piston rod end (high lift ram)	With pressure gun grease
25.	Pivot - high lift ram	With pressure gun grease
26.	Bearing - steering post	With pressure gun grease
27.	Pedals - brake and circle latch	With pressure gun grease
28.	Clutch - pedal cross shaft	With pressure gun grease
29.	Clutch - throw-out shaft	With pressure gun grease
30.	Clutch - pilot bearing (UD-14A engine)(see Page 80, (2)	With pressure gun grease
30.	Clutch - pilot bearing (UD-16 engine)	(Special - see page 82A)
31.	Bearing - clutch shaft	With pressure gun grease
32.	Engine support - front	With pressure gun grease

LUBRICATE EVERY 200 HOURS OF OPERATION
Two strokes of lubricator at each grease fitting

33.	Universal joints - propeller shafts	With pressure gun grease

LUBRICATE ONCE PER YEAR (APPROXIMATELY 2000 HOURS OF OPERATION)

34.	Bearings - front and rear wheels	Remove wheel drive flanges from all wheels and check bearing adjustment. Adjust bearings if necessary. Inspect grease compartment and replenish with wheel bearing grease. Also check when overhauling.

(Continued)

Key to Lubrication Chart - Refer to Figure 1

CHECK WEEKLY (50 to 80 HOURS OF OPERATION)

Ref.	*Point of Lubrication:*	*Remarks:*
35.	Gear and pinion carrier (front and rear axles)	When temperatures are 32°F. and above, use SAE-140 extreme pressure lubricant. When temperatures are below 32°F., use SAE-90 extreme pressure lubricant. NEVER MIX GRADES OR KINDS OF EXTREME PRESSURE LUBRICANTS. If in doubt, drain, flush and refill.
36. 37.	Transfer case) Transmission)	Check every 50 hours of operation and refill if necessary with SAE-140 extreme pressure lubricant. When temperatures are below 32°F., use SAE-90 extreme pressure lubricant. NEVER MIX GRADES OR KINDS OF EXTREME PRESSURE LUBRICANTS. Check oil level after grader has stood at least one hour. (See high level test plugs and filler ports at side of lubricant cases.) NOTE: Drain and flush every 1000 hours of operation (or at least twice a year). Refill with extreme pressure lubricant.
	Note: On Machines H-100 to H-1838 inclusive, the transfer case requires 28 qts. and the transmission case 4 qts. of oil for initial filling.	
	Note: On Machines H-1840 and up the transfer case filler plug is to be used for determining oil level in both the transfer case and transmission case, due to both oil compartments being interconnected. 32 qts. of oil will be required for initial filling.	
38. 39.	Hydraulic oil	Check oil level pet cocks at Ref. 38 and refill with SAE-10W for temperatures of 32°F. and above. For temperatures below 32°F. use ice machine oil having a pour point of minus 40 and a viscosity of 100 seconds at 100°F. Drain and clean entire hydraulic system at least twice a year.
	Battery	Check and add distilled water if needed. See electrical section (page 77).

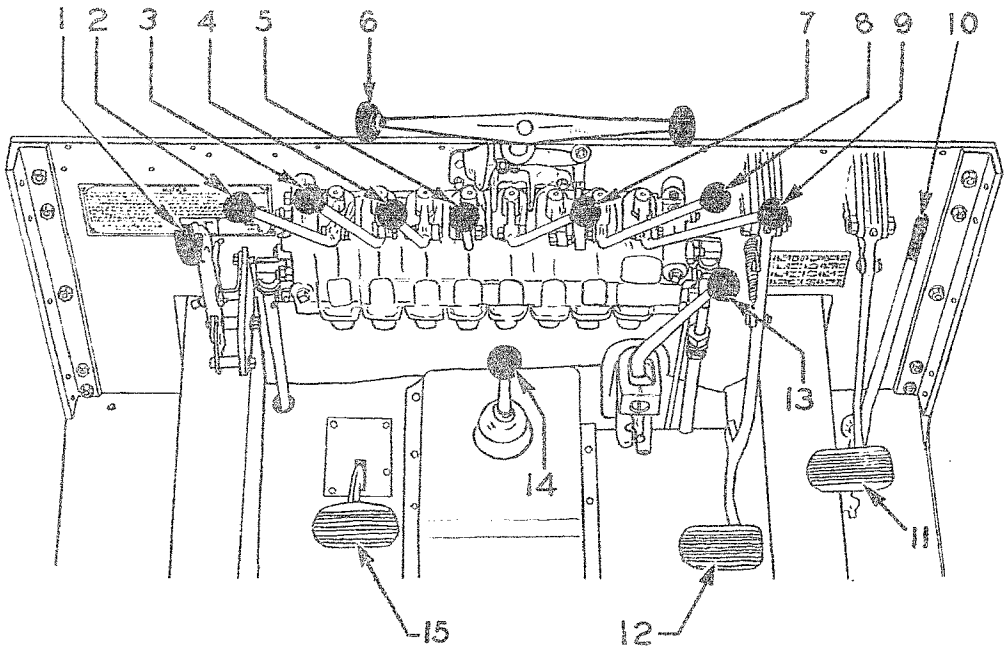
CHECK EVERY 4 WEEKS

40. 41.	Master cylinder - brake) Master cylinder - circle latch)	Check the hydraulic master cylinder and refill with genuine Lockheed #21 brake fluid.
42.	Clutch Brake	With pressure gun grease. Two strokes of lubricator.

CHECK PERIODICALLY

43.	Vent plugs - gear carrier (front and rear axles)	To prevent accumulation of air pressure in gear carriers. CAUTION: Do not remove unless for cleaning because of dirt or dust stoppage. Keep air vent in plug open.
44.	Bearings - pinion carrier (front and rear axles)	After repairing or overhauling front or rear gear carrier unit, be sure to remove the pipe plugs at Ref. 44 and inject about one pint of SAE-140 or SAE-90 extreme pressure lubricant. If you do not do this you may start out with dry pinion bearings.
45.	UD-14A engine, air cleaner, and fuel injection pump	See engine section (pages 52, 52C and 52D).
45.	UD-16 engine, air cleaner, and fuel injection pump	See engine section (pages 52A to 52D incl.).
46. 47.	Generator) Starting motor)	See electrical section (pages 76 and 77).

We recommend that you use only the best lubricants obtainable varied to suit temperature changes.



2. *OPERATING CONTROLS.*

The operator should thoroly familiarize himself with the various controls and speed changes as shown.

There are important differences between various graders; therefore, regardless of previous experience with other graders, the operator will secure the best results if he fully understands what each control is for and how to use it.

(1) Hand brake. (To apply, pull back. Press the lock and push forward to release.)

(2) Circle rotation. (Pull back to rotate circle anti-clockwise. Push forward to rotate circle clockwise.)

(3) Left hand blade lift. (Pull back to raise blade. Push forward to lower blade.)

(4) Moldboard side shift. (Pull back to shift left direction. Push forward to shift right direction.)

(5) Circle side shift. (Pull back to side shift left direction. Push forward to side shift right direction.)

(6) Front steer. (Pull back to steer left. Push forward to steer right.)

(7) Rear steer. (Pull back to steer right. Push forward to steer left.)

(8) Right hand blade lift. (Pull back to raise blade. Push forward to lower blade.)

(9) Scarifier. (Pull back to raise scarifier. Push forward to lower scarifier.)

(10) Engine speed control lever. (Pull back to increase speed. Opposite to reduce speed or complete shut-off.)

(11) Circle latch. (Step on pedal to release the circle latch.)

(12) Foot brake. (Step on pedal to apply brake.)

(13) Transfer case gear shift. (See page 15 for shift chart for speeds.)

(14) Transmission gear shift. (See page 15 for shift chart for speeds.)

(15) Clutch pedal. (Step on pedal to release clutch. Do not ride this pedal with your foot.)

NOTE: To start engine see instructions on page 49.

3. *FUNCTION OF THE "99-H" POWER GRADER.*

The 99-H Power Grader does heavy grading jobs because of its All-Wheel Drive, All-Wheel Steer, greater flexibility and tremendous tractive effort.

The ability to at all times move the maximum amount of material and simultaneously overcome the side thrust caused by the load on the angled blade, is accomplished by All-Wheel Drive and All-Wheel Steer.

Largely because of these features, the 99-H:

(1) Will move more material than other motor graders, and move it farther and faster.

(2) Will work in rough ground where other motor graders cannot work at all.

(3) Will work in sand and other soft and wet materials, where other motor graders cannot even travel with blades empty.

(4) Will work on narrow trails, around corners, and in close places where other motor graders cannot work at all.

(5) Will work on the faces of steeper slopes than other motor graders.

(6) Will finish to closer tolerances in fine grading than other motor graders.

(7) Will give a better year around, all season performance than any other motor grader.

Evidence of the truth of these statements will be found in the pages which follow.

4. *SHIPMENT FROM FACTORY.*

Before shipment from the factory, the 99-H graders are assembled with the moldboard and controlling parts for right hand operation.

Due to its unique design, the following type of work may be done without the operator leaving his station. (It is not necessary for him to get up from his seat and reach around the windshield, to remove or change linkage pins, or step to the ground and procure suitable wrenches, hammers, bars or jacks, plus a helper, to change the moldboard position on the circle supporting arms.)

(1) Regular maintenance.

(2) Scarifying.

(3) Ditch cut. (Right or left).

(4) Flat bottom ditch. (Right hand).

(5) Ditching or maintaining in reverse.

(6) Wide reach or moving over ditch windrow.

(7) Side shift circle.

(8) Side shift moldboard on circle. (Right or left hand).

(9) Cut low or medium ditch or bank. (Right or left hand).

(10) Cut high bank or slopes. (Right hand).

NOTE: See page 29 for left hand high lift or bank cutting operation.

5. PREPARING GRADER FOR BLADE OPERATION.

After completely lubricating and fueling the grader (pages 10 and 52 to 52D inclusive), and learning the location and method of the various controls (pages 13 and 48), proceed as follows:

(1) Adjustment of Blade Tilting Links.

Loosen the four vertical and the two horizontal bolts at the links (20), page 130.

For all general grading, set both tilting links in the central position.

When cutting hard pan, clay, or caliche, tilt moldboard back to suit local conditions.

Tilt moldboard ahead full distance for light maintenance.

(2) Cleaning Paint off Face of New Moldboard.

Apply paint remover to paint. Let set for a few minutes and rub clean using old cloth or sack. Always oil all moldboard faces at end of each day's work.

(3) Moldboard Extension.

Extensions are available in 1 ft. or 2 ft. lengths.

1 ft. or 2 ft. extensions may be placed on both moldboard ends.

One of either length may be put on either right or left moldboard end and none on the other moldboard end.

The standard length of a 99-H moldboard is 13 ft. (6 ft. bit on right side and 7 ft. bit on the left.)

The maximum length of moldboard, with extensions, is 17 ft.

NOTE: Always remove all extensions when doing heavy grading work.

See the repair parts book for bits and extensions repair part numbers. When ordering bits or extensions always show quantity of each part wanted together with the repair part number.

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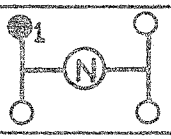
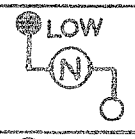
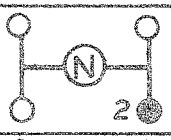
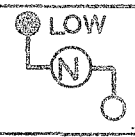
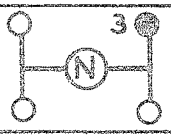
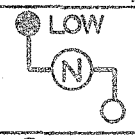
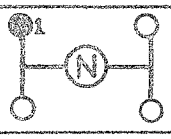
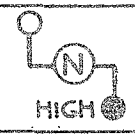
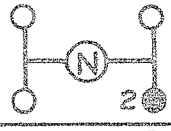
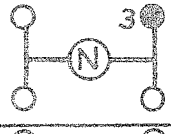
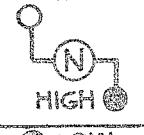
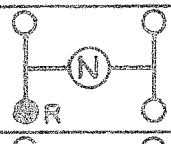
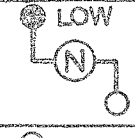
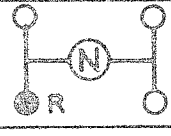
1			1.7
2			2.78
3			4.06
4			5.8
5			9.4
6			15.
R			1.74
R			5.87

6. GEAR SHIFT CHART.

The 99-H power grader is fitted with six forward speeds and two reverse.

The second forward speed (2.78 M.P.H.) is generally used when ditching and in heavy road maintenance. (Full wide open engine speed.)

The still lower forward speed (1.7 M.P.H.) is generally used in the following types of work:

Heavy work at full wide open engine speed.

Also working between forms, final bank finishing, bulldozing and rear mounted loader, at reduced engine speed (about 3/4 throttle opening).

SECTION 2

EARTH ROAD CONSTRUCTION

The data on these pages show the "99-H" grading but one side of the road. The other side is handled in the same manner.

7. *EARTH ROAD CONSTRUCTION.*

a. Operating.

We recommend the operator first practice with the controls, slowly placing the moldboard in the various positions illustrated and explained in the following pages. By proceeding in this way he will learn all of the various operations much quicker.

The hydraulic "Finger Control Levers" at the operator's station, when manipulated, control the flow of oil. The operator controls the amount of oil flow; namely, from the smallest perceptable amount to full flow of eight gallons of oil per minute.

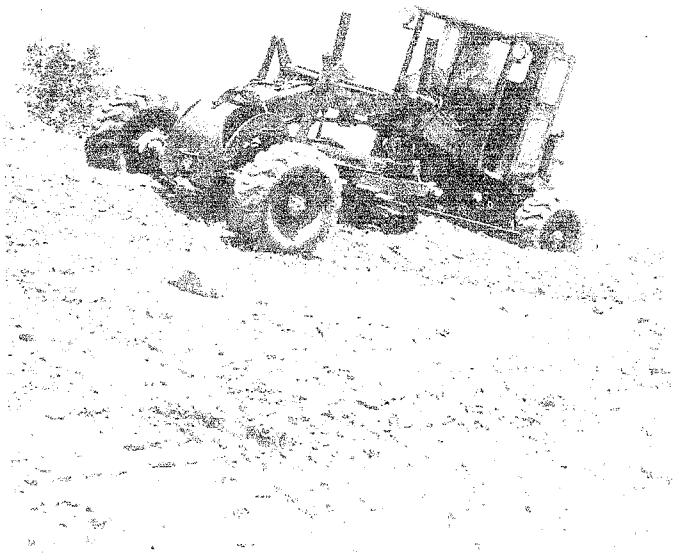
The 99-H power grader, with All-Wheel Steer, will turn around on a thirty foot road or less, and therefore it is very easy to quickly maneuver it into practical operating position for maximum loading of the work to be done. For similar reasons the 99-H may be quickly and easily turned at the end of the section.

For many years Austin-Western "99" power graders have been satisfactorily operated with all four drive wheels on slopes of all types of specifications, running from (2 to 1) to level grade.

When operating an Austin-Western 99-H power grader, always "ride the bank" with all four wheels, in order that the grader may be placed in position to most effectively load the engine for maximum work. The reason for this is that All-Wheel Steer and All-Wheel Drive make it possible to effectively hold and load the grader.

Follow these suggestions when grading with a 99-H and the work will be accomplished and finished in the shortest possible time.

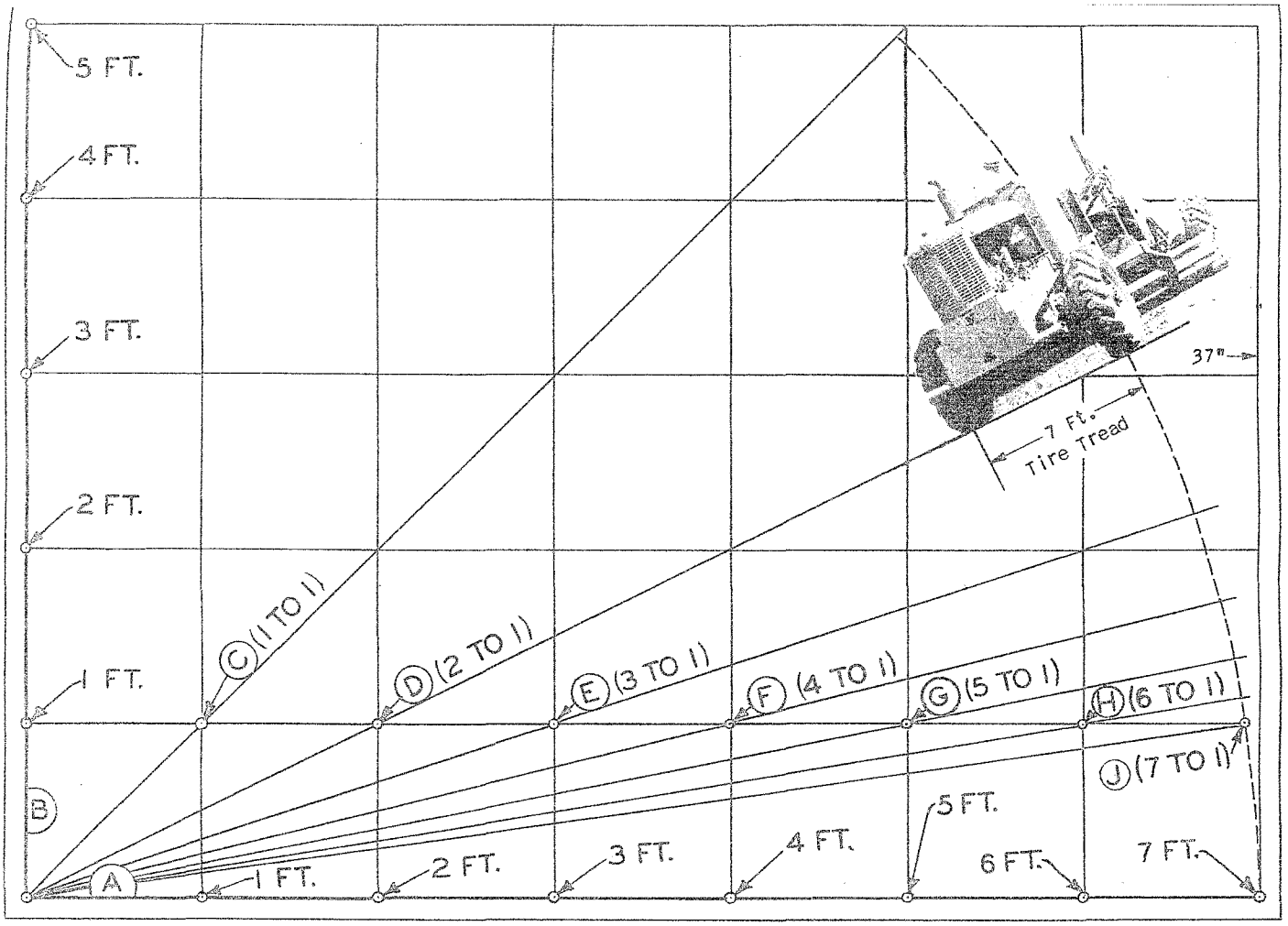
When grading less than (2 to 1) to vertical bank, or extremely high bank sloping jobs, see the recommendations on pages 17, 27, 28, and 30 to 34 inclusive.



8. GRADING ON (3 to 1) SLOPE.

The front and rear wheels are steered in order to place the frame in offset position.

NOTE: In our experience "riding the bank" with the wheels of rear drive tandem graders is limited to (3 to 1) slopes and down to level ground. At best, the soil conditions will have to be very favorable.



9. *GRADING SLOPE CHART.*

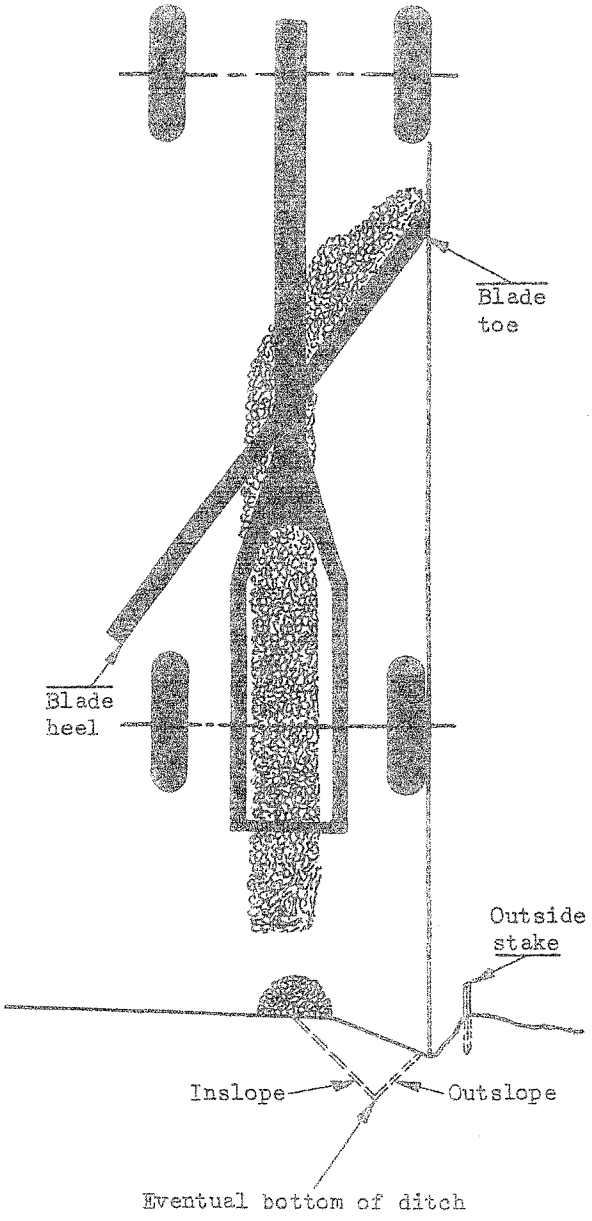
This chart has purposely been made 7 inches wide because the center distance from the right rear tire tread to the left rear tire tread is about 7 ft. One inch spacing on the lower horizontal line (A) represents one foot. One inch spacing on the right and left vertical lines (B) represent one foot.

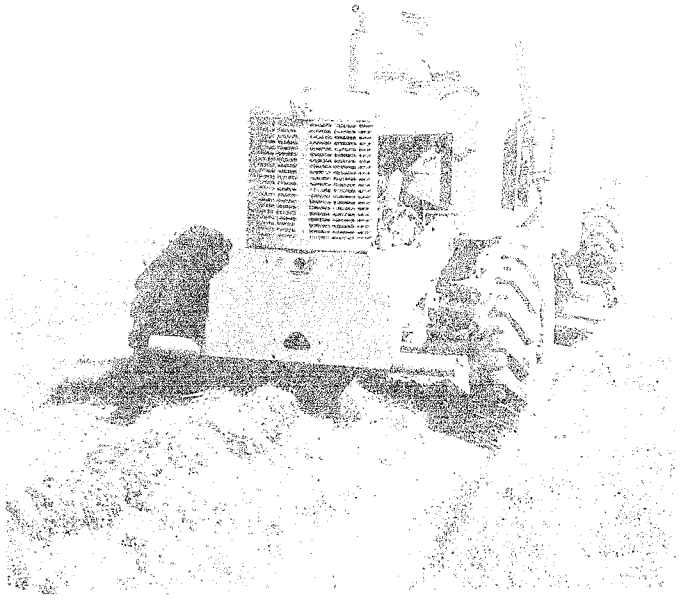
(C) This line represents a (1 to 1) slope. All bank sloping work from perpendicular to horizontal may be done with the 99-H moldboard in the high lift position. See pages 30 to 34 inclusive.

(D) This line represents a (2 to 1) slope. By placing all four wheels of the 99-H on the slope, grading may be very satisfactorily done from line (D) down and thru lines (E), (F), (G), (H) and (J), to flat on the ground. The extreme right end of line (D) shows the right hand tires of the grader will be elevated about 37 inches higher than the left tires.

(E) This line represents a (3 to 1) slope.

NOTE: When grading from line (D) to horizontal, locating the moldboard under the grader and placing all four wheels on the bank, will make it possible for the operator to finish the work in a better way and in the shortest possible time. The reason for this is the full weight of the grader can most effectively be placed on the moldboard and all four driving wheels. The engine, in turn, will be in position to drive the grader at its fully loaded capacity.



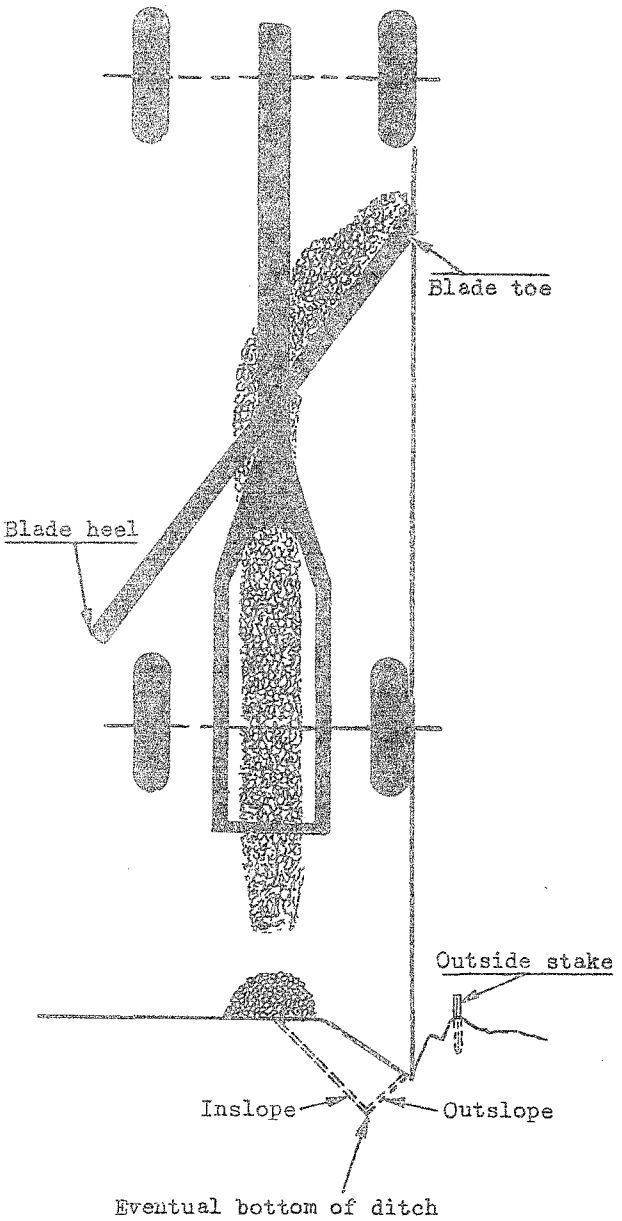


10. *STARTING A NEW DITCH.*

When starting a new ditch do not attempt to cut too deep the first time thru. Straight steering considered.

(1) Rotate circle, lever (2). Side shift the moldboard, lever (4), setting the toe of the blade behind the front wheel.

(2) Elevate heel of blade, lever (3), so material is delivered between the rear wheels as shown.



11. *SECOND PASS, OR CLEANING OLD DITCH.*

(1) Rotate the circle, lever (2). Side shift the moldboard, lever (4), setting the toe of the blade behind the front wheel, but not clear out to outside edge of tire.

(2) Lower heel of blade, lever (3), so material is delivered between the rear wheels as shown, or to outside of left rear tire as required.

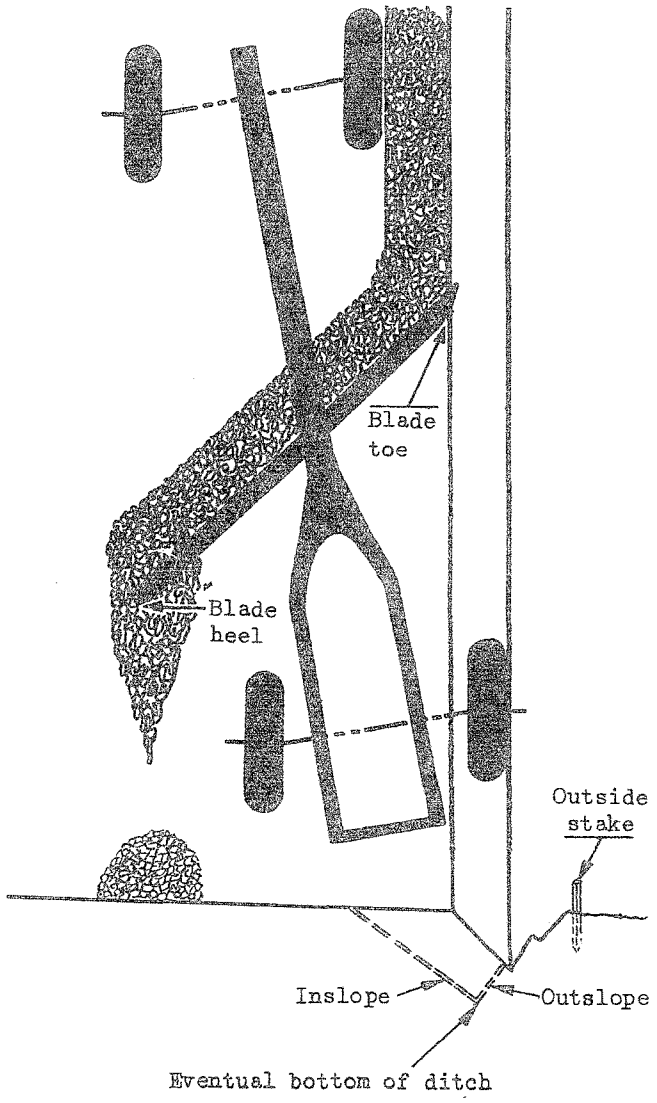
NOTE: All consecutive ditch cuts are made in the same fashion as shown. Remember, as ditch progresses deeper, the point of blade must follow the dotted line to eventual shape of the ditch slopes and bottom of ditch. This means that when another ditch cut is made, both front and rear wheels must be positioned a little further to the left in order that the toe of the blade can cut and follow the dotted line to the eventual bottom of the ditch.

12. *CUTTING WET DITCH.*

When there is water in the ditch, steer the grader with rear wheels offset, as shown in the above photo.

This places both rear wheels on solid footing and permits the use of full engine power and capacity of the grader on this type of ditch work. Also cleaning old ditches having overhanging rock ledges, trees, and etc.

Steering the grader as shown, positions the cab away from ledge or obstruction.



The third pass or windrow move-over is always the most difficult for any but the Austin-Western All-Wheel Drive and All-Wheel Steer power grader, due to the side load on the heel of the blade affecting the course of the rear wheels.

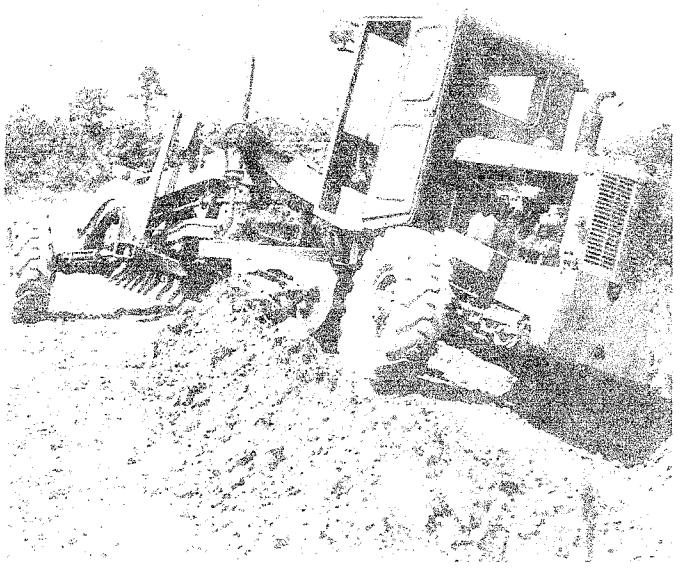
To perform this operation, proceed as follows:

(1) Steer rear wheels, lever (7), to maximum, toward the blade toe.

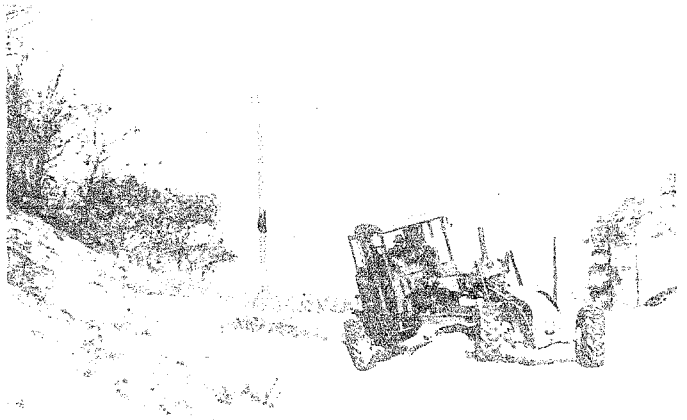
(2) Rotate circle, lever (2), and shift the moldboard sidewise, lever (4), sufficiently to reach the windrow.

(3) Steer the grader offset, levers (6) and (7), as shown, with both front wheels missing the windrow.

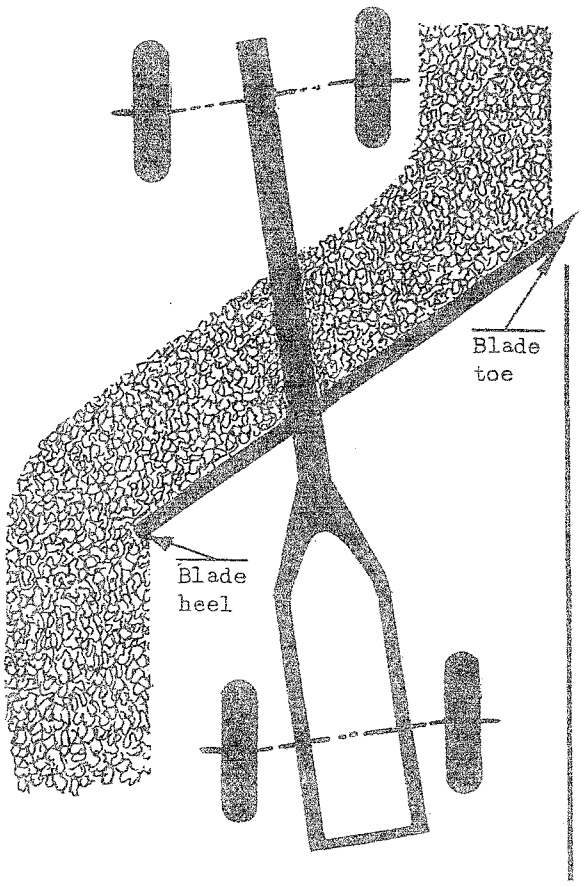
(4) All consecutive windrow move-over passes near the ditch or crown of the road are made in the same fashion; namely, both front wheels on one side of the windrow and both rear wheels on the other side. The job will be finished quicker if this is done because the full engine power is used effectively.



13. *THIRD PASS, OR WINDROW MOVE-OVER.*

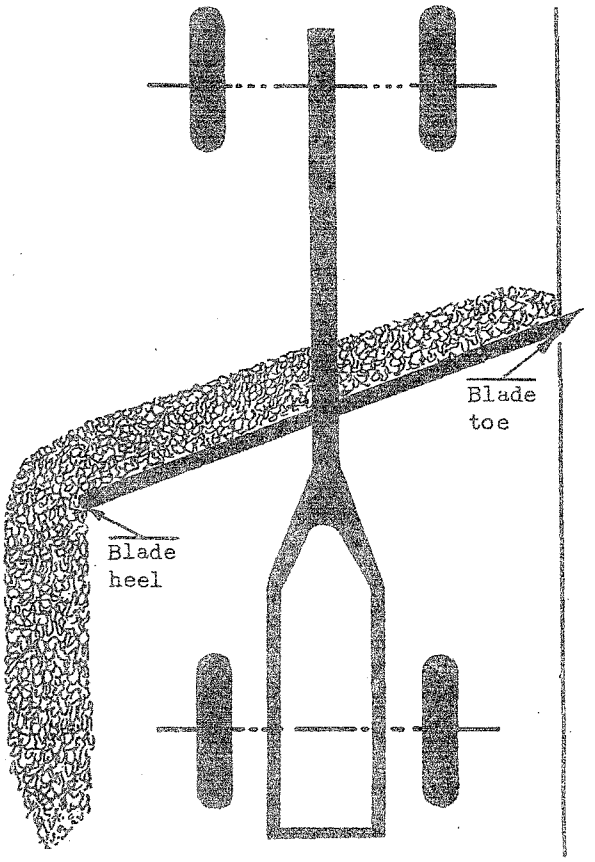


14. *WINDROW MOVE-OVER IN BLOW SAND.*

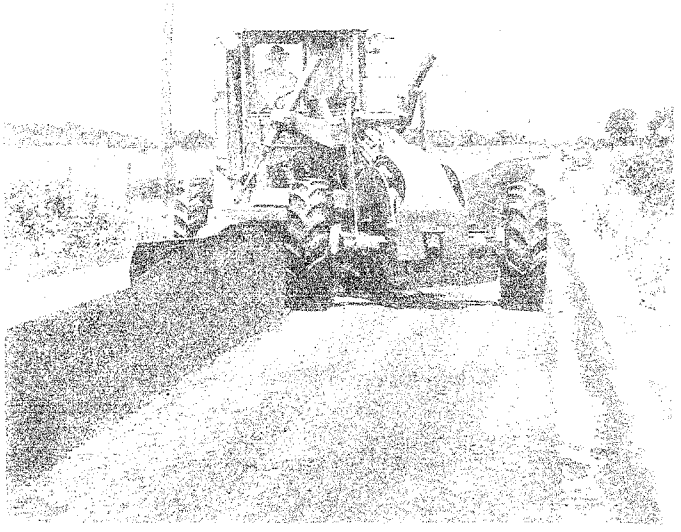


(1) Steer rear wheels, lever (7), to extreme, toward blade toe.

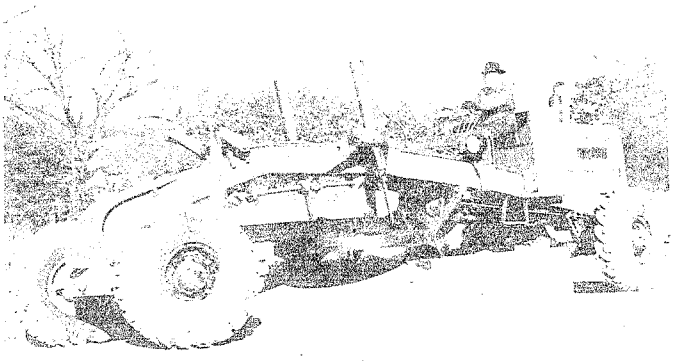
(2) Rotate circle, lever (2), and side shift, lever (4), to suit conditions, approximately as shown. Guide grader with front steer, lever (6), missing windrow with both front and rear wheels.



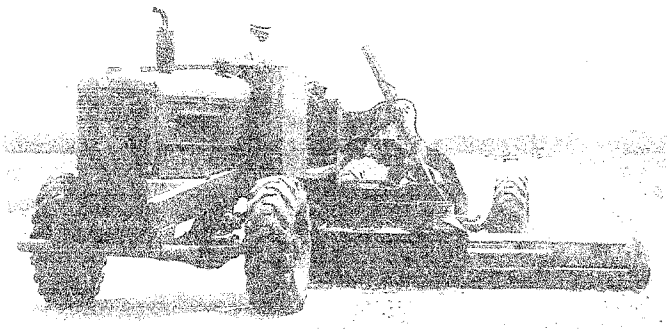
The above shows wheel and blade adjustment for conventional maintenance operation.

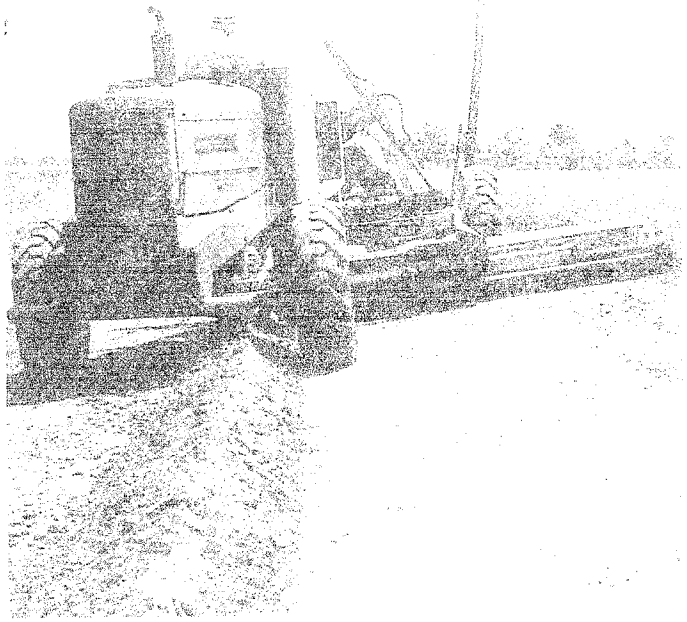


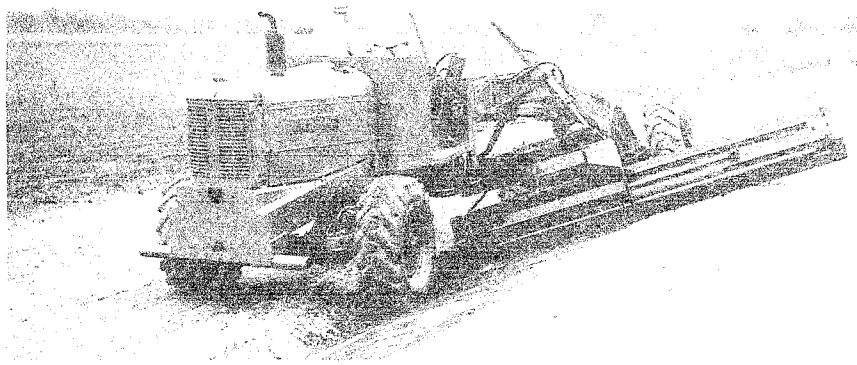
15. *HANDLING OIL-MIX, OR HEAVY MAINTENANCE. (See above)*

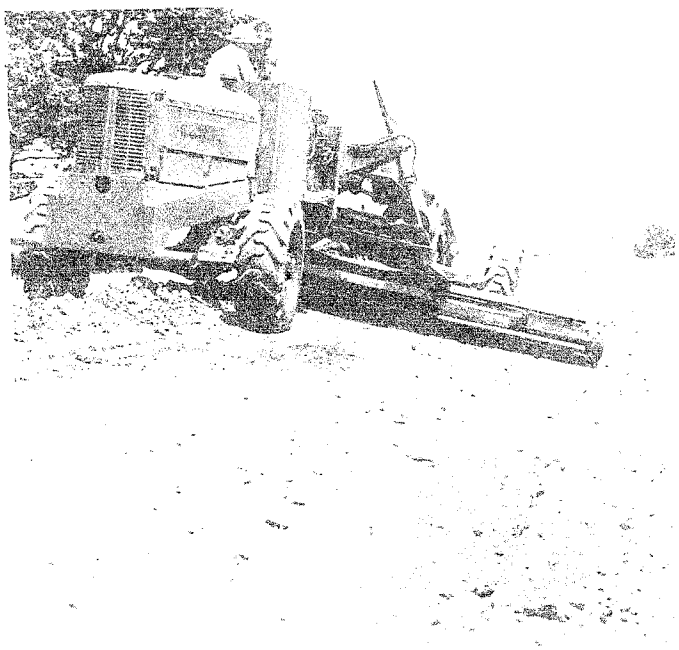


16. *CONVENTIONAL MAINTENANCE. (See above)*









Extreme wide reach for finishing shoulders, slopes, etc., leaving no tire marks.

(1) Moldboard is side shifted, lever (4), as far as it will go.

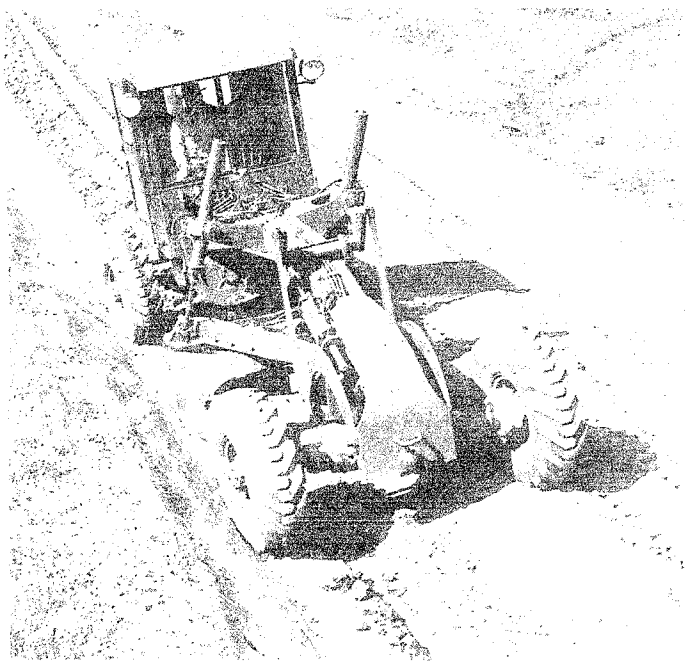
(2) Circle side shift arm, lever (5), is moved to horizontal position against side frame rail.

(3) Rear wheels are steered, lever (7), to extreme, toward heel of blade.

(4) Drive machine by using front steer, lever (6).

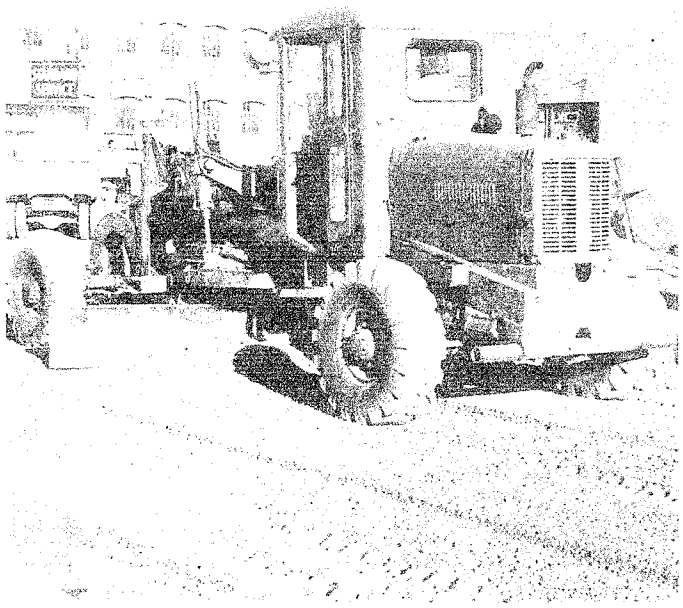
(5) Circle may be rotated, lever (2), to give desired cutting angle on moldboard, and also adjusted so windrow of material is deposited just inside of rear wheel as shown.

17. WIDE REACH, OR RESLOPING OF GRADE SHOULDERS.



18. *FLAT BOTTOM DITCH.*

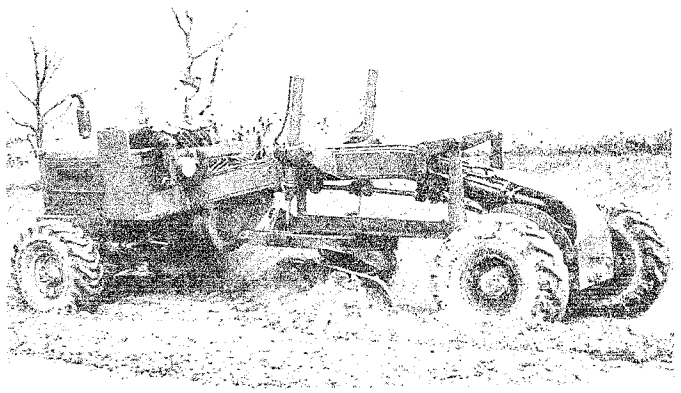
Circle side shift arm, lever (5), is moved from vertical position to horizontal position against side frame rail. Circle can be rotated, lever (2), to suit different width flat bottom ditches. Precaution must be taken not to foul moldboard into tires, transfer case and guard.



19. *GRADING IN REVERSE "BETWEEN FORMS".*

The fully reversible blade and rear steer are an ideal and very practical combination when operating and steering the grader while blading in reverse. The reason for this is because the front wheels are not steered; instead, the operator steers the grader by using the rear steer control. Since he is looking back, it naturally follows he can steer the rear end of the grader much easier than by using the front steer control.

Both rough and finish grading between forms and grading dead end streets, is work which lends itself to the reverse grading feature of the 99-H power grader.

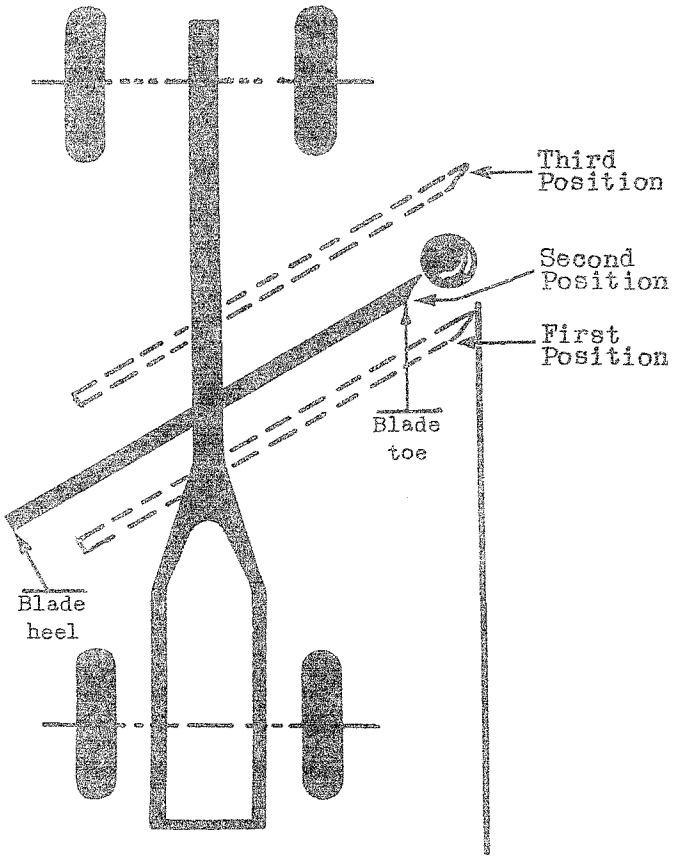


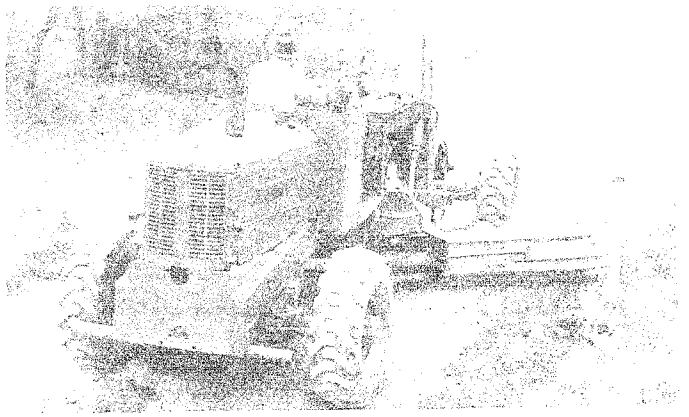
20. *GRADING IN REVERSE.*

(1) Moldboard may be reversed, lever (2), with scarifier on the machine, by rotating the circle clockwise when machine is set up for right side high lift. (Anti-clockwise when set up for left side high lift.) The reverse procedure is used to get moldboard back into forward position again.

(2) Moldboard is side shifted, lever (4), so end of it just clears back side of scarifier block. The circle should be on a level with the machine both fore and aft, as well as sideways, in which position cutting edge is clearing ground approximately 2 inches. Caution should be taken not to foul tires and transfer case guard.

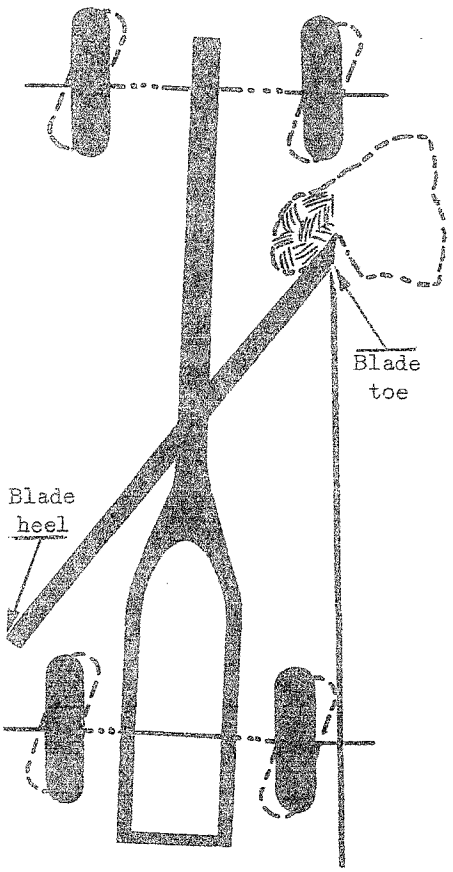
(3) Use rear steer, lever (7), for guiding machine when grading in reverse.

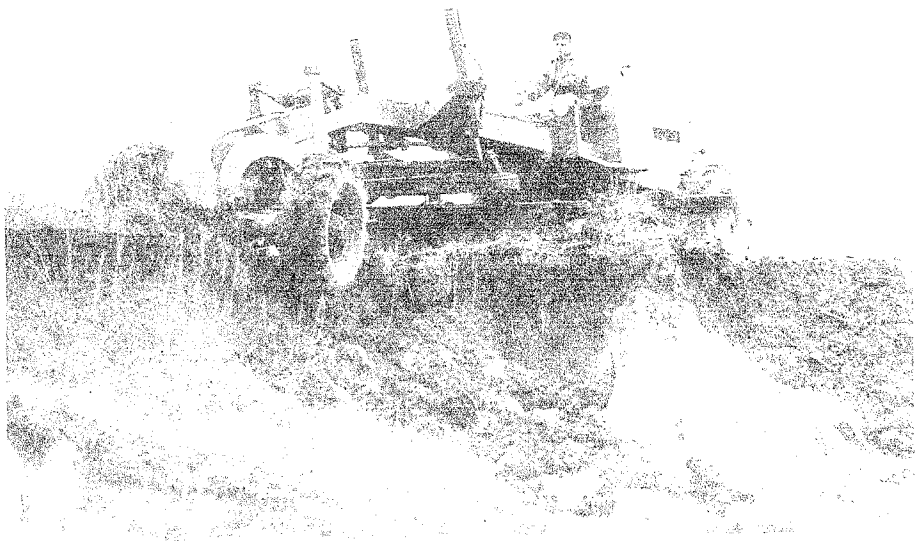




21. *GRADING CLOSE TO AN IMMOVABLE OBJECT. (See photo above and illustration to left)*

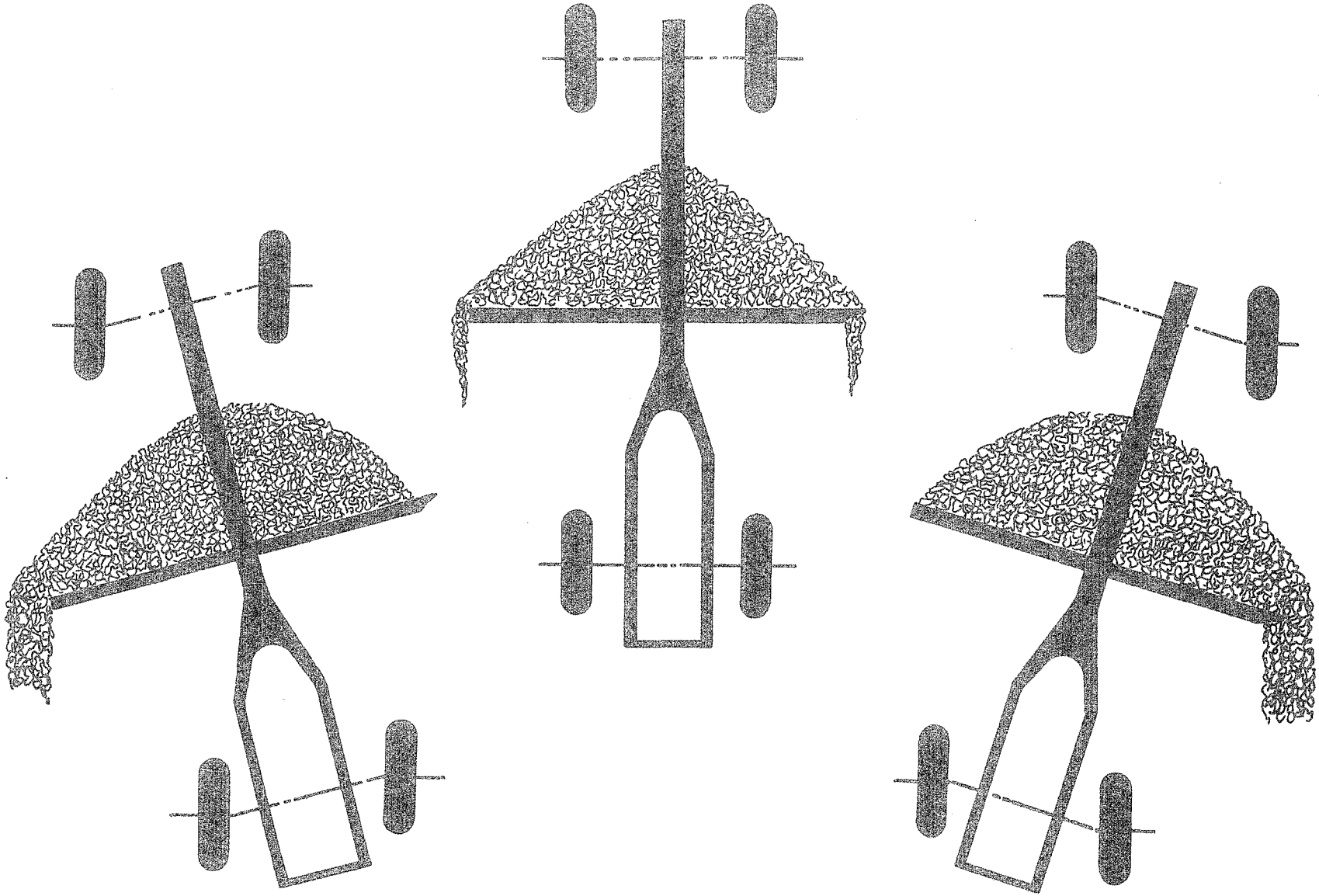
The moldboard can be either extended or retracted, side shift lever (4), without leaving the "floor", and "grade" maintained close to obstructions. Ditch lines can be straightened with ease. This operation saves hand labor finishing time because the blade can cut right up to the guard rail, post, or bridge abutment. The grader is momentarily stopped and blade shifted hydraulically sideways without the operator leaving his station. Grader is then moved forward and blade shifted outward at once to full grading width.





22. *BACKING OUT. (See photo above and illustration to left)*

When obstructions are encountered, steer front and rear wheels, levers (6) and (7), as shown by dotted lines. Shift into reverse, lever (14), and slowly back up. The machine will move sidewise as it goes backwards away from obstruction or out of the ditch.



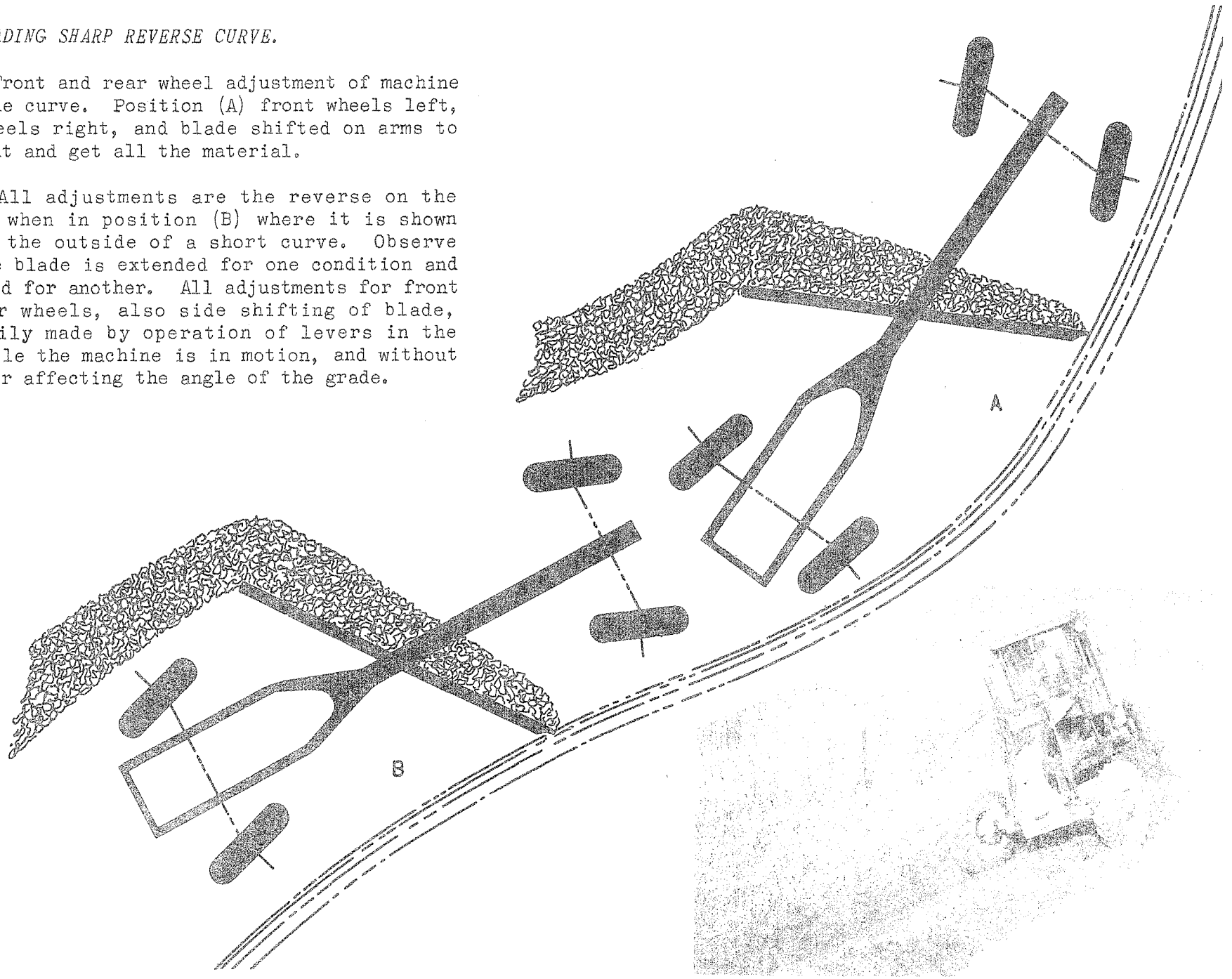
23. CUTTING HIGH AND FILLING LOW PLACES.

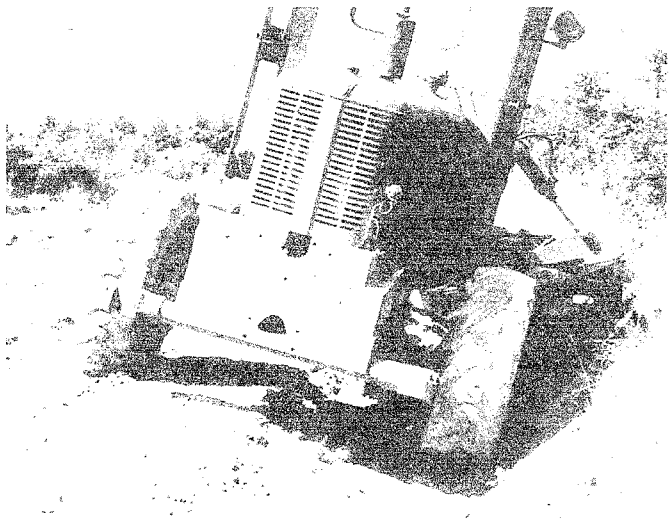
This operation is performed easiest by setting the blade square across the frame and controlling the "drifting" by adjusting the rear wheels to suit. The rear wheel adjustment responds to a valve in the cab. It is simple and easy.

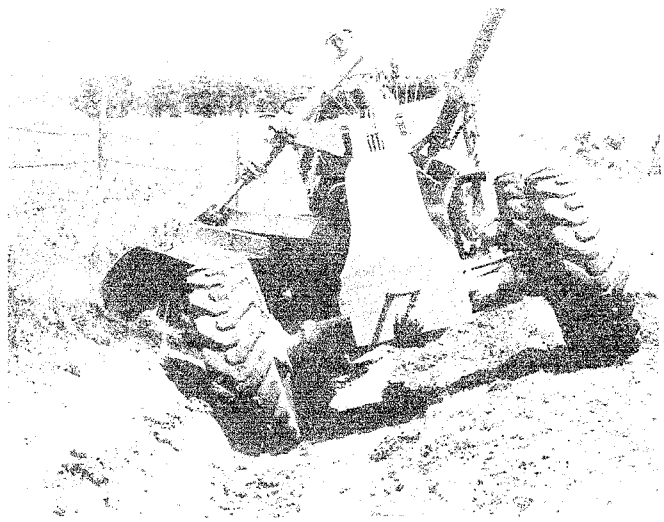
24. GRADING SHARP REVERSE CURVE.

NOTE: Front and rear wheel adjustment of machine on inside curve. Position (A) front wheels left, rear wheels right, and blade shifted on arms to reach out and get all the material.

NOTE: All adjustments are the reverse on the machine when in position (B) where it is shown working the outside of a short curve. Observe that the blade is extended for one condition and retracted for another. All adjustments for front and rear wheels, also side shifting of blade, are easily made by operation of levers in the cab, while the machine is in motion, and without losing or affecting the angle of the grade.





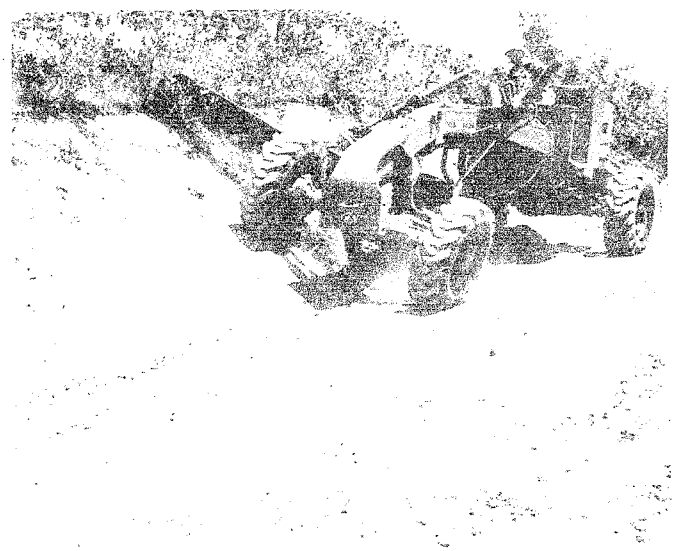


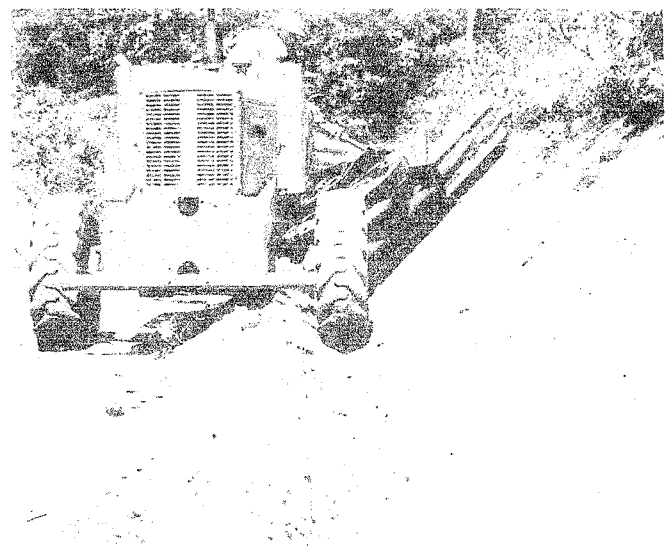
25. *GRADING THE OUTSLOPE OF A LOW BANKED DITCH.*

All-Wheel Steer makes it possible for four wheels to drive on smooth ground.

The rear drive wheels are steered to the right sufficiently to permit the right rear wheel to drive and ride the bank slightly. Most of the windrow passes to the left side of the right rear tire, and therefore the operator finds he can finish the complete outslope job quicker and better.

The front drive wheels are steered and drive on smooth ground also, as shown. The toe of the moldboard is turned down in order to grade near the fence line.

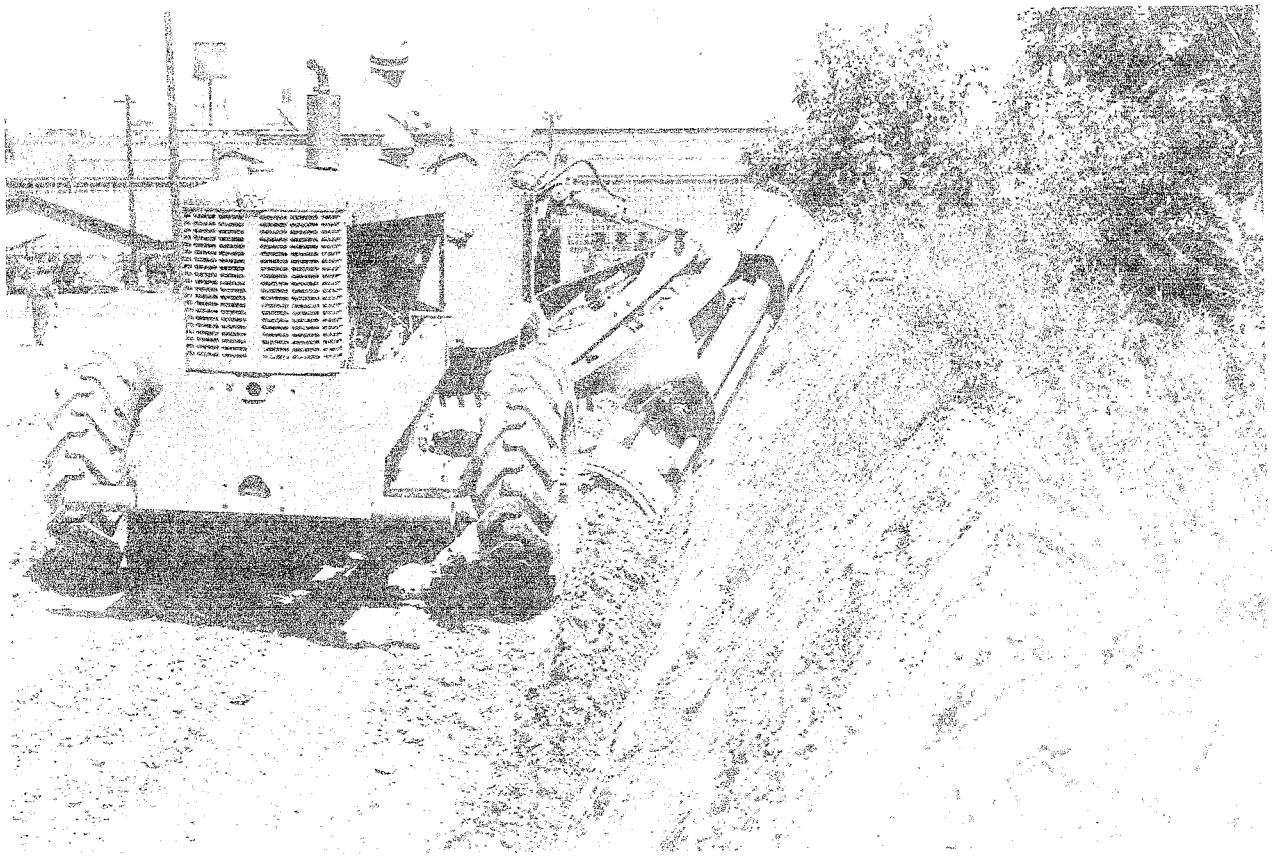




26. *HEAVY GRADING OF HIGH BANK SLOPES.*

a. As shown in the above photo, the right front wheel is riding the smooth bank in order to permit the grader and engine to do its most effective work when heavy or light grading work is to be done. The left front wheel is also driving on smooth ground.

b. The above photo shows the right rear wheel riding the bank slightly. It is driving on smooth ground because the windrow is delivered to the left of it. All four wheels effectively travel on smooth ground permitting the work to be finished in the shortest possible time.



c. The above photo shows the 99-H sloping a bank. A tremendous cut has been taken off the bank. Heavy cuts of this type are easy work for the 99-H, for the following reasons:

(1) All four wheels drive and steer on smooth ground.

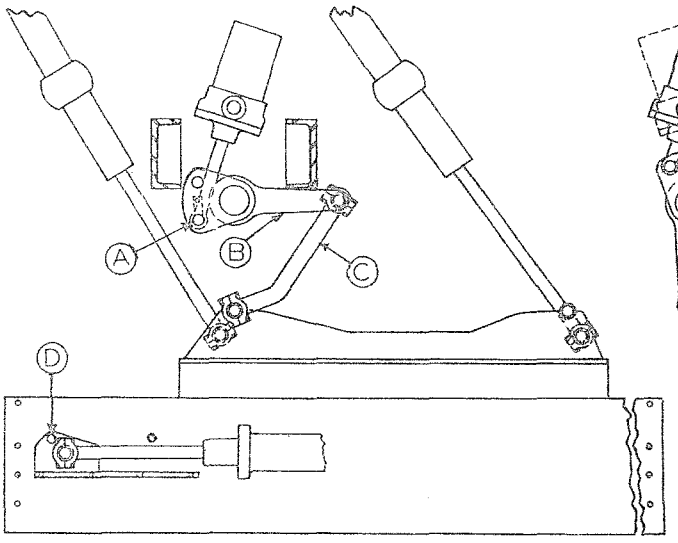
(2) The right front wheel is located close to the bank ahead.

(3) The grader is steered in the offset position by the All-Wheel Steer. The windrow passes to the right side of the right rear wheel. Hard or soft spots in the bank do not cause the moldboard to first suck into the bank, then push it out of the bank, because both front and rear wheels, together with moldboard, are held into the work by the All-Wheel Drive and All-Wheel Steer.

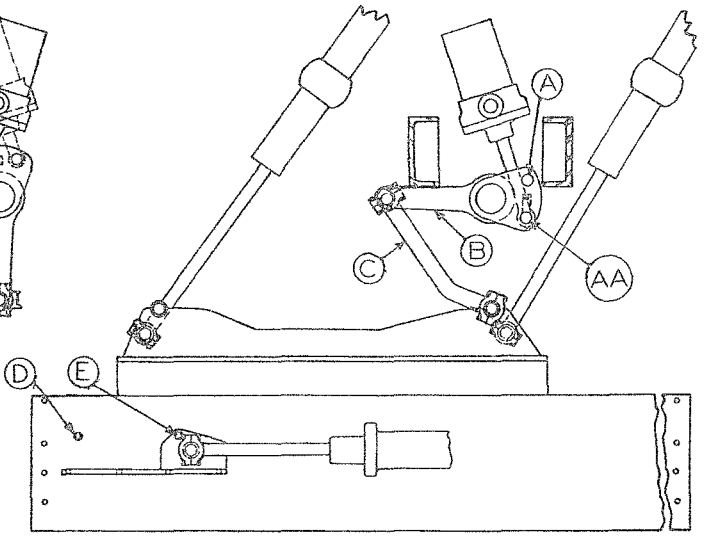
The surprising feature is that the operator can cut more or can cut less at the bank, as he wishes, by steering the rear wheels only.

NOTE: The front wheels and both right and left blade lift controls at the operator's station, are used but very little when taking heavy or light moldboard cuts from a bank of this kind.

Bank sloping work with a 99-H power grader is easily performed and quickly finished.



27. *RIGHT HAND HIGH LIFT.*



28. *LEFT HAND HIGH LIFT.*
(See photos below.)

Before shipment from the factory, the 99-H power graders are assembled with the moldboard and controlling linkage parts in position for right hand operation, as shown in drawing above.

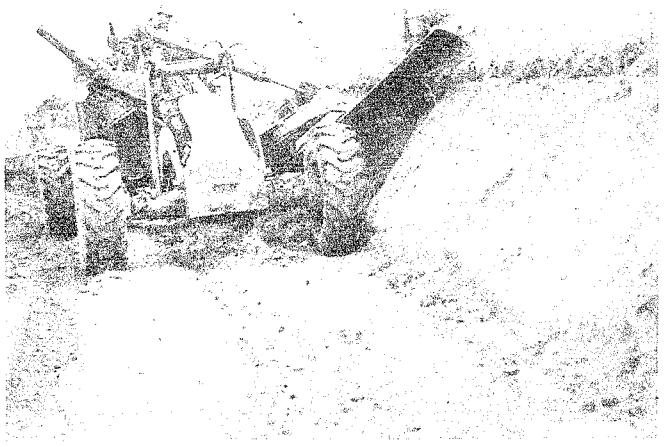
As viewed from the operator's seat, the top of the circle side shift cylinder will be tilted toward the right. The removable pin (A) is located in the lower hole as shown.

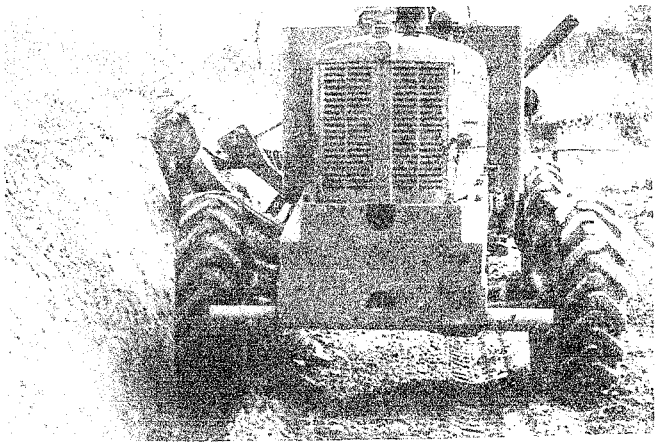
Arm (B) is contacting the bottom side of the right frame rail (this is explained on page 32). Link (C), at its lower end, is connected to the trunnion ball located at the left side of the circle cross member (this is shown on page 34). The moldboard side shift bracket (D) is attached with one bolt in the location as shown above.

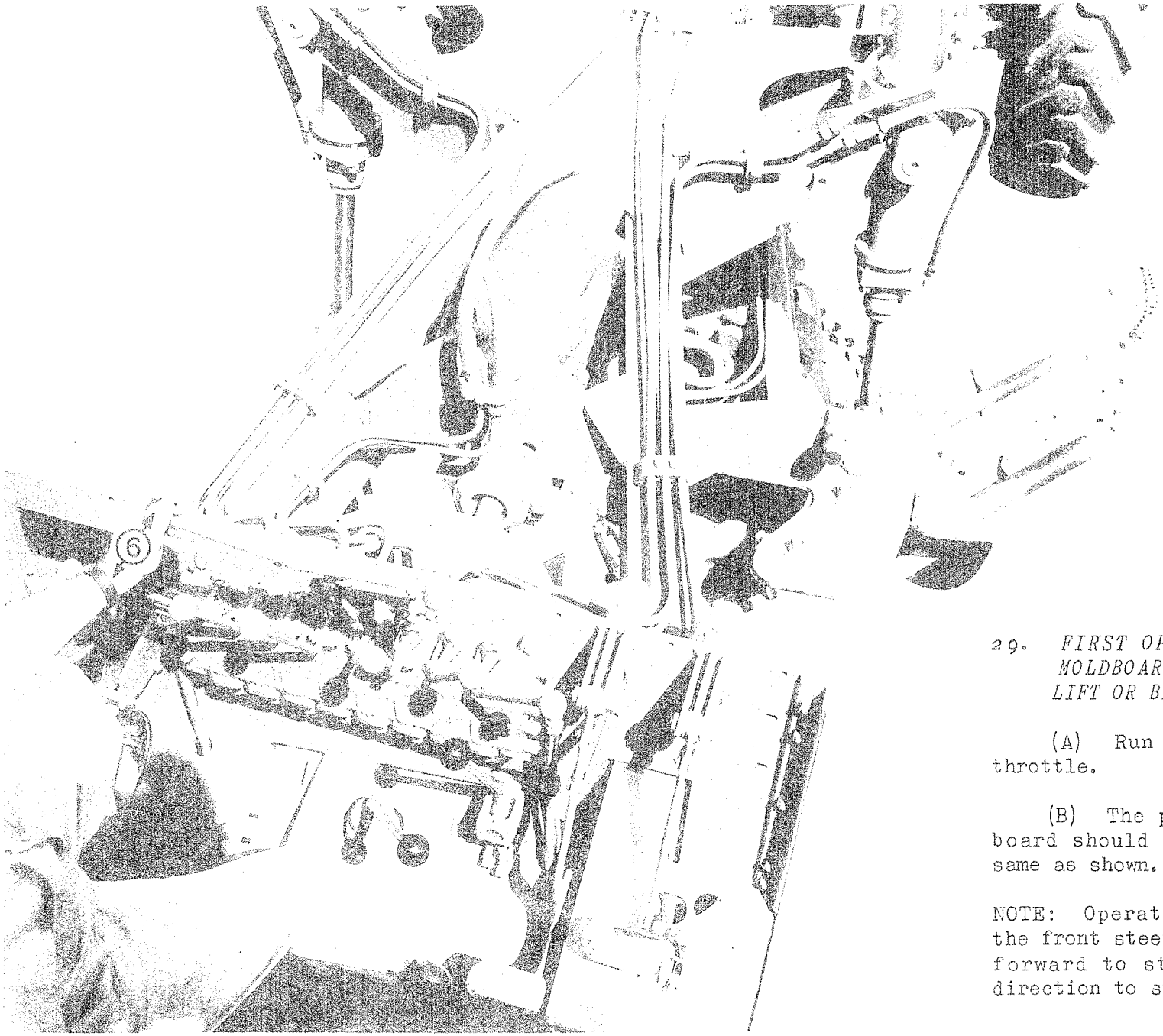
To change from right to left hand high lift operation (drawing above), place the circle directly under the grader, and lower the moldboard to the ground.

Remove link (C) and pin (A). Then swing the piston rod to the right and reinstall the pin into the hole at (AA). Reinstall link (C) as shown, connecting its lower end to the right side of circle. Remove the bracket at (D). Use hydraulic power to side shift the bracket into position, and reinstall the one attaching bolt at (E).

The 99-H grader is now mechanically changed over to provide maximum left hand operation, as shown in the two photos below. After some practice, the operator will be able to effectively operate the grader and do the same quality of work as shown in the preceding pages.





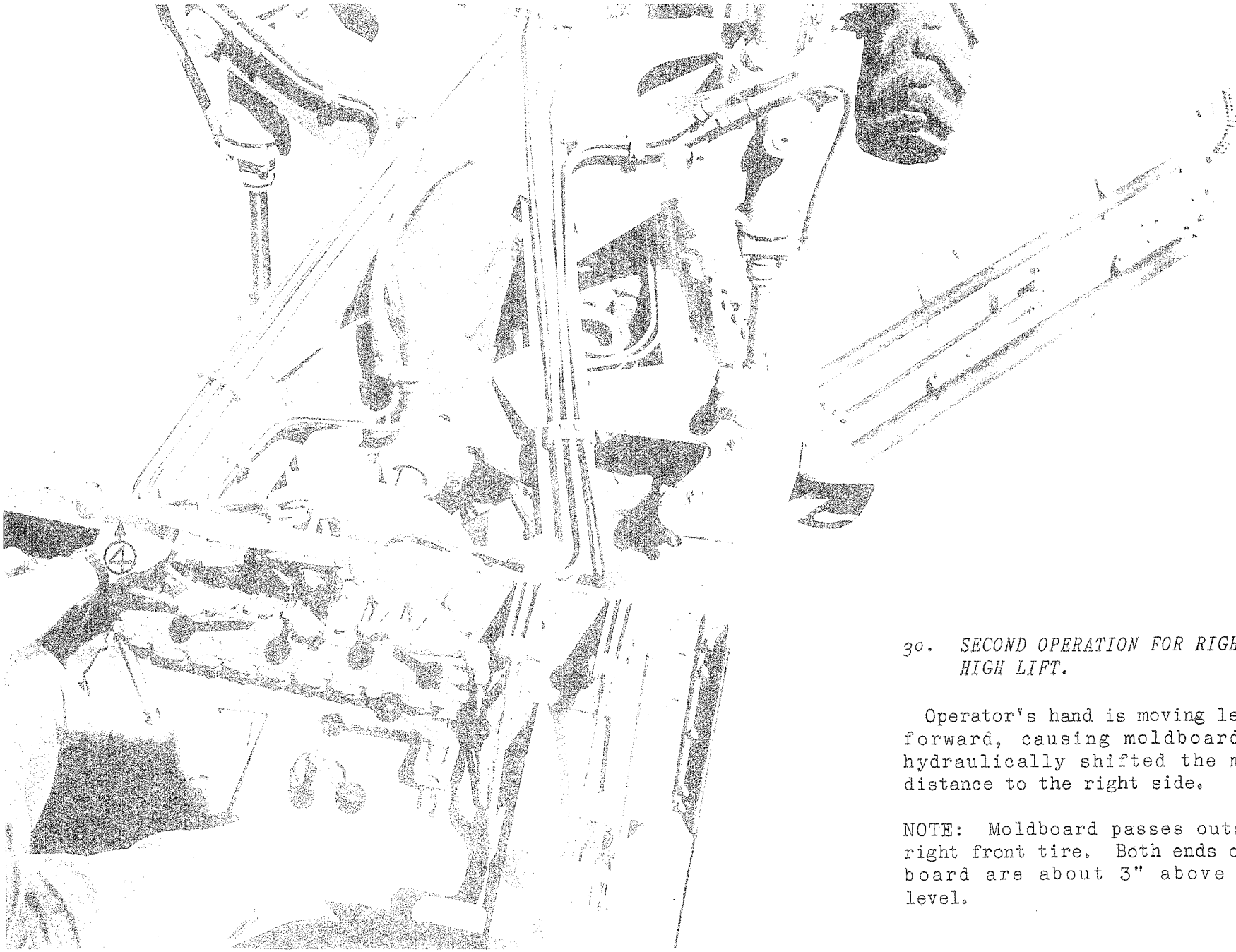


29. *FIRST OPERATION FOR PLACING MOLDBOARD IN RIGHT HAND HIGH LIFT OR BANK SLOPING POSITION.*

(A) Run engine at wide open throttle.

(B) The position of the moldboard should be approximately the same as shown.

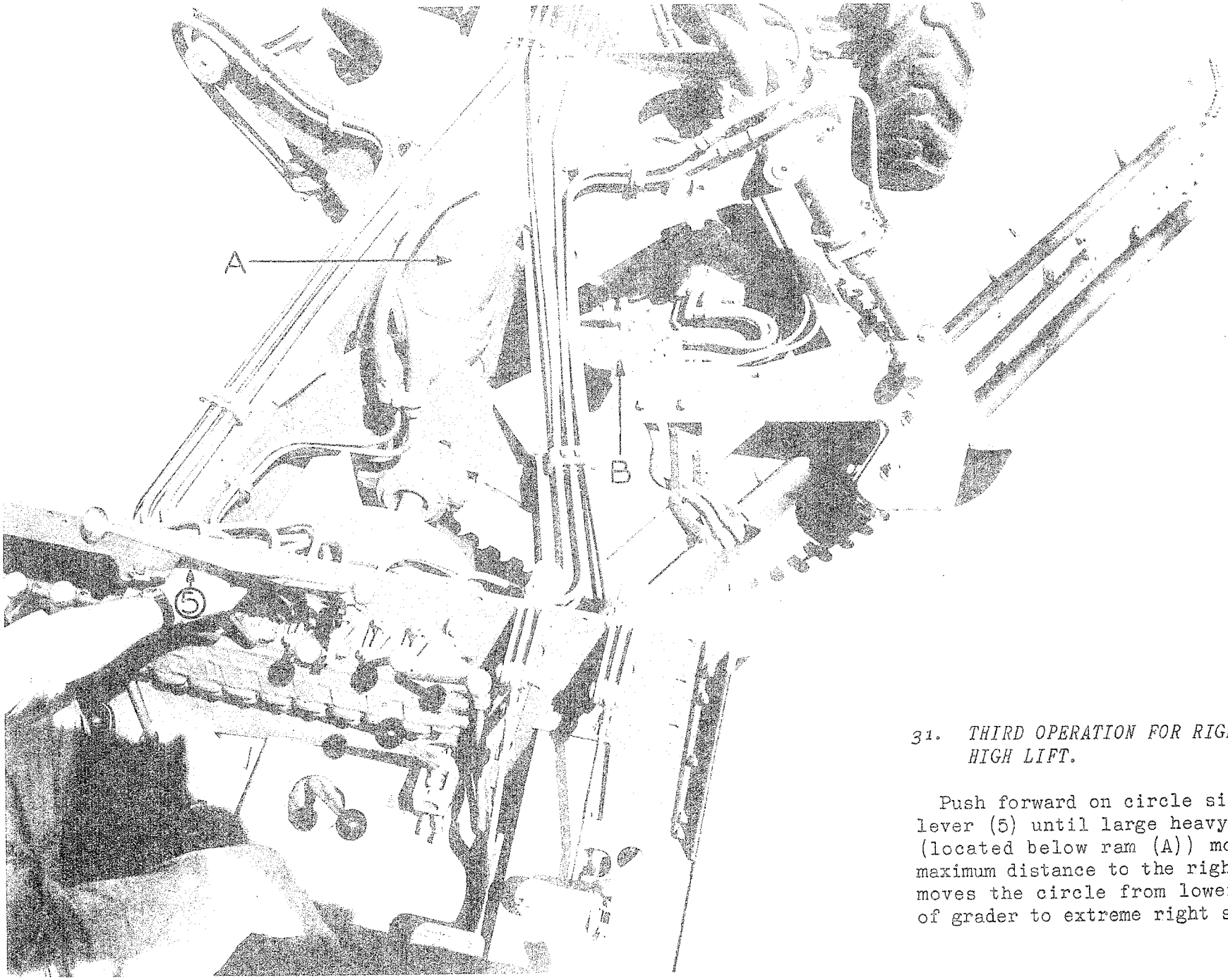
NOTE: Operator's left hand is on the front steering lever (6). (Push forward to steer right; opposite direction to steer left.)



30. *SECOND OPERATION FOR RIGHT HAND HIGH LIFT.*

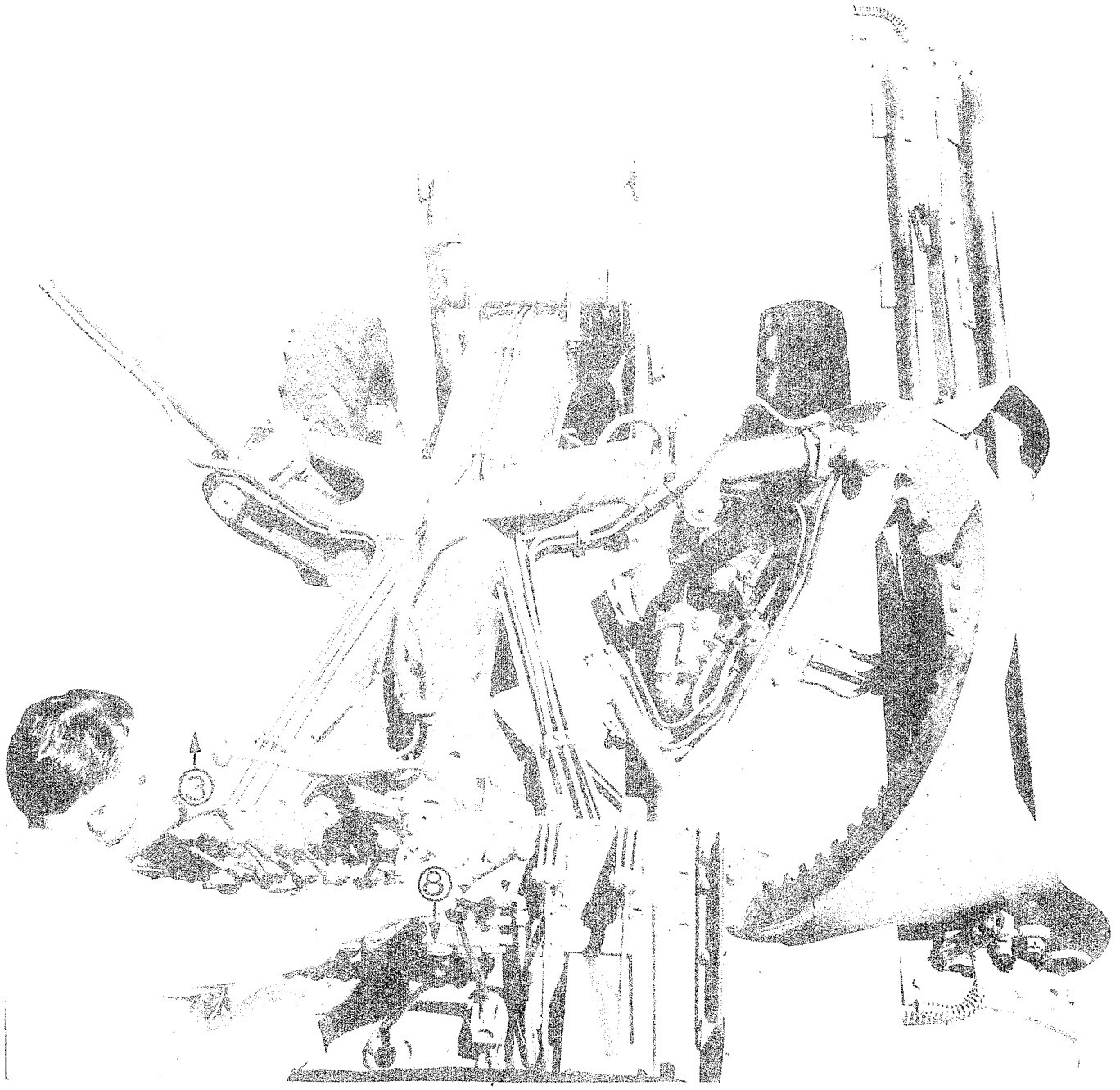
Operator's hand is moving lever (4) forward, causing moldboard to be hydraulically shifted the maximum distance to the right side.

NOTE: Moldboard passes outside of right front tire. Both ends of moldboard are about 3" above ground level.



31. THIRD OPERATION FOR RIGHT HAND HIGH LIFT.

Push forward on circle side shift lever (5) until large heavy arm (B) (located below ram (A)) moves the maximum distance to the right. This moves the circle from lower center of grader to extreme right side.

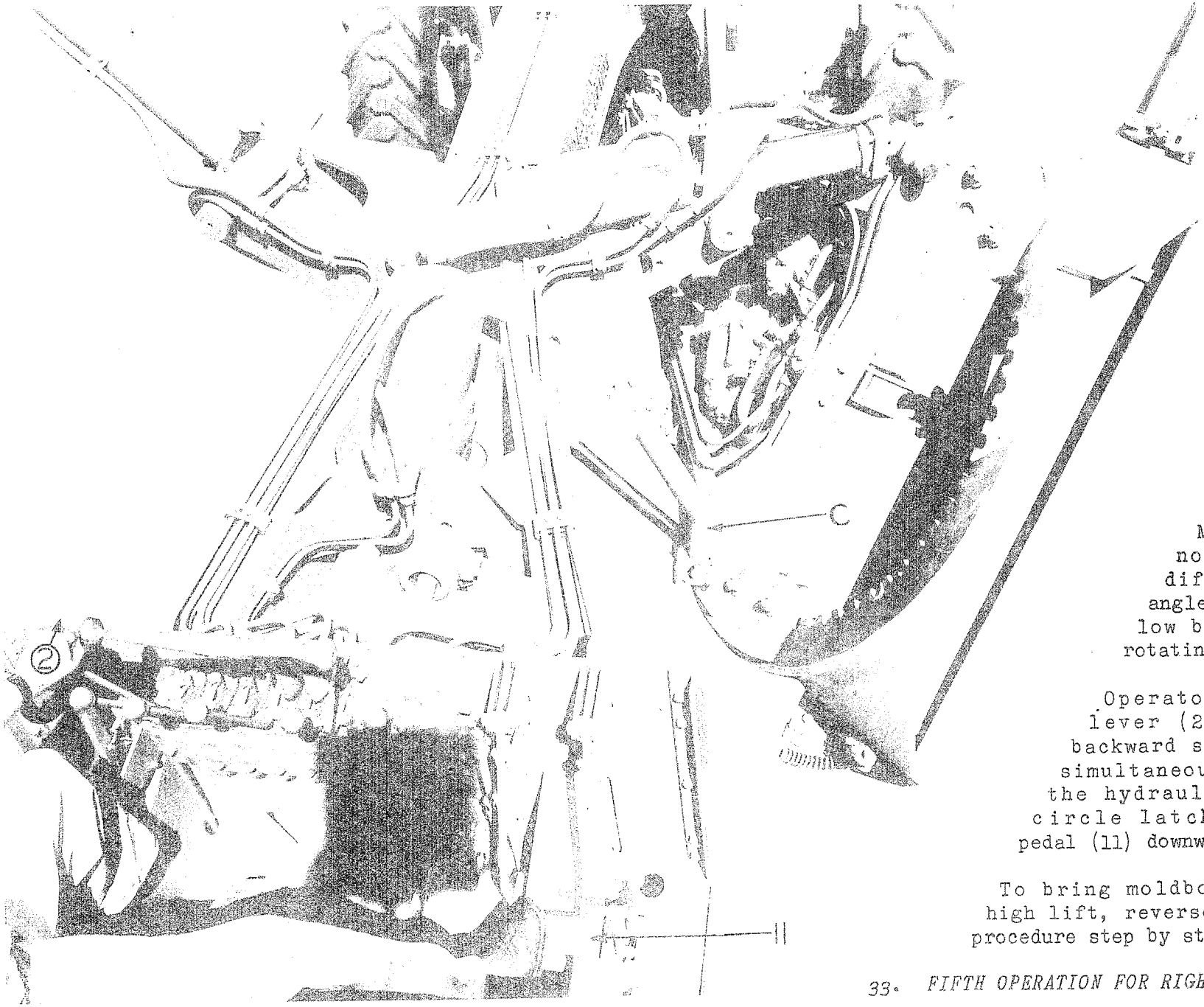


32. *FOURTH OPERATION FOR RIGHT HAND HIGH LIFT.*

(A) Pull back on the right hand blade lift control lever (8).

(B) Push forward on the left hand blade lift control lever (3).

This raises the right side of the circle and pushes the left side of the circle downward and outward simultaneously, into the position as shown.



Moldboard may now be placed in different cutting angles, for high and low banks, etc., by rotating circle.

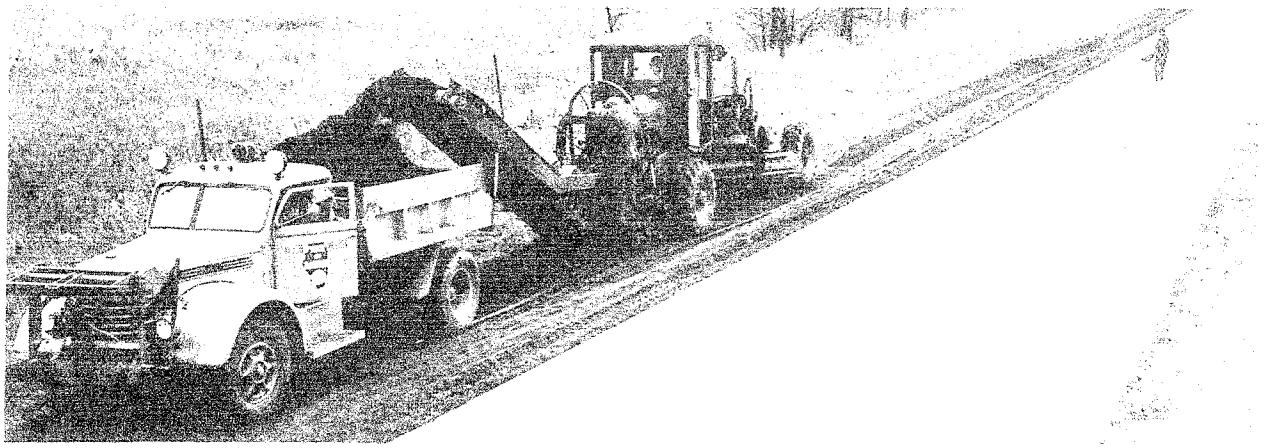
Operator should move lever (2) forward and backward slightly, while simultaneously unlocking the hydraulic controlled circle latch. Push foot pedal (11) downward.

To bring moldboard down from high lift, reverse the foregoing procedure step by step.

33. *FIFTH OPERATION FOR RIGHT HAND HIGH LIFT.*

SECTION 3

POWER GRADER ATTACHMENTS



34. CONVEYOR LOADER.

a. Function.

The 99-H rear loader attachment was designed primarily for loading loose material. It is not a scraper and should not be used as such. Scarify all other material before trying to pick it up.

b. Attaching.

All 99-H power graders have the necessary holes drilled at the rear of the machine for attaching a conveyor loader. Refer to lubrication chart, page 39.

c. Removing.
(Time required approx. 18 minutes)

The weight of this attachment and its overhanging load, and the nature of its mounting, makes it imperative that it be removed when the 99-H is used for purposes other than loading loose material.

First, back up to a level spot and install the supporting legs under the conveyor at the projecting lugs provided for that purpose. In removing the conveyor, unbolt the forward vertical channels (7A), Fig. 35, page 37, from the side of the loader box.

Remove the bolts and caps (6).

When the loader is removed from the grader and the power take-off is not removed, it is advisable to use the lock on the clutch lever (3), so that the clutch cannot be engaged. A locking sleeve is provided for this purpose, and when placed over the lever, with the prong extending toward the take-off case, will lock the clutch in the disengaged position. When the loader is in use the lock is put over the lever with the prong extending away from the case. When in this position, the clutch can be engaged or disengaged at will.

The throw-out bearing and ball bearings, located underneath and back of the radiator, rotate even tho the clutch is released; therefore do not forget to lubricate them if operating with clutch locked out of engagement.

The power grader can now be driven away from the loader attachment.

It will not be necessary to remove the two castings (7), on each end of the bumper pipes, or the arch frame (2), and the hydraulic system, unless some other rear mounted attachment is to be mounted on the rear of this machine.

If it is desired to remove the power take-off entirely, the inner end of the coupling between the crank shaft and the power take-off should be detached from the front fan drive pulley. Then remove the mounting bolts holding the power take-off case to the rear bumper, and replace the front cranking support bracket.

d. Starting.

Before starting to use this loader attachment, thoroly grease same. Consult conveyor loader lubrication chart, page 39, for data.

e. Operating Suggestions.

Use the front steer when operating loader. The rear wheels should run

straight at all times, as it will be almost impossible for inexperienced truck drivers to keep their trucks under the stream of dirt being discharged by the conveyor.

This conveyor loader was designed for operation at approximately 3/4 (or less) of the governed engine speed. The grader should likewise be operated as slowly as possible (in low forward speed) since the amount of dirt this unit can handle per hour is more than the loader can handle, if operated in any other gear.

The end or tail gate of the truck absolutely must be removed. This is to prevent damage to the carrier and also permit backing under far enough to load the truck at the front end. Avoid the use of very high bodied trucks. Truck drivers will have some difficulty at first in staying under the stream of dirt, but after the first half day they will encounter no further difficulty. Be sure to raise the carrier by means of hydraulic control lever (4), page 37, located at the operator's platform, when backing the grader, otherwise the conveyor belt may be ruined. Also disengage power take-off clutch.

The cutting edge can be made to make light cuts on sodded shoulders or light dirt. Deep cuts cannot be made in anything but soft material. If carrier support cables have any tendency to slacken, due to either extremely heavy work at the bit or to the truck raising the elevator, declutch at once or breakage will surely result. Using the power grader scarifier to loosen the material is sometimes very necessary.

In order to use this loader on an angle, that is, for sloping or grading shoulders, and work other than picking up windrows, it will be necessary to set this loader at the desired angle and then lock it there. To secure the desired angle, proceed as follows: lower the loader to the ground, then shut off the two valves (5), page 37, near the right hand lift cylinder, which will hold the left hand side or lift cylinder in position. Then the right side may be either raised or lowered until the desired cutting angle is obtained.

First windrow the material by using the power grader blade, and then use the loader attachment to pick it up. Do not make the windrows too large. Make this loading operation in two stages by picking up windrows of the proper size rather than trying to do it by having one oversize windrow. The power grader can sometimes be used to blade at the same time the loading operation is taking place at the rear. This frequently will be found convenient to do when cutting a deeper ditch with the point of the blade. Keep the heel of the blade quite high so the material will flow out under the central part of the blade. This dual operation can also be used if material is being removed from a bank with the end of the power grader moldboard. This cannot be done in extremely hard dirt, especially in a primary ditch cut.

Very light sod will sometimes load much better if cut and loaded directly with the loader, instead of windrowing. It may tend to push ahead of the loader if windrowed first.

Watch the conveyor belt and keep it centered in the carrier. Sticky dirt sometimes builds up on one end of the lower tail roller and is usually the chief cause of the belt shifting suddenly to one side or another and staying there. This dirt must be removed and the tail roller compartment kept free of dirt accumulation. After the material loading job has been completed, we strongly recommend the removal of the loader attachment. The grader certainly should not be used except for very light grading if the loader attachment remains attached.

f. Clutch.

After removing the inspection plate, the toggle type clutch may be adjusted by unlocking the adjustment ring and turning it clockwise, one notch at a time, until a definite resistance is felt against the engaging lever. Then reinsert the lock.

Avoid over-greasing the three inner bearings on the rear of the power take-off mechanism. Grease may get on the clutch facings and cause slippage.

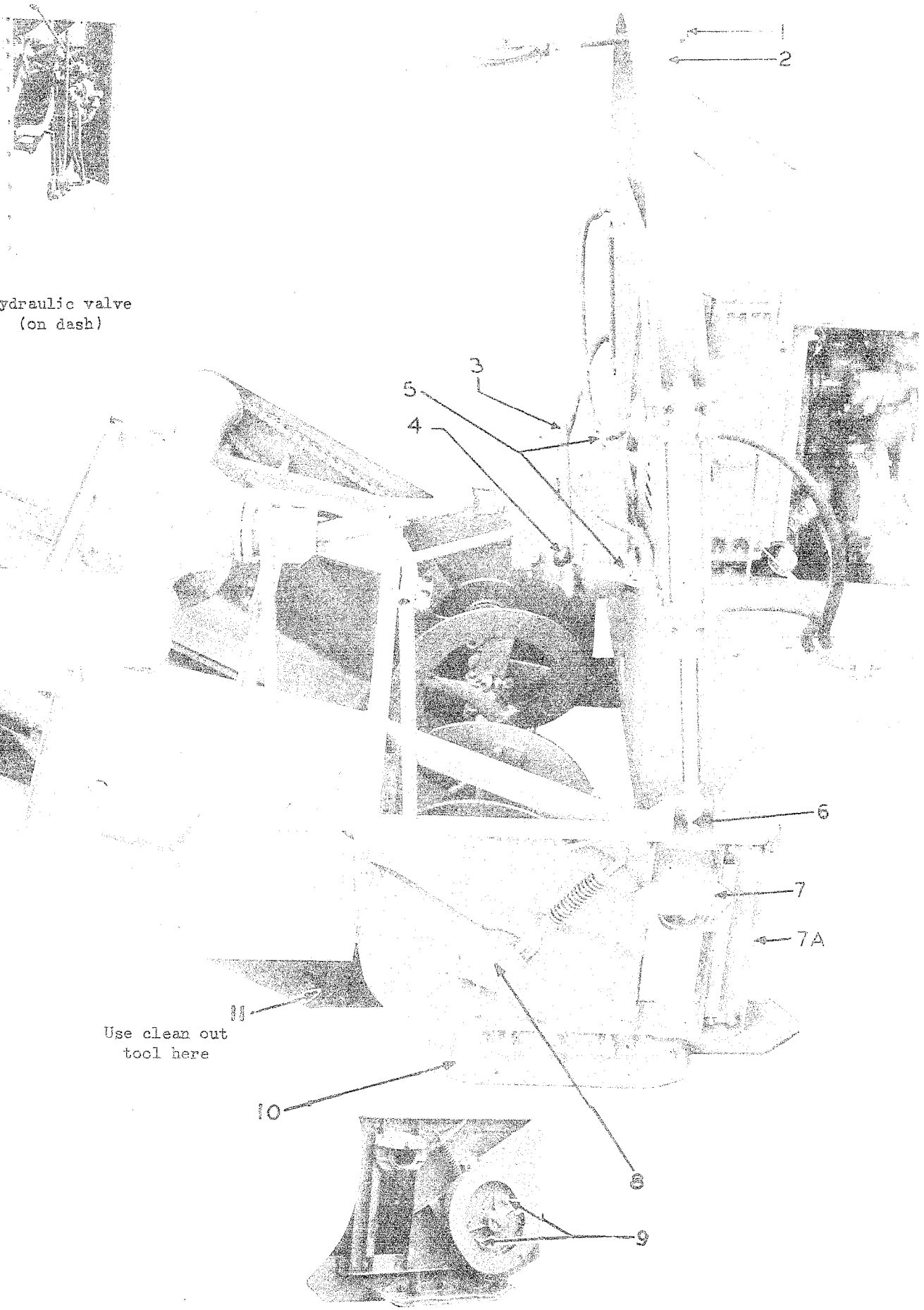


Figure 35. Conveyor Loader

g. Power Take-Off.

In the power take-off mechanism there is only one adjustment necessary, that of the clutch (see clutch). All of the bearings in the power take-off attachment are of the ball bearing type. One end of the propeller shaft is fixed, and the power take-off end is floating in the splined drive member. (See page 39 for lubrication instructions.)

Slotted holes and tension screws are provided on the bevel gear housing outer bearings, likewise on the idler shaft midway on the conveyor frame, and also on the conveyor head pulley. Should excessive wear develop in any one of these three runs of chains, taking up this adjustment may be necessary in one or all three of the places described above.

h. Feeder Shaft.

The feed spiral drive shaft (8), page 37, is arranged so that either end can float upward independently of the other (approximately 3"). Provision has been made for very accurately adjusting the low position of this shaft so the spiral blades can be made to operate within 1/16" of the cutting bit, while the floating feature permits the spiral to readily jump upward over a 2-1/2" or 3" stone or brick, without interfering with the flow of material or breaking the shear pins. On the outer or sprocket end of this feeder shaft are two shear bolts (9), page 37, especially provided for safety purposes in case a large obstacle should jam between the feeder spirals and the conveyor box. These shear bolts are provided with removable and hardened bushings to confine the wear, if any, to the shear bolt itself. Use only soft bolts, as hardened bolts will defeat the object of this safety feature. Spare soft shear bolts are shipped with each loader.

Periodic tightening of the U-bolts holding cutter blades to shaft may be necessary, as constant usage may loosen these bolts.

i. Runners.

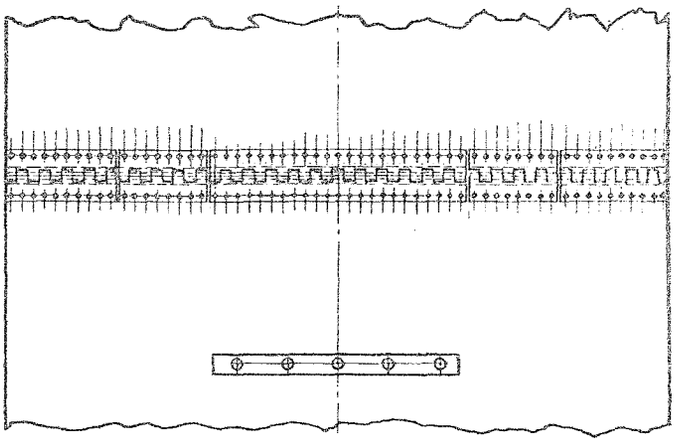
An adjustment for the two runners (10), page 37, at the lower end of the conveyor is provided in order to control the height of the cutting bit from the surface. Renewable wearing shoes are provided. With proper attention and renewal of these shoes, damage to, and excessive wear on the cutting bit itself can be avoided.

j. Clean Out.

Openings (11), page 37, are provided at each side of the lower end of the conveyor frame for cleaning out any accumulated dirt at the tail pulley. Periodic inspection at this point may be necessary in order to avoid damage to the belt as frequently small pebbles wedge in between the belt and the roller. These should be removed before excessive damage occurs. A clean-out tool is shipped with each loader attachment.

k. Conveyor Belt.

The conveyor belt tension is controlled by means of adjusting screws on the conveyor head pulley, and care should be exercised in making a uniform adjustment on each side so the belt may run true over both head and tail rollers. There is likewise a vertical adjustment on the snub pulley, and an unequal adjustment at this point will also cause the belt to run out of true.

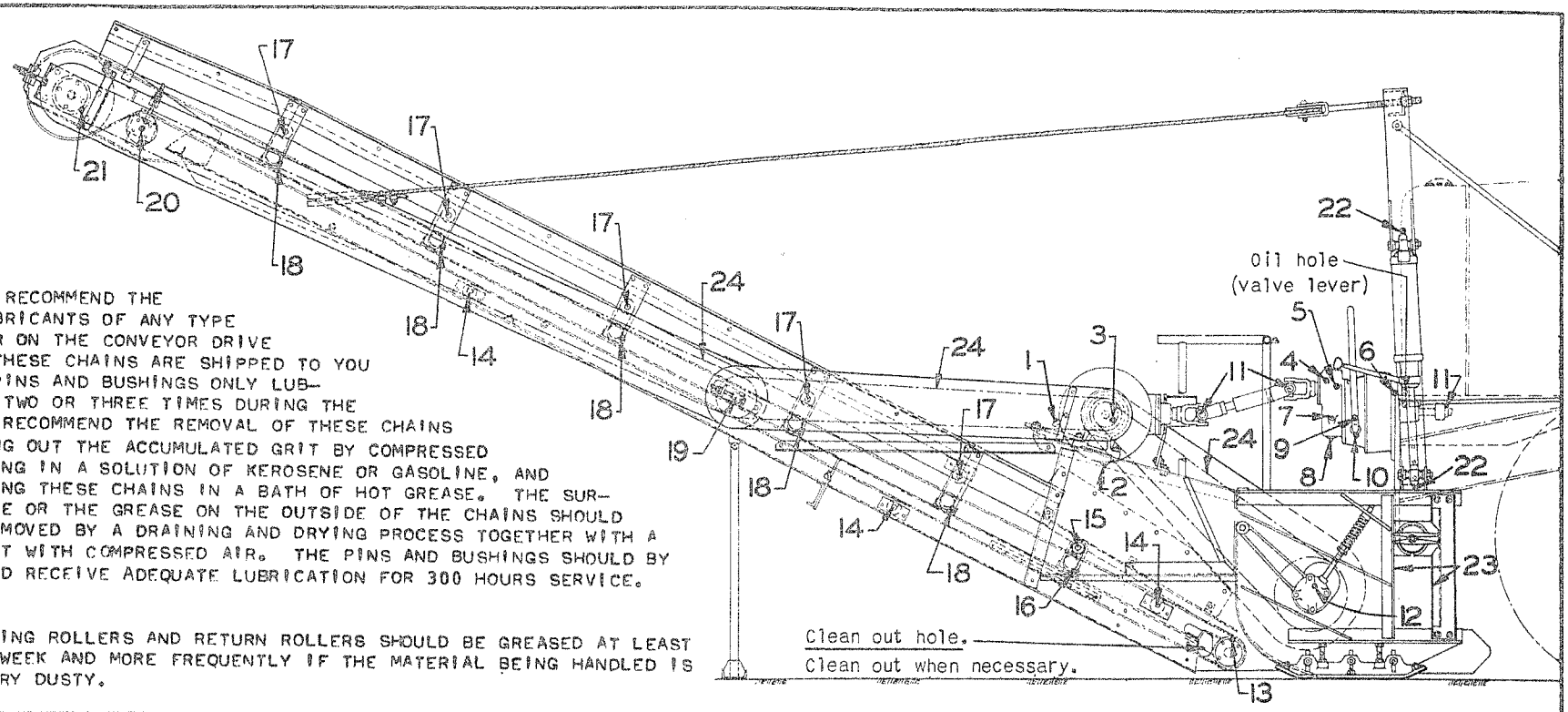


l. Belt Splice and Cleats.

Cleats are placed on the conveyor belt approximately two feet apart. Bolt nuts should be on carrying side of the belt. Excess thread length should be cut off and rivetted over. Cleats will assist conveying sod and large lumps of earth up an inclined belt. The condition of the cleats must be observed from time to time to be sure they are securely fastened to the belt.

m. Cable Tension.

The nut (1), page 37, on the end of the supporting cable, should normally be set so the box (or hopper) is level with the pavement.



NOTE-A-
WE DO NOT RECOMMEND THE USE OF LUBRICANTS OF ANY TYPE WHATSOEVER ON THE CONVEYOR DRIVE CHAINS. THESE CHAINS ARE SHIPPED TO YOU WITH THE PINS AND BUSHINGS ONLY LUBRICATED. TWO OR THREE TIMES DURING THE SEASON WE RECOMMEND THE REMOVAL OF THESE CHAINS AND BLOWING OUT THE ACCUMULATED GRIT BY COMPRESSED AIR, WASHING IN A SOLUTION OF KEROSENE OR GASOLINE, AND THEN DIPPING THESE CHAINS IN A BATH OF HOT GREASE. THE SURPLUS GREASE OR THE GREASE ON THE OUTSIDE OF THE CHAINS SHOULD THEN BE REMOVED BY A DRAINING AND DRYING PROCESS TOGETHER WITH A BLOWING OUT WITH COMPRESSED AIR. THE PINS AND BUSHINGS SHOULD BY THIS METHOD RECEIVE ADEQUATE LUBRICATION FOR 300 HOURS SERVICE.

NOTE-B-
THE TROUGHING ROLLERS AND RETURN ROLLERS SHOULD BE GREASED AT LEAST ONCE EACH WEEK AND MORE FREQUENTLY IF THE MATERIAL BEING HANDLED IS DRY AND VERY DUSTY.

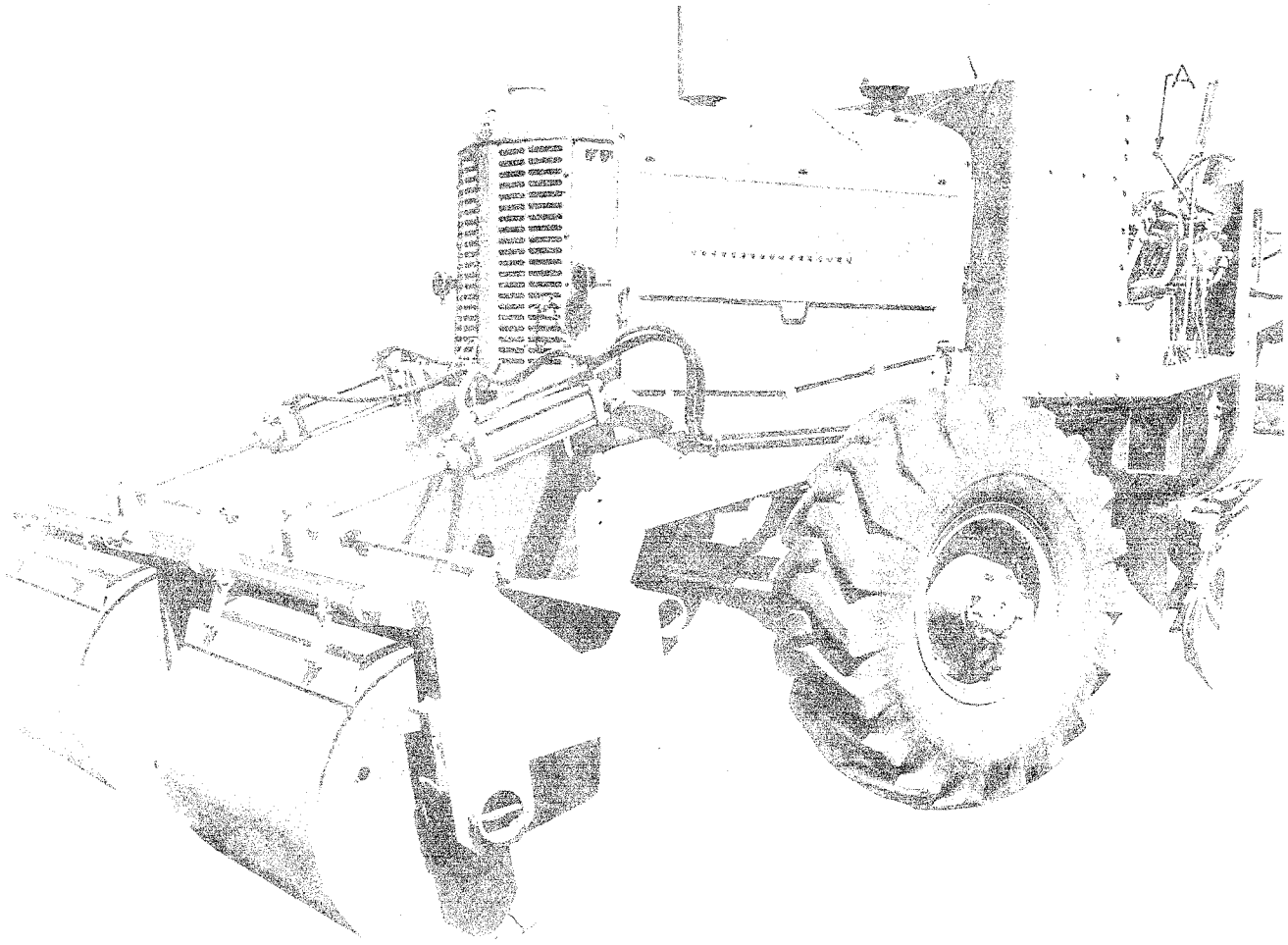
REF. NO.	LOCATION OR FUNCTION	TYPE OF LUBRICANT USED → FREQUENCY / REMARKS	PRESSURE GUN GREASE EVERY WEEK	PRESSURE GUN GREASE EVERY DAY	WHEEL BEARING GREASE EVERY 300 HR.	EXTREME PRESSURE LUBRICANT SAE 140 OR SAE90 (SEE NOTE-C)
1	BEVEL GEAR DRIVE PINION, GEARS & INNER BEARINGS	FILLER				X (CHECK PERIODICALLY)
2	BEVEL GEAR DRIVE HOUSING	DRAIN				
3	BEVEL GEAR DRIVE SHAFT END BEARINGS	BOTH ENDS	X			
4	POWER TAKE-OFF BEARING (REAR)	SPLASH LUBRD.				
5	POWER TAKE-OFF BEARING (FRONT)	SPLASH LUBRD.				
6	POWER TAKE-OFF SHAFT BEARINGS		X (SLIGHTLY)			
7	POWER TAKE-OFF	FILLER				X (CHECK PERIODICALLY)
8	POWER TAKE-OFF	DRAIN				
9	CLUTCH THROW OUT BEARING		X (SLIGHTLY)			
10	CLUTCH THROW OUT SHAFT	BOTH ENDS	X			
11	PROPELLER SHAFT JOINT NEEDLE BEARINGS	BOTH ENDS			X (PACK)	
12	FEEDER SHAFT BEARINGS	BOTH ENDS	X			
13	TAIL PULLEY SHAFT BEARINGS	BOTH ENDS		X		
14	RETURN AND LOWER CARRYING ROLLER SHAFT BEARINGS	BOTH ENDS	X (SEE NOTE B)			
15	INTERMEDIATE CARRYING ROLLER SHAFT BEARINGS (OUTER)	BOTH ENDS	X (SEE NOTE B)			
16	INTERMEDIATE CARRYING ROLLER SHAFT BEARINGS (INNER)	BOTH ENDS	X (SEE NOTE B)			
17	UPPER CARRYING ROLLER SHAFT BEARINGS (OUTER)	BOTH ENDS	X (SEE NOTE B)			
18	UPPER CARRYING ROLLER SHAFT BEARINGS (INNER)	BOTH ENDS	X (SEE NOTE B)			
19	COUNTERSHAFT BEARINGS	RIGHT SIDE		X		
20	SNUB ROLLER SHAFT BEARINGS	BOTH ENDS	X			
21	HEAD DRUM SHAFT BEARINGS	BOTH ENDS	X			
22	LIFT RAM BALL CAPS (BOTH ENDS)	BOTH SIDES	X			
23	GUIDES - HOPPER (2 TO 3 TIMES DAILY)	BOTH SIDES		X		
24	CHAINS - CONVEYOR DRIVE				X (SEE NOTE A)	

NOTE-C-
IN SEASON WHEN TEMPERATURES ARE 32 DEGREES F. AND ABOVE USE SAE140 EXTREME PRESSURE LUBRICANT

IN SEASON WHEN TEMPERATURES ARE BELOW 32 DEGREES F. USE SAE90 EXTREME PRESSURE LUBRICANT

NEVER MIX DIFFERENT GRADES OR KINDS OF EXTREME LUBRICANTS. IF IN DOUBT DRAIN, FLUSH AND REFILL.

36. *CONVEYOR LOADER LUBRICATION CHART.*



37. *REAR ROLLER.*

The roller attachment has many uses on light construction and reconstruction jobs and on many materials, including gravel, black-top and soil-cement.

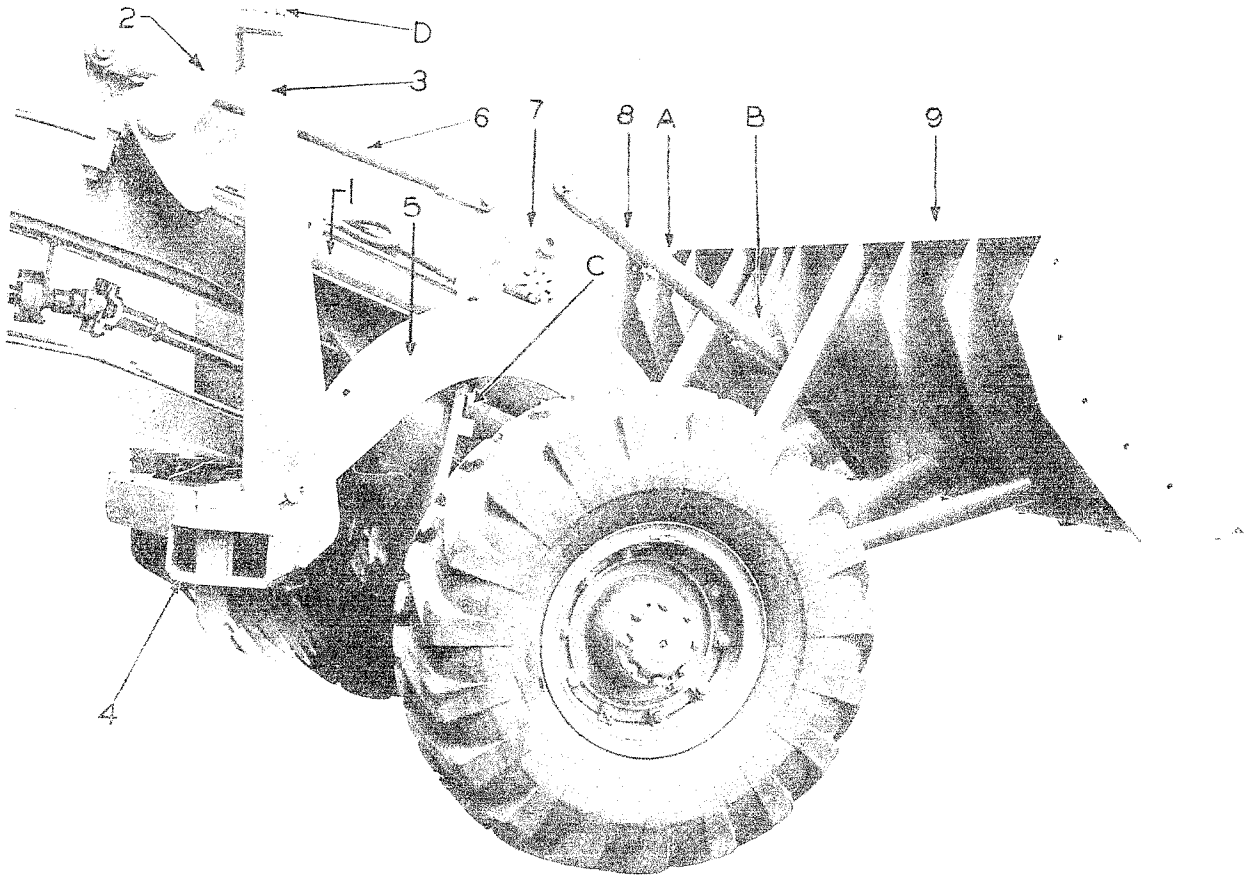
The rolls track behind the wheels, eliminating tire marks and making it possible to roll out to the edge of the material, or close to a curb.

To attach the roller, the pivot brackets are placed over the grader bumper and bolted to the roller frame. The lock collars are clamped on the bumper to prevent side movement of the roller.

The rolls are spaced in order to roll out the tire marks. In making the first pass over the surface, back onto the work to give the material an initial compression before the tires contact the work. When the grader is reversed, the rolls will iron out wheel marks and leave a smooth surface. Subsequent passes will cover the unrolled strip left between the rolls on the first pass. Variable rear roll compression (from a few hundred pounds, to lifting the rear wheels off the ground utilizing all the rear end grader weight on the rolls) is controlled by the operator with lever (A) as shown above.

Kerosene or water saturated cocoa mats are sometimes placed on top of the rolls.

The rear roll bushings are lubricated thru four high pressure fittings located at both ends of each roller. The bronze bearings should be greased (using high pressure grease) every four hours of operation. Sufficient lubricant must be injected to a point where the excess lubricant (about 2 teaspoonsful) is forced out of the inner and outer ends of both rolls.



38. *SCARIFIER AND BULLDOZER.*

a. General.

The 99-H may be fitted simultaneously with both scarifier and bulldozer attachments, parts (1) to (9) inclusive, with hydraulic piping and connections.

NOTE: Lubricate all grease fittings with pressure gun grease; two strokes of lubricator every 50 hours of operation.

b. To Fit Grader With Scarifier Only.

Parts (1) to (5) inclusive are required. See repair parts catalog No. 470B.

c. To Fit Grader With Bulldozer Only.

Parts (1), (2), (6), (7), (8) and (9) inclusive are required. See repair parts catalog No. 470B.

d. To Operate Scarifier.

The above photo shown the scarifier block (4) and bulldozer blade (9) in carrying position.

The scarifier tynes will be entered into the ground when the scarifier hydraulic control lever (9), page 13, paragraph 2., at operator's station, is pushed ahead. The tynes are raised when the lever is pulled back. With pin (A) in upper hole of the telescopic tube (8), the bulldozer blade will not contact the ground.

Tynes may be raised or lowered in block (4), after first removing the wedges. If engine cannot pull a full set of tynes, remove the necessary and same number of tynes from both sides of the scarifier block. (The remaining tynes should be centered in the block.) Keep on removing tynes until the engine can pull the load.

When not using scarifier, remove all tynes. Proceed as shown in the following paragraphs; (1), (2), (3) and (4).

e. To Operate Bulldozer.

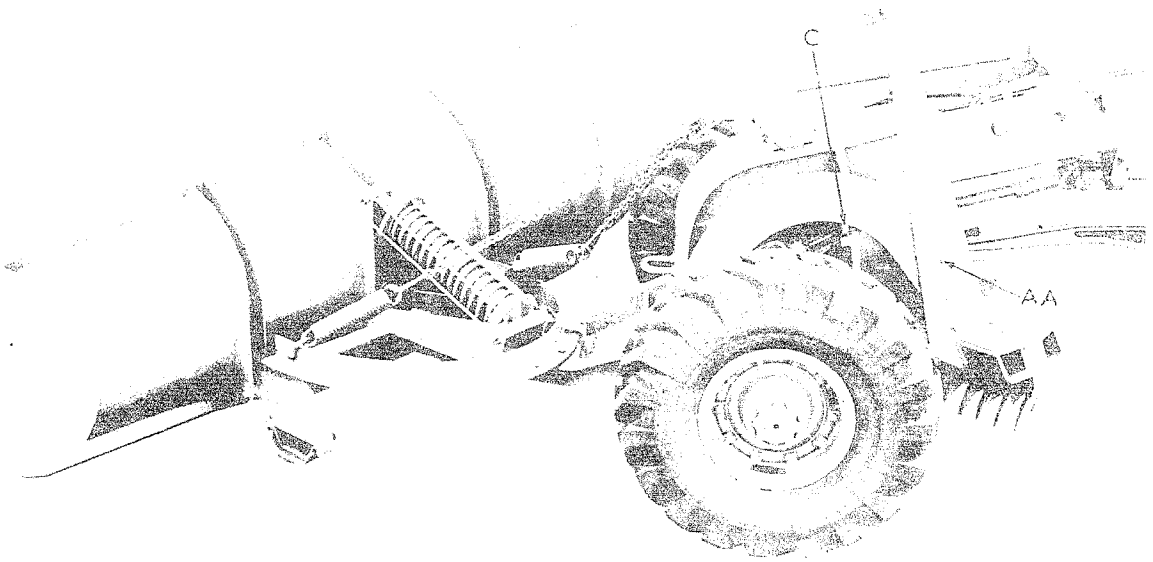
(1) To change over from scarifier to bulldozer operation, turn outward both scarifier draft beam support levers (C), page 41. (One on each side of grader.)

(2) Lower the scarifier draft beams against the levers (C).

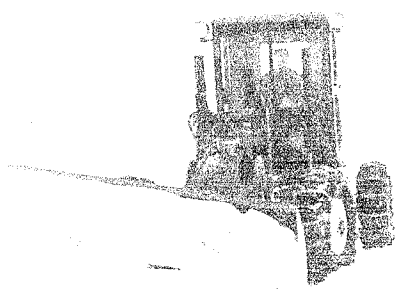
(3) Remove both right and left arm ball caps (D).

(4) Raise the bulldozer blade (9). Swing the arms (3) ahead and lock them to the draft beams (5) by use of bolt as shown at (AA), paragraph 39.

(5) Lower the bulldozer blade (9) to the ground, then remove pin (A). With hydraulic control, move tube (8) back sufficiently to enter pin into hole position (B). The bulldozer blade (9) may now be used effectively.



39. ONE WAY ADJUSTABLE SNOW PLOW.



If the scarifier is not required, then parts groups (1), (2), (6) and (7), page 41, must be on the grader before the reversible plow attachment can be installed.

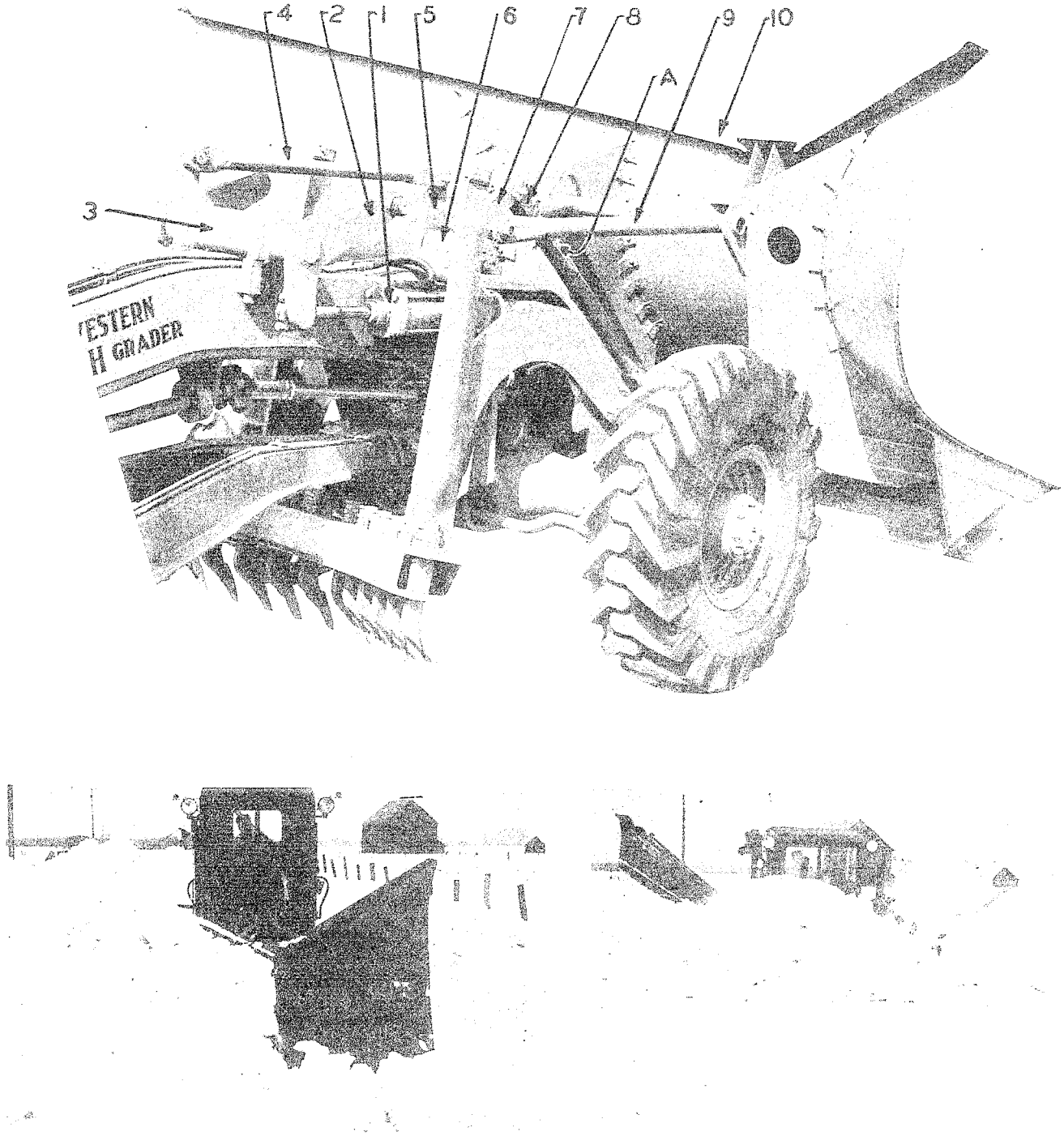
The one way plow is easily attached and removed.

The angle of the blade and chain tension may be changed to meet local operating conditions.

Renewable shoe runners are located on each end of the circle frame.

The hydraulic scarifier control lever (9), page 13, paragraph 2., at the operator's station, is used to raise and lower the plow.

NOTE: Lubricate all grease fittings with pressure gun grease; two strokes of lubricator every 50 hours of operation.



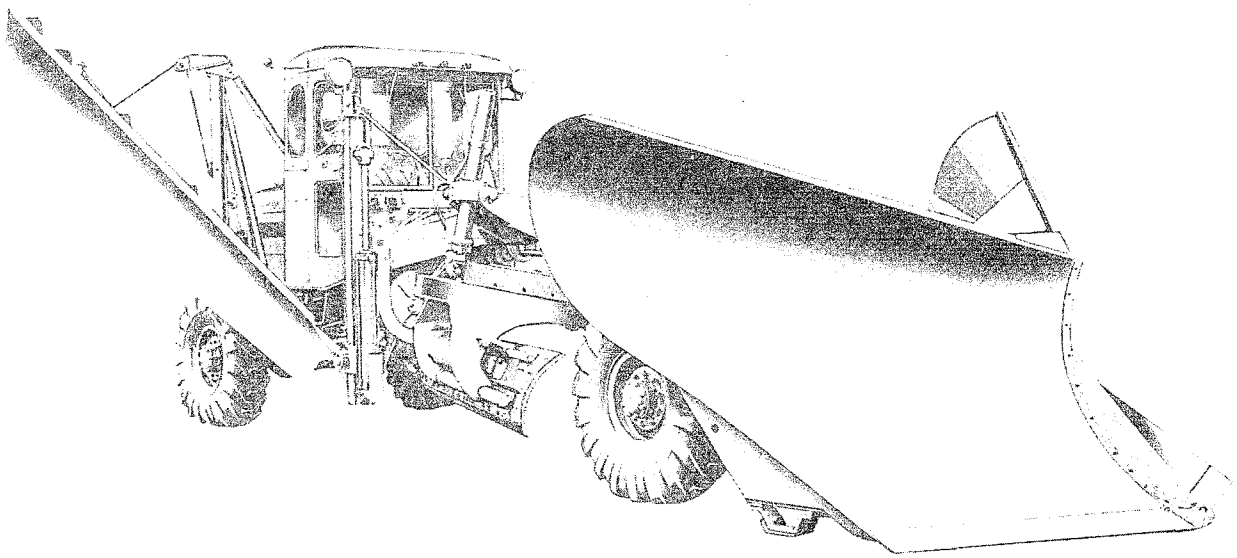
40. GIANT "V" SNOW PLOW.

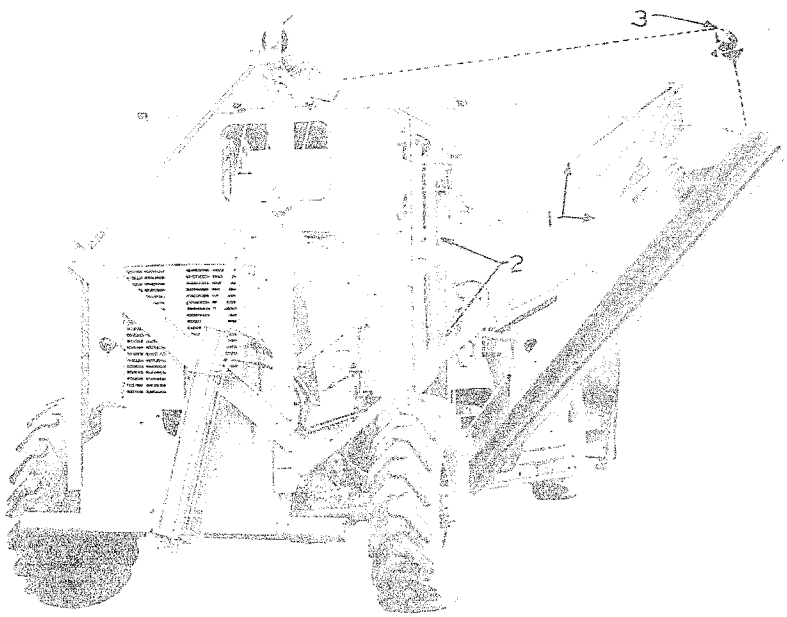
The following parts groups, (1) to (10) inclusive, must be on the grader in order to operate the giant "V" plow attachment.

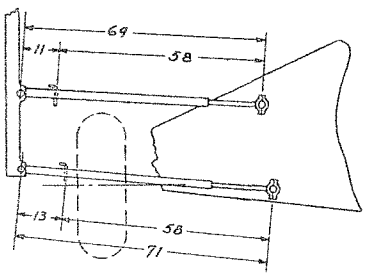
The pin (A), thru the slotted hole in the telescopic tube, is provided in order that the giant plow may float over rough ground.

The amount of float of the "V" plow is hydraulically controlled by the operator while in the cab. Actually he can operate the hydraulic controls to force the "V" plow cutting bit into the ground when plowing hard snow. This happens when the pin (A) reaches the lowermost point of the slot in telescopic tube (8).

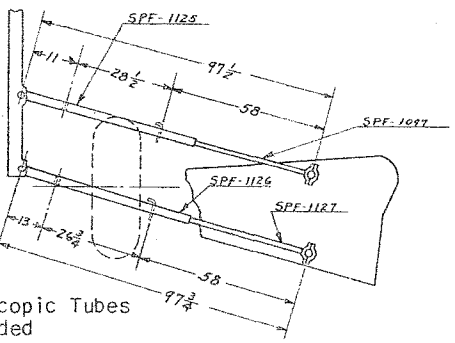
NOTE: Lubricate all grease fittings with pressure gun grease; two strokes of lubricator every 50 hours of operation.







Telescopic Tubes Collapsed



Telescopic Tubes Extended

Instruction Drawing Showing The Proper Location of Telescopic Tubes and Shafts

41. SNOW WING.

Both ends of the wing are raised by means of a hydraulic ram located front and rear.

The two telescopic rods (1) may be lengthened or shortened as required. To change the length, lower the moldboard to the ground and remove two (handled) pins (2). Move the grader either forward or backward until moldboard is set at required angle; then replace the two pins (2).

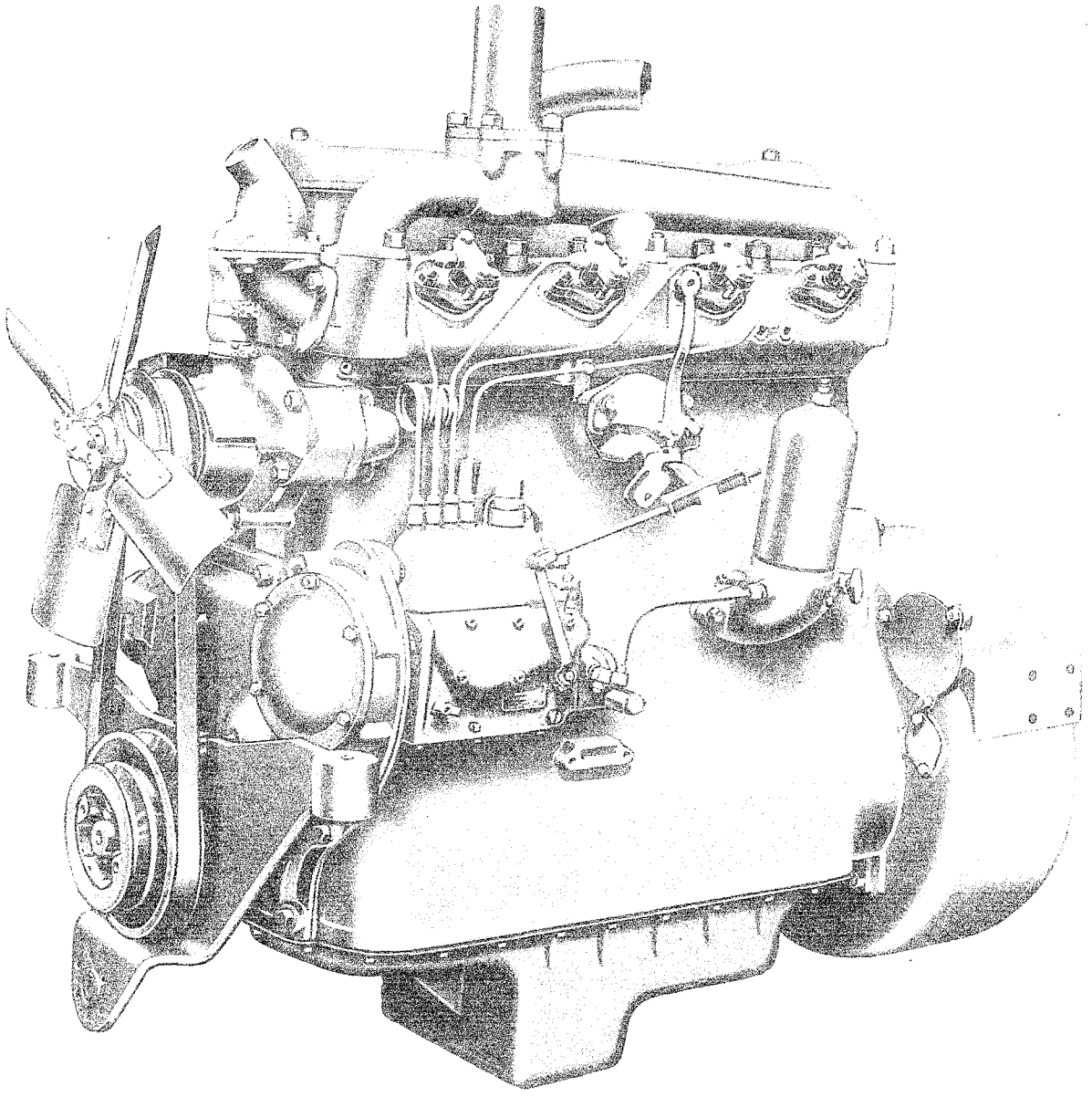
An extra valve (in the cab) is added to raise or lower the inner end of the moldboard (nearest to cab).

The hydraulic valve (in cab) regularly used with the rear roller or rear end loader, is used to control the rear ram.

The rear wheel end of the moldboard may be swung inward over the right rear wheel when passing thru garage doors eleven (11) ft. high and thirteen (13) ft. wide. To accomplish this the moldboard is first lowered to the ground, both pins (2) are removed, and both tubes (1) shortened to maximum, and pins reinserted. The rear cable is raised up and hooked over the moldboard bracket (3). (Overall length is 33 ft.)

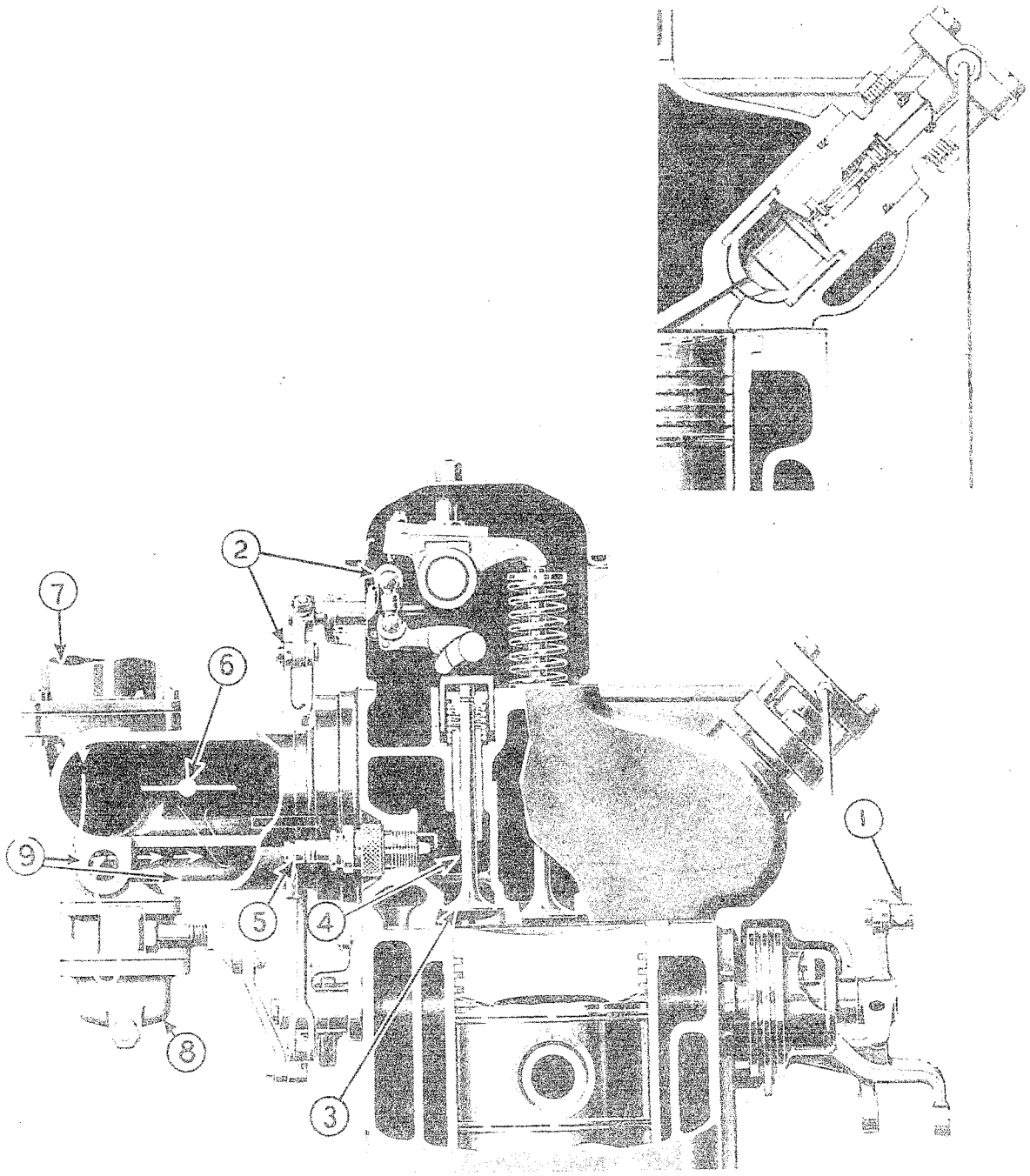
The inner or cab end of the moldboard should be half way up before the outer end is raised up.

NOTE: Lubricate all grease fittings with pressure gun grease; two strokes of lubricator every 50 hours of operation.



42. SIDE VIEW OF UD-14A DIESEL ENGINE.

This engine has features that are typical of International Diesel Engines, including heat-treated replaceable cylinders, exhaust valve inserts, full floating piston pins, electrically hardened crankshaft, tri-metal precision type bearings, and full pressure lubrication to all wearing parts, through drilled passages. The gear type oil pump is equipped with floating oil screen which draws sediment-free oil from the top of the crankcase oil level. The cooling system is the thermostatically controlled by-pass type. The centrifugal water pump impeller shaft is full floating, thus relieving the pump shaft and packing of fan stresses. Precision fuel injection is accomplished by the International single plunger injection pump, through evenly cooled injection nozzles. The governor is enclosed in the injection pump housing. Prompt reaction to engine load and speed demands result from gearing the governor shaft to twice engine speed, and a special torque control device is incorporated to give the engine exceptional lugging power. International Diesel Engines are valve-in-head four-cycle design. Construction is simple and rugged. The four-cycle diesel has fewer heat applications on cylinder walls, larger water cooling passages, and better cylinder wall lubrication.



43. CONVERSION STARTING SYSTEM.

Here is how the simple International gasoline conversion starting system works. The operator, when pulling back lever (1) until it latches, accomplishes these four things:

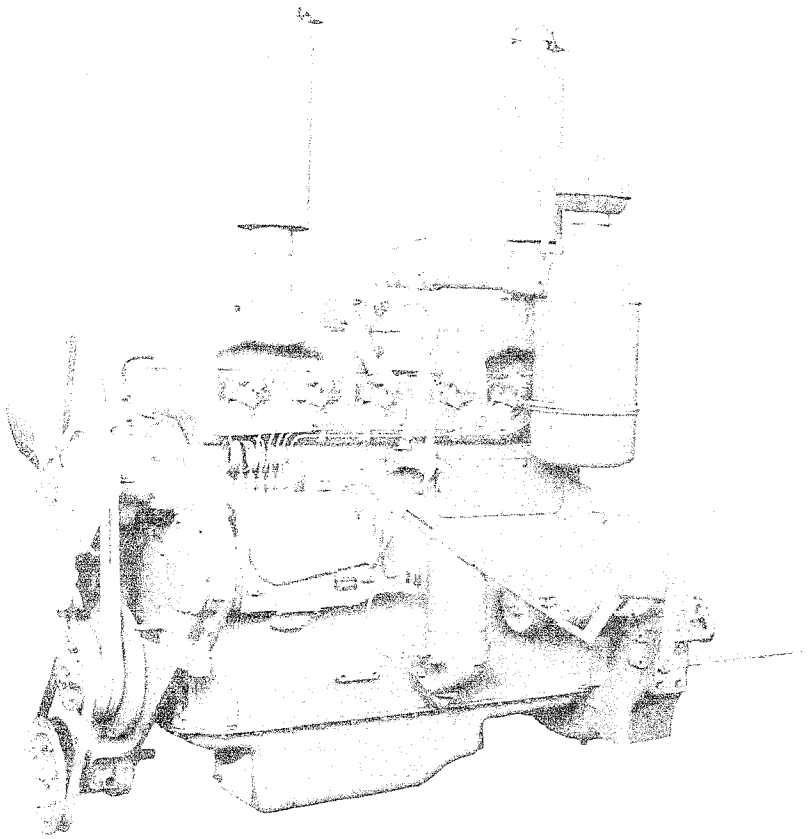
(1) He actuates linkage (2) and opens the starting valves (3), reducing engine compression ratio.

(2) He energizes previously isolated spark plugs (5) in auxiliary chambers (4).

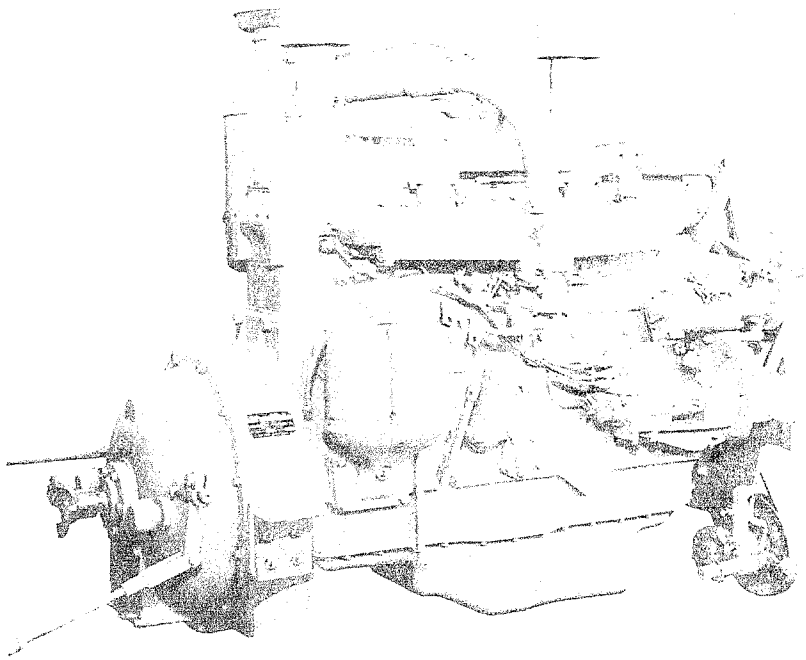
(3) He opens the gasoline shut-off valve in the carburetor (8).

(4) He closes valves (6) in the air intake manifold (7), shunting air from the air cleaner, as indicated by arrows at (9), thru carburetor (8), past the regular intake valves and into the engine combustion chambers.

With the above changes made, the engine is ready to be started in the conventional way, either by hand cranking or by a low voltage electric starter. After a brief direct flame cylinder warm up, the operator converts the engine to full diesel operation (the position shown), simply by tripping lever (1).



UD-16 DIESEL ENGINE
(Fuel Injection Pump Side)



UD-16 DIESEL ENGINE
(Magneto Side)

ENGINE SPECIFICATIONS

Description	UD-14A	UD-16
Make of engine.	IHC	IHC
Number of cylinders	4	6
Cylinder type	Replaceable, wet sleeve	Replaceable, dry sleeve
Bore and stroke, inches . . .	4-3/4 x 6-1/2	4.4 x 5.5
Displacement, cubic inch. . .	460.7	501.8
Governed high idle speed rpm.	1540	1980 ± 20
Governed low idle speed rpm .	500 to 600	500 to 600
Compression ratio (Diesel). .	15.5:1	16.6:1
Fuel.	Diesel	Diesel
Power unit horsepower	76	100
Crankcase refill cap. (qts.).	16	18
CRANKSHAFT (BEARINGS)		
Bearing running clearance, inch.	.003 - .005	.0022 - .0047
End clearance, inch	.006 - .014	.006 - .014
Bearing cap nut torque, foot-pounds	150	90
Thrust taken by	Center bearing	Center bearing
CAMSHAFT		
Running clearance, inches . .	.0015 - .0035	.0015 - .0035
End clearance, inch	.005 - .011	.002 - .010

Description	UD-14A	UD-16
Service bushings.	Reamed to size	Reamed to size
CONNECTING RODS		
Connecting rod bearing end clearance, inch	.005 - .012	.005 - .012
Connecting rod bearing running clearance, inch . .	.003 - .004	.003 - .0045
Connecting rod bolt nut tension, foot-pounds. . . .	70	55
Service bushing	Not reamed to size	Not reamed to size
PISTONS		
Type.	Dish top	Dish top
Clearance at bottom of skirt inch.	.0076 - .0084	.0066 - .0074
Clearance at top of skirt (measured 90° from pin hole) inch	.0096 - .0104	.0086 - .0094
Piston check with 1/2 inch shim stock.	7 - 10 lbs.	3 - 6 lbs.
PISTON PINS		
Recommended running clearance in rod bushing, inch. . . .	.0005 - .0007	.0005 - .0007
Interference in piston bore (cold) inch	.0001 - .0003	.0001 - .0003

ENGINE SPECIFICATIONS

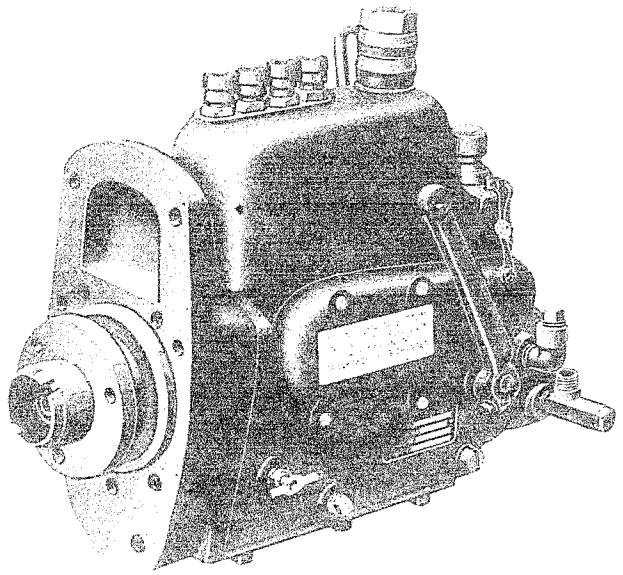
Description	UD-14A	UD-16
CYLINDER SLEEVES		
Allowable taper, inch. . . .	.001	.0005
Allowable out of round, inch	.001	.0005
RING GAP		
Compression (first), inch .	.010 - .020	.010 - .020
Compression (second), inch .	.010 - .020	.010 - .020
Compression (third), inch .	.010 - .020	.010 - .018
Compression (fourth), inch .	.010 - .018	
Oil control, inch.	.010 - .018	.013 - .023
CLEARANCE IN GROOVE		
Compression (first), inch .	.004 - .006	.0035 - .0050
Compression (second), inch .	.003 - .005	.0025 - .0040
Compression (third), inch .	.0025 - .0045	.0020 - .
Compression (fourth), inch .	.0025 - .0045	
Oil control, inch.	.0025 - .004	.0025 - .004
INTAKE VALVES		
Tappet clearance (hot), inch	.018	.017
Tappet clearance (cold), inch	.020	.019
Stem clearance in guide, inch	.002 - .004	.002 - .004
Valve seat angle.	45 degree	45 degree
Width of valve seat, inch . .	3/32	3/32

Description	UD-14A	UD-16
EXHAUST VALVES		
Tappet clearance (hot), inch.	.018	.018
Tappet clearance (cold), inch	.020	.019
Stem clearance in guide, inch	.003 - .005	.002 - .004
Valve seat angle.	45 degree	45 degree
Width of valve seat, inch . .	3/32	3/32
Stem guide above top of cylinder head, inches . . .	1-3/8	1/8
VALVE SPRINGS		
Free length, inches	2-7/8	2-7/8
Test length, closed, inches .	2-1/2	2-1/2
Test load, closed, pounds . .	53	53
VALVE TIMING		
Intake opens, degrees	20° before TDC	20° before TDC
Intake closes, degrees. . . .	40° after BDC	40° after BDC
Exhaust opens, degrees. . . .	40° before BDC	40° before BDC
Exhaust closes, degrees . . .	10° after TDC	10° after TDC
STARTING VALVES		
Valve seat angle.	45 degree	45 degree
Valve seat width, inch. . . .	3/64	3/64

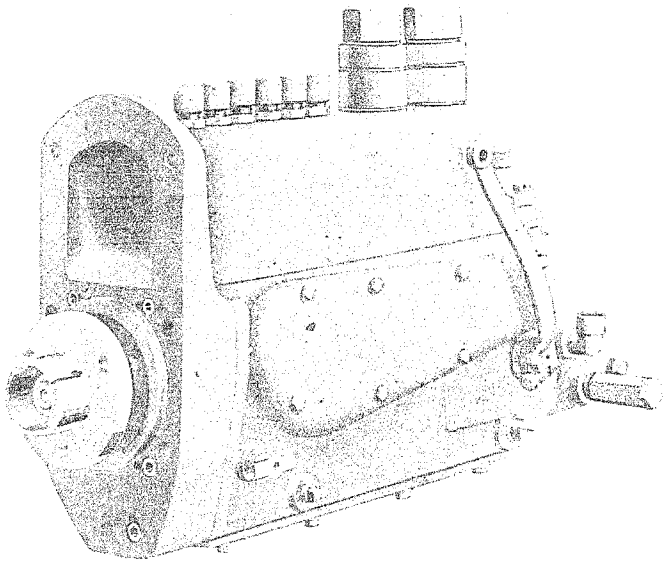
ENGINE SPECIFICATIONS

Description	UD-14A	UD-16
Clearance in guide, inch. . .	.002 - .004	.002 - .004
Approximate clearance travel of valve spring cover in cylinder head (starting position), inch	1/64	1/64
STARTING VALVE STEM GUIDE		
Stem guide below top of cylinder head, inches. . . .	15/16	1-3/4
STARTING VALVE SPRING		
Free length, inches	1-31/32	1-31/32
Test length, inches	1-5/32	1-5/32
Test load, pounds	23.9	23.9
VALVE TAPPETS		
Tappet clearance in guide . .	.0005 - .003	.0005 - .0025
TIMING GEARS		
Backlash, inch.	.003 - .006	.003 - .006
LUBRICATION SYSTEM		
Oil pressure at rated rpm . . lb./sq. inch.	40 - 45	40 - 45
LUBRICATING OIL PUMP		
End play between gear and end plate, inch	.003 - .006	.003 - .006

Description	UD-14A	UD-16
Gear clearance to housing, inch.	.012 - .015	.012 - .015
Backlash of gears, inch . . .	.004 - .006	.004 - .006
Drive shaft running clearance, inch	.0015 - .003	.0015 - .003
Idler gear running clearance, inch	.0015 - .003	.0015 - .003
Clearance between body and drive pinion, inch.	.005 - .010	.005 - .010
OIL PRESSURE VALVE REGULATING SPRING		
Free length, inches	4-15/64	2-13/16
Test length, inches	2-3/32	2-3/32
Test load, pounds	27	37
COMPRESSION PRESSURE		
Running (high compression). .	545 lbs. per sq. inch at 1555 rpm.	545 lbs. per sq. inch at 2000 rpm.
NUT AND BOLT TORQUE DATA (Foot-pounds Torque)		
Cylinder head	190 - 215	160 - 185
Connecting rod.	70	55
Main bearing.	250 - 275	110 - 135
Flywheel bolts.	150	150
Manifold nut to stud.	75	75
Nozzle body to stud	45	45



Front and Side View of IHC Single-Plunger Injection Pump for UD-14A Diesel Engines.



Front and Side View of IHC Twin-Plunger Injection Pump for UD-16 Diesel Engines.

UD-14A Engine Fuel Pump Test Stand Calibration Specifications.

NOTE: The fuel injection pump is IHC part number 65314-DA101. It is set for a high idling speed of 1540 RPM. Following are the test bench calibration figures for this pump:

Average delivery in cubic centimeters at 550 pump RPM for 1 minute with .093 ID flow bench injection tubing	73 cc
Maximum permissible variation of any nozzle from average delivery cubic centimeters	±3 cc
High idle gap	.100"
Torque lever stop screw	3/8"
Torque spring shoe screw	5/8"
Torque lever pickup screw	3/32"

UD-16 Engine Fuel Pump Test Stand Calibration Specifications.

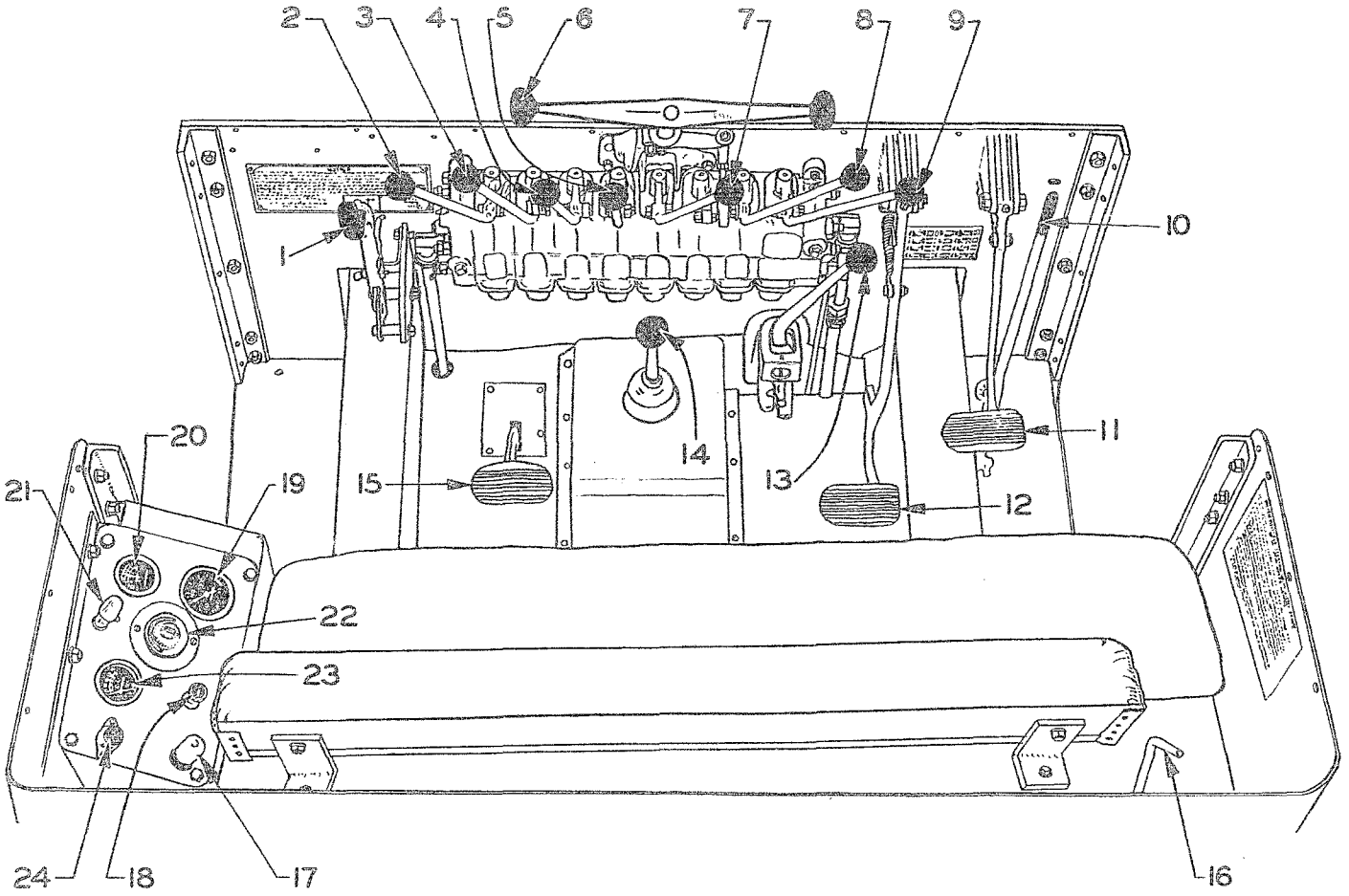
NOTE: The fuel injection pump is IHC part number 253602R91. It is set for a high idling speed of 1980 ± 20 RPM. Following are the test bench calibration figures for this pump.

Average delivery in cubic centimeters at 550 pump RPM for 1 minute with .093 ID flow bench injection tubing	73 cc
Maximum permissible variation of any nozzle from average delivery cubic centimeters	±3 cc
High idle gap	.075"
Torque lever stop screw	3/8"
Torque spring shoe screw	11/16"
Torque lever pickup screw	1/8"

ADJUSTING IHC INJECTION PUMP FOR HIGH ALTITUDE OPERATIONS
(START ADJUSTMENT FROM STANDARD SETTING)

Altitude Feet Above Sea Level	UD-14A Engine * Pump Adjustment Number of Turns	UD-16 Engine * Pump Adjustment Number of Turns
3000	None	None
4000	None	None
5000	None	None
6000	None	None
8000	1	1/2
10,000	1-3/4	1-1/4

Note: * Indicates partial or total number of turns counterclockwise of fuel rack adjusting nut necessary, from standard setting, to reduce fuel delivery to keep exhaust acceptably clear.



44. INSTRUMENTS AND CONTROLS.

The operator should thoroly familiarize himself with the instruments and controls provided for operation. Regardless of previous experience with other engines, the operator will secure the best results if he fully understands what each control is for, and how to use it.

REF.	*DESCRIPTION*
1.	Hand brake
2.	Circle rotation
3.	Left hand blade lift
4.	Moldboard side shift
5.	Circle side shift
6.	Front steer
7.	Rear steer
8.	Right hand blade lift
9.	Scarifier
10.	Engine speed control
11.	Circle latch
12.	Foot brake

REF.	*DESCRIPTION*
13.	Transfer case gear shift lever
14.	Transmission gear shift lever
15.	Clutch pedal
16.	Compression release lever
17.	Starter button
18.	Choke button
19.	Heat indicator
20.	Ammeter
21.	Dash panel light
22.	Switch
23.	Oil pressure indicator
24.	Horn button

a. Engine Speed Control Lever.

This lever (10) controls the speed of the engine. When set in a given position it maintains a uniform engine speed under variable loads. Pull the lever backward to increase the speed.

b. Compression Release Lever.

Pulling toward the operator on the compression release lever (16) converts the diesel engine into a gasoline engine for starting. See page 46, paragraph 43.

c. Choke Button.

The choke (18) aids in starting the engine when it is cold. Pulling the choke out shuts off the air to the carburetor, giving a rich mixture.

d. Starting Switch.

Pressing the starting switch button (17) completes the electric circuit between the battery and the starting motor, causing the starting motor to crank the engine. See paragraph 45.-e., this page.

e. Oil Pressure Indicator.

The oil pressure indicator (23) shows whether the lubricating oil is circulating thru the engine. See page 51, paragraph 51.

f. Ammeter.

This instrument (20) indicates the charging rate of the generator or the rate at which the battery is being discharged. See page 76, paragraph 89.-a.

g. Heat Indicator.

The heat indicator (19) registers the temperature of the liquid in the cooling system. The indicator should be near 180° F. for normal operation.

h. Radiator Shutter. (winter usage)

Radiator shutters are available and should be installed when the engine temperature cannot be held near 180° F.

45. STARTING ENGINE ON GASOLINE.

a. Place transmission shifting lever (14) in disengaged position.

b. Open gasoline tank shut-off valve. The diesel fuel line from the supply tank to fuel transfer pump is equipped with a shut-off valve (5), page 58. Make sure this valve is open.

c. Place the compression release lever (16) in the gasoline (starting) position. Pull toward the operator.

d. Place the engine speed control lever (10) in forward (shut-off) position. This lever should remain in shut-off position until the engine is switched to diesel operation, to prevent flooding with fuel oil. Release clutch.

e. When the engine is equipped with an electric starter, set the choke (18) part way open and press the starter button (17).

NOTE: Never operate the starting motor more than twenty seconds at a time. Allow starting motor to cool a few seconds and repeat the starting operation.

f. Choking and Hand Cranking. Excessive choking will flood the engine with gasoline and make it hard to start. Choke and crank the engine as follows:

(1) During warm weather; or,
During cold weather when engine is warm.

Set the choke (18) in the fully choked position (pull choke button out) and make one or two up-strokes of the crank. Then set choke 1/4 to 1/3 open and crank the engine until it starts. (Crank engine with quick up-strokes, making only half a turn. Do not attempt to make a full turn or to spin the engine.)

(2) During cold weather when engine is cold.

Set the choke in fully choked position and make three or four up-strokes of the crank. Then set choke 1/4 to 1/3 open and crank engine until it starts.

g. As soon as the engine starts, the choke (18) should be adjusted to where the engine operates steadily, and, as the engine warms up, push the choke all the way down.

h. Check the oil pressure indicator (23) to see if oil is circulating thru the engine. If not, stop the engine immediately and determine the cause of the oil pressure failure.

i. The engine should be operated on the gasoline cycle about one minute (two or three minutes in cold weather) before switching to the diesel cycle.

46. CHANGING TO DIESEL OPERATION.

a. After starting the engine, before switching to the diesel cycle, operate it on gasoline with the choke wide open (pushed down) until the exhaust becomes clear. This will clean the spark plugs for the next starting.

b. For severe cold conditions the engine should be run two or three minutes on gasoline before switching to diesel fuel.

c. Push the compression release lever (16) toward radiator to the diesel position, then immediately advance the engine speed control lever (10) part way, and the engine will operate on diesel fuel as a diesel engine.

d. The carburetor is automatically cut out when on diesel, and is ready for use again when stopping on gasoline.

e. The magneto is timed with the engine and is permanently connected. The ignition switch is operated automatically by the starting mechanism.

f. The engine may start noisily when diesel operation begins, but the noise will be eliminated as the engine warms up.

47. REGULATING ENGINE SPEED.

a. The engine speed control lever (10) regulates the speed of the engine. After you have selected the desired engine speed, the governor will automatically maintain this speed under variable loads.

b. The engine speed control lever (10) should not be fully advanced until the engine has been operating a few minutes. This will assure thorough distribution of the lubricating oil.

c. Operate a new engine with a light load for the first thirty to thirty-six hours, at 3/4 throttle opening.

d. The fast idle governed (no load) speed is 1540 RPM; low idle speed is 500 to 600 RPM. (The UD-16 engine fast idle speed is 1980 ± 20 RPM.)

48. STOPPING ENGINE.

a. Make sure the gasoline shut-off valve is open.

b. Place the engine speed control lever (10) in the starting (shut-off) position, and at the same time pull the compression release lever (16) out to the gasoline (starting) position.

c. Close the shut-off valve at the one gallon gasoline tank.

d. Allow engine to use up the gasoline in the carburetor and come to a stop.

e. After the engine stops, push the compression release lever (16) back to the diesel position to permit the starting valves to cool in their seats.

49. LUBRICATION.

The life of any engine depends on the care it is given. Proper lubrication is an essential part of preventive maintenance. It is important that lubricants, pressure gun, and containers be kept clean and free from foreign matter; also that each lubrication point be well cleaned before the pressure gun is applied.

Use only high quality lubricating oils and grease. Engine lubricating oil should be of well refined petroleum oils, free from water and sediment, and without mixtures of fatty oils, acids, soaps, resins, or any other substance not derived from petroleum. Oil should not corrode any metal used in engine construction. Also, engine lubricating oil containing additive products not necessarily derived from petroleum, but being of non-corrosive type, is satisfactory.

Do not operate the engine for any length of time with the crankcase oil level below the low mark on the bayonet gauge.

To change oil, see pages 52D and 53. Drain the crankcase while the oil is warm so it will drain freely and completely.

50. OIL FILTERS.

This engine is equipped with oil filters which continually clean the oil while the engine is operating. To obtain the full benefit from the filters, the elements should be replaced each time the oil in the crankcase is changed (see pages 52D and 53). Cleaning the old elements is not satisfactory.

51. OIL PRESSURE INDICATOR.

Under all operating conditions the oil pressure of the engine should hold the indicator at about 45#. Should the indicator not register, stop the engine at once and inspect the oil system to find the cause of failure. If unable to find the cause, consult your Austin-Western dealer before operating the engine. Always look at the oil pressure indicator immediately after starting the engine.

52. OIL PUMP.

The gear type oil pump in the crankcase has a screen attached to the oil intake to stop large dirt particles from entering the lubrication system. This screen should be cleaned whenever the oil pan is removed. The oil intake floats on the top of the oil in the crankcase and always draws the oil from the surface, thus preventing water or sediment from mixing with the oil.

53. LUBRICATION WHEN SHIPPED.

Engines shipped to destinations in the Unites States, Canada and Mexico, are filled with thinned SAE-10 oil in the lubricant compartment when leaving the factory. However, all lubricant compartments should be checked for proper level before starting the engine. This oil, as shipped from the factory, can be left in the engine up to one hundred hours of operation, if the weather is 10° to 32° F. For light loads it can be used up to one hundred hours of operation if the temperature is below 50° F. At other temperatures lubricants should be used as specified in the lubrication chart on pages 52 to 52D inclusive.

When engines are packed for export, all oil is drained from the lubricant compartments. Before starting, give complete lubrication service. Refer to lubrication chart on pages 52 to 52D inclusive.

54. SELECTING PROPER OIL.

During cold weather the selection of crankcase lubricating oils should be based on the lowest anticipated temperature for the day, to make starting easier. For hot weather operation the selection should be based on the highest anticipated temperature. Refer to lubrication chart on pages 52 to 52D inclusive.

After changing to a lighter grade of oil, the engine should be operated at least five to ten minutes, so the lighter oil is worked into the bearings and onto the cylinder walls.

a. Thinning Crankcase Oil.

When using the lighter grades of lubricating oils, there may be a tendency for the oil in the crankcase to gradually become thicker; in this case it is desirable in cold weather to add one quart of kerosene or diesel fuel to the crankcase between the specified oil changes, to maintain easy cranking. Kerosene is preferable for thinning the engine oil because some diesel fuels do not have a low pour point.

b. Changes in Temperature.

It is not necessary to change crankcase oil during operation when the atmospheric temperature rises or falls into another temperature range (as specified in the lubrication chart on page 52 or 52A). For example: SAE-30 may be used instead of SAE-20, except for starting conditions in the lower temperature ranges where SAE-20 is specified; or, SAE-10 may be used up to around 40° to 50° F; or, 10-W may be used up to 32° F., and even up to 40° or 45° F., except when operating on continuously heavy loads.

KEY TO SPECIFICATIONS OF LUBRICANTS

OE (Oil, engine)—SAE-30, SAE-20, SAE-10, 10-W, according to anticipated air temperature.
CG (Pressure-gun grease)—All temperatures.

APPLICATION	CAPACITY	ANTICIPATED AIR TEMPERATURE			
		Above 90°F	90°F to 32°F	32°F to 10°F	10°F to Sub-zero
Crankcase	16 quarts	SAE-30	SAE-20	SAE-10	10-W
Air cleaner	5½ pints	SAE-30	SAE-20	SAE-10	10-W
IHC fuel injection pump	½ pint	SAE-30	SAE-20	SAE-10	10-W
Magneto distributor bearing		Very light electric motor oil, or SAE-10	Very light electric motor oil, or SAE-10	Very light electric motor oil, or SAE-10	Very light electric motor oil, or SAE-10
Magneto impulse coupling		Very light electric motor oil, or SAE-10	Very light electric motor oil, or SAE-10	Very light electric motor oil, or SAE-10	KEROSENE

Point of Lubrication — Lubricant — Hours

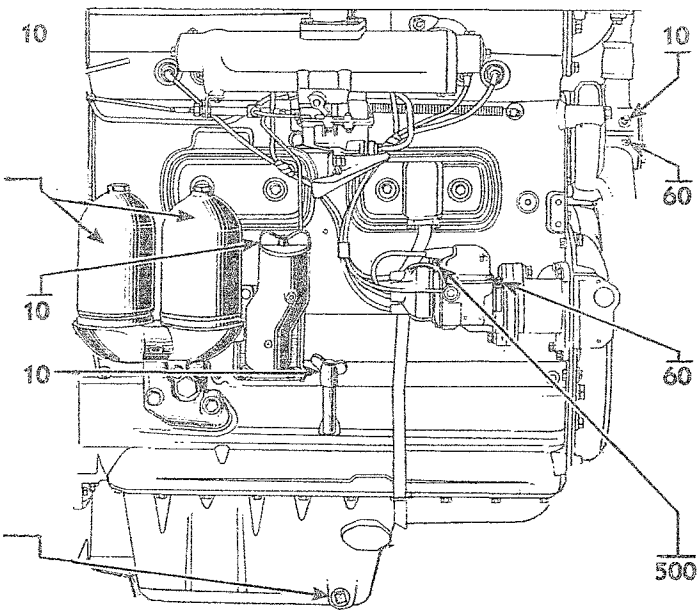
Air cleaner . . . . . OE 10
Clean and refill the oil cup to the oil level bead with the grade of oil specified in "KEY" above. (Also see page 54)

Lubricating oil filters 10
Drain the filters and replace the filter elements when crankcase oil is changed. (See pages 520 and 53)

Crankcase filler . . . . . OE 10

Crankcase gauge 10
Check oil level with gauge; add oil to bring level to "FULL" mark; refer to "KEY" above for proper grade of oil to be used. (Also see "NOTE B" below.)

Crankcase drain . . . . . OE
Remove crankcase oil pan drain plug and drain completely while the oil is warm; refill to "FULL" mark on gauge; refer to "KEY" above for proper grade of oil to be used. (See pages 520 and 53)



Hours — Lubricant — Point of Lubrication

10 CG **Water pump shaft**
Give pressure-gun not over 2 strokes. Overlubrication will force lubricant into the cooling system, which may cause clogging.

60 CG **Fan hub bearing**
Give pressure-gun 1 or 2 strokes. DO NOT OVER-LUBRICATE. If lubricant oozes out of fan hub while using pressure-gun, stop the application.

60 OE **Magneto impulse coupling**
Oil liberally with grade of oil specified in "KEY" above (Also see pages 64 and 65 for complete magneto lubrication instructions.)

500 OE **Magneto distributor bearing**
Fill oil cup with grade of oil specified in "KEY" above (Also see pages 64 and 65 for complete magneto lubrication instructions.)

NOTE A—Lubrication of Engine Control Linkage

Occasionally apply a few drops of engine oil to the engine speed control, compression release and other linkage.

NOTE B—Checking Crankcase Oil Level with Bayonet Gauge

The bayonet type oil level gauge has readings on both sides, showing the crankcase oil level when the engine is operating and when it is stopped. Check the oil level as follows:

(1) Unscrew the wing nut, remove the gauge, and wipe it clean.
(2) Reinsert the gauge until the wing nut rests on the top of the gauge sleeve threads; do not screw the nut onto the sleeve.
(3) Remove the gauge and check the oil level.

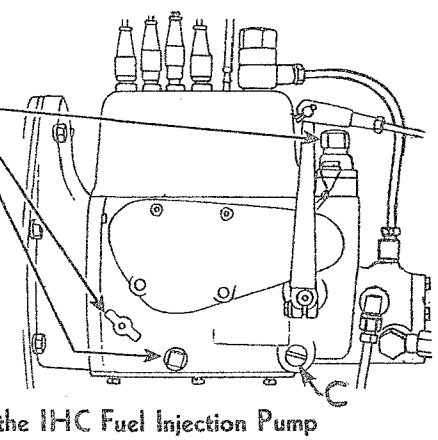
Point of Lubrication — Lubricant — Hours

IHC fuel injection pump

Lubricating oil filler
Oil level cock
Oil drain plug

Open oil level cock; if no oil appears, bring up to the level cock with grade of oil specified in "KEY" above. OE 10

Remove oil drain plug and drain pump housing; refill to the level cock with grade of oil specified in "KEY" above. OE 100



Lubrication Points of the IHC Fuel Injection Pump

NOTE C—Fuel Pump Scavenger Valve

If excessive diesel fuel flows out when oil level cock is opened, remove plug (C) and clean the scavenger valve parts as shown on page 57. (Always install a new rubber seal, IHC part no. 65029-D.)

See page 47 for fuel injection pump repair part number and data.

Notice: See separate Manual No. 472-A for gas engine.

KEY TO SPECIFICATIONS OF LUBRICANTS

OE (Oil, engine)—SAE-30, SAE-20, SAE-10, 10-W, according to anticipated air temperature.
CG (Pressure-gun grease)—All temperatures.

APPLICATION	CAPACITY	ANTICIPATED AIR TEMPERATURE			
		Above 90°F	90°F to 32°F	32°F to 10°F	10°F to Sub-zero
Crankcase	18 quarts	SAE-30	SAE-20	SAE-10	10-W
Air cleaner	5½ pints	SAE-30	SAE-20	SAE-10	10-W
Magneto distributor bearing		SAE-10 or very light electric motor oil	SAE-10 or very light electric motor oil	SAE-10 or very light electric motor oil	SAE-10 or very light electric motor oil
Magneto impulse coupling		SAE-10 or very light electric motor oil	SAE-10 or very light electric motor oil	SAE-10 or very light electric motor oil	KEROSENE

Point of Lubrication — Lubricant — Hours

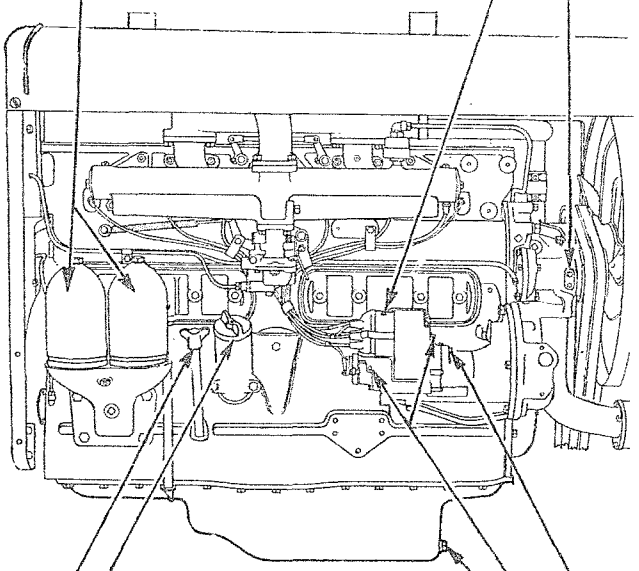
Air cleaner . . . . . OE 10
Clean and refill the oil cup to the oil level bead with the grade of oil specified in "KEY" above. (Also see page 54.)

Lubricating oil filters . . . . . .
Renew the oil filter elements at the same time the engine crankcase oil is changed. (See pages 52D and 53.)

Hours — Lubricant — Point of Lubrication

480 OE **Magneto distributor bearing**
Fill the oil cup with the grade of oil specified in the "KEY" above. (See pages 68A and B for complete magneto lubrication instructions.)

240 CG **Generator idler pulley bracket**
Remove the level plug; if no grease oozes out, apply the pressure gun until grease appears.



Point of Lubrication — Lubricant — Hours

Oil level gauge 10
Check the oil level with the gauge; add oil to bring level to the "FULL" mark. Refer to the "KEY" above for the proper grade of oil to be used. (Also see "NOTE B" below.)

Crankcase filler . . . . . OE 10

Point of Lubrication — Lubricant

Crankcase drain . . . . . OE
Remove the crankcase oil pan drain plug and drain completely while the oil is warm. Refill to the "FULL" mark on the gauge. Refer to the "KEY" above for the proper grade of oil to be used. (Also see "NOTE B" below.) (See pages 52D and 53.)

Hours — Lubricant — Point of Lubrication

60 OE **Mag. impulse coupling**
Oil liberally with the grade of oil specified in the "KEY" above.

960 OE **Mag. rotor bearings**
Put several drops of oil in 2 oil cups. (See "KEY" for correct lubricant.)

NOTE A — Lubrication of Engine Control Linkage
Occasionally apply a few drops of engine oil to the engine speed control, compression release and other linkage.

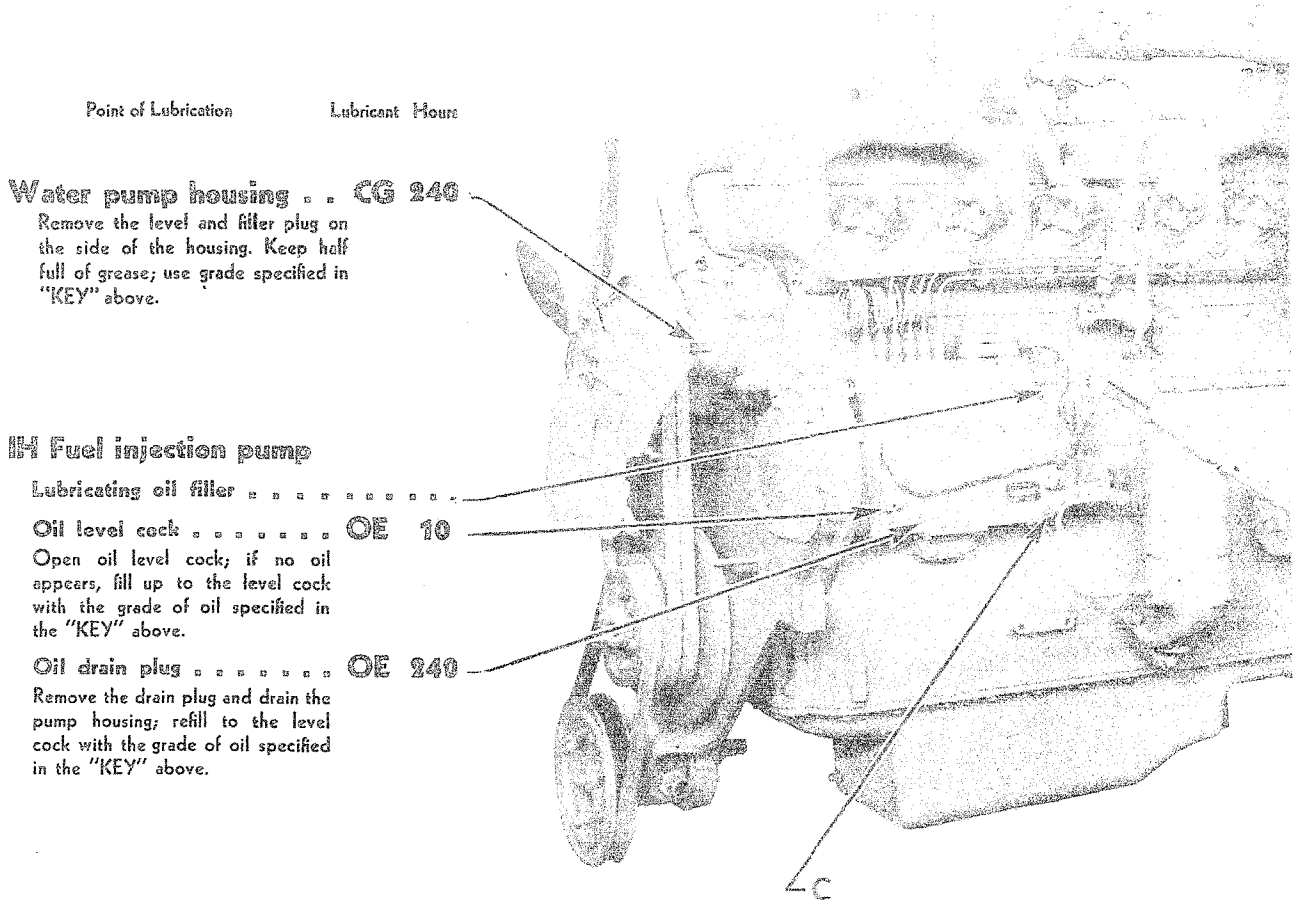
NOTE B—Checking Crankcase Oil Level with Bayonet Gauge
The bayonet type oil level gauge has readings on both sides, showing the crankcase oil level when the engine is operating and when it is stopped. Check the oil level as follows:
(1) Unscrew the wing nut, remove the gauge, and wipe it clean.
(2) Reinsert the gauge until the wing nut rests on top of the gauge sleeve threads; do not screw the nut onto the sleeve.
(3) Remove the gauge and check the oil level.

Note: See page 52B for further lubrication points.

KEY TO SPECIFICATIONS OF LUBRICANTS

OE (Oil, engine)—SAE-30, SAE-20, SAE-10, 10-W, according to anticipated air temperature.
CG (Pressure-gun grease)—All temperatures.

APPLICATION	CAPACITY	ANTICIPATED AIR TEMPERATURE			
		Above 90°F.	90°F. to 32°F.	32°F. to 10°F.	10°F. to sub-zero
IH fuel injection pump	⅞ pint	SAE-30	SAE-20	SAE-10	10-W
Water pump housing	½ pint	CG	CG	CG	CG



NOTE:

Always use clean containers. Keep the pressure gun clean. Wipe dirt from fittings before applying pressure gun.

Note C—Fuel Pump Scavenger Valve

If excessive diesel fuel flows out when oil level cock is opened, remove plug (C) and clean the scavenger valve parts as shown on pages 62A and 62B.

See page 47 for fuel injection pump repair part number and data.

Lubrication Points of the IHC Fuel Injection Pump and Water Pump Housing

54A. *HEAVY DUTY LUBRICATING OILS. (Crankcase or Engine)*

Up to 1945 automotive crankcase oils and engine oils were classified in terms of viscosity only, other factors of oil quality or characteristics not being considered. New refining methods and treatments of oils have led to an increased variety of these oils making it necessary to classify them as to type.

a. Regular Type.

This term designates motor oil generally suitable for use in internal combustion engines under moderate operating conditions.

b. Premium Type.

This term designates motor oil having the oxidation stability and bearing corrosion preventive properties necessary to make it generally suitable for use in internal combustion engines where operating conditions are more severe than regular duty.

c. Heavy Duty Type.

This term designates motor oil having the oxidation stability, bearing corrosion preventive properties, and detergent dispersant characteristics necessary to make it generally suitable for use in both high-speed diesel and gasoling engines under heavy duty service conditions.

The premium and heavy duty oils are commonly called detergent or additive oils. The increased specific output of all IHC diesel engines and the changes in post war diesel fuel composition have resulted in more stringent requirements with respect to crankcase lubricating oil performance. For this reason, IHC diesel engines when operating at sustained high load factors and/or long sustained light or no load operation, may show improved piston ring and valve life with increased engine cleanliness if heavy duty motor oils are used. These oils must meet the engine test requirements of U.S. Army specifications 2-104B or the U.S. Navy specifications 14-0-13A, better known as the 9000 series oils. These oils contain additives for the following purposes: detergent dispersive, corrosion preventive, oxidation inhibitor, extreme pressure improver, and rust preventive. The influence of high sulphur content in the present diesel fuels on lubricating oils is a new problem. Many of the present day crankcase lubricants including practically all of the regular type, many of the premium type, and some of the heavy duty oils deteriorate rapidly when brought in contact with the products of combustion from high sulphur fuels breaking down into gums, varnish, and sludge, which may eventually stick the rings and valves.

Under certain operating conditions and with some of these lubricating oils, the products of combustion form corrosive compounds which break down the oil film on the cylinder walls and rings and cause corrosive wear on these parts.

Although many of these lubricants are quite satisfactory in normal continuous operation with fuels having sulphur content below 0.5% most of them are not satisfactory when operating at reduced engine loads and temperatures common to intermittent load operation and/or with fuels having higher sulphur content than 0.5%.

A new type of heavy duty oil has been developed to work satisfactorily with diesel engine fuels having sulphur contents 0.5% to 1.0% and under extreme high load or intermittent conditions without noticeable deterioration. There are a number of these oils on the market carrying the designation of Superior All Purpose or Series #2 Heavy Duty oils and they have shown excellent performance under stringent engine and fuel requirements.

It must be understood that the use of heavy duty oils may not be required under all operating conditions with fuels having lower than 0.5% sulphur content, but benefits may be realized from their use in the more demanding operations. On the other hand better grade heavy duty or the Series #2 Heavy Duty oils may be required for satisfactory engine life with the high sulphur fuels.

Therefore, it is advisable, when using fuels with sulphur content of 0.5% or higher, to consult your supplier of crankcase lubricants and have him recommend the

proper oil. High speed diesel fuels and oils should be procured from a reliable source. Regular and premium oils are not recommended where the sulphur content of the fuel exceeds 0.5%. Heavy duty oils qualified as 2-104B are widely available in viscosity range of SAE 10, 30 and 50. Most refiners market similar oils in the SAE 20 and 40 grade. Series #2 Heavy Duty oils are not widely distributed at present but are available in SAE 10 and 30 grade.

d. Installation Procedure for Heavy Duty Oils.

(1) NEW ENGINE: No special procedure is required, when heavy duty oils are used from the start, other than to have the proper viscosity grade as specified in this instruction manual.

(2) RECONDITIONED ENGINES: The engine crankcase, oil gallery oil leads and all parts of the engine where the oil may be in contact should be thoroughly cleaned before reconditioning.

Regardless of the type of oil used it is good practice to run the engine 20 or 30 minutes after reconditioning then drain the oil and refill with fresh oil. This will remove abrasives which may be in the engine.

(3) FAIRLY NEW OR RECONDITIONED ENGINES: which have been operating on lower grade oils but are still comparatively clean should be serviced as follows:

(a) Drain old oil while engine is hot, remove filter element.

(b) Replace filter and refill engine with the proper viscosity heavy duty oil. Run for a short time (5 to 8 hours) and drain while the engine is hot.

(c) Refill crankcase, watch the oil pressure and inspect the filter. If oil pressure drops excessively drain the oil and check the pump strainer. If oil pressure remains normal drain the crankcase at 1/4 of the usual drain period and refill. Subsequent drainings will depend on service conditions and the condition of the oil.

(4) OLD ENGINES: which have been in service for a long period of time operating on lower grade oils should be thoroughly cleaned mechanically after dropping the pan. After cleaning follow the procedure for fairly new or reconditioned engines. If this is impossible it is advisable to change the oil every day and inspect filter until operating conditions are normal. However, it is urged that the pan be removed for cleaning.

(5) GENERAL: The detergent dispersant characteristics of heavy duty oils tend to keep the fuel soot and partially burned fuel and oil residues separated. These particles are non-abrasive and are so small that they will readily pass through the filter element with the oil. Consequently the conventional oil filters will not remove them. Therefore, these oils become dark in service and their useful life cannot be determined by their color.

55. LUBRICATING OIL FILTERS. (UD-14A and UD-16 Engines)

The life of your engine depends upon clean oil being circulated to all bearings. Minute particles of abrasive matter eventually accumulate in the crankcase of the engine, and lubricating oil undergoes changes which produce sludge, acids, gums, varnish, and other harmful by-products. The purpose of the oil filters is to separate and remove the dirt and other foreign substances from the oil to prevent these injurious materials from being circulated to the engine. Simple, common-sense precautions for keeping dirt and oil impurities away from precision-made engine parts will safeguard your engine against undue wear and the operating troubles and upkeep expense which are a natural result of that condition.

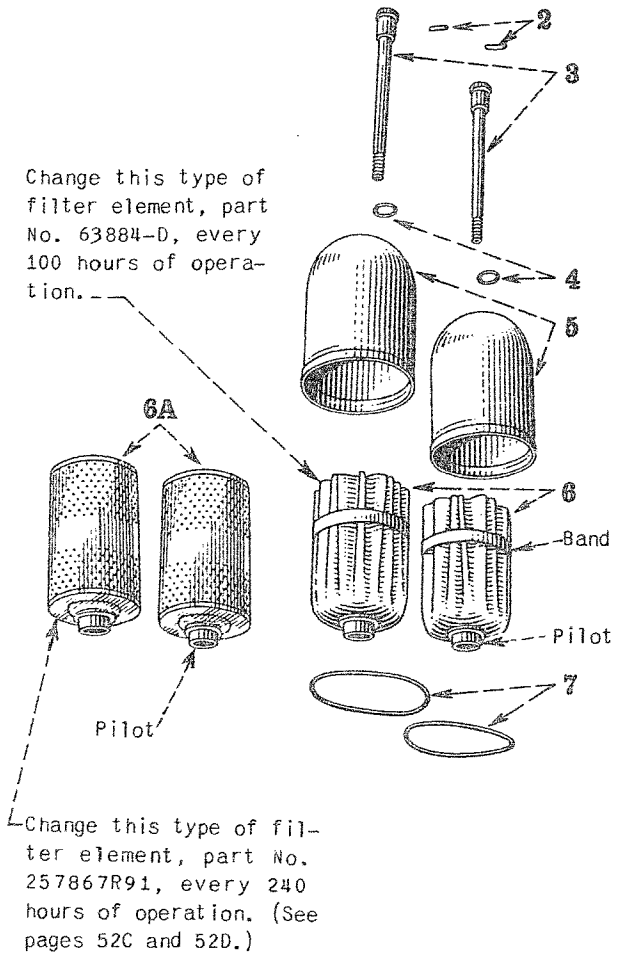
a. Oil Filter Element.

A new radial fin type lubricating oil filter element is now available for service in the UD-14A and UD-16 diesel engines, replacing the umbrella type element.

The radial fin type filter element gives more efficient oil filtering, which results in filter life being extended from 100 hours as at present to 240 hours with

the new element under normal conditions of operation. The oil change period may also be extended to 240 hours under normal operating conditions.

Shorter oil change periods (120 hours) will be required when operating under extreme dust conditions, low engine temperature, intermittent load operation with long standby periods, or under excessively heavy load conditions where high oil temperatures are the rule. The use of high sulphur content fuels (over 0.5% sulphur) with other than Series #2 Heavy Duty oils may also require the shorter change period. Refer to pages 52C and 52D on use of heavy duty oils.



Oil Filter Disassembled

(2) Retaining bar pin. (3) Retaining bar. (4) Retaining bar gasket. (5) Case. (6) Element (umbrella type). (6A) Element (radial fin type). (7) Case gasket.

b. Changing Filter Elements.

(1) Stop the engine.

(2) Remove the oil filter base drain plugs and allow the filters to drain completely.

(3) Clean off the filter cases to prevent dirt dropping into the base.

(4) Unscrew and remove the retaining bars.

(5) Lift up and remove the cases.

(6) Remove the old elements.

(7) Wipe out the base and cases with a cloth dampened with kerosene.

(8) See that the case gaskets are in position.

(9) Install the drain plugs in the filter bases and install the new filter elements. (The pilots must be down.)

(10) Replace the cases and carefully insert the retaining bars and draw up tight.

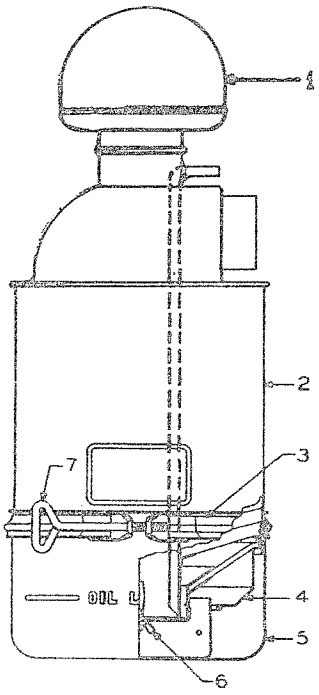
> CAUTION: Do not drive or force the retaining bars thru the oil seals, but carefully screw the bars thru the seals and into the base threads. Before tightening the retaining bars, the cases should be turned slightly on the gaskets to assist in properly seating the cases; then tighten the retaining bars securely.

(11) Check the oil level in the crankcase to see that the oil is up to the proper level. Refer to lubrication chart on page 52 or 52A.

(12) Start the engine and see that the oil pressure indicator is registering pressure.

(13) Inspect the filters for oil leaks.

NOTE: To avoid delays, you should carry extra elements (also gaskets) on hand for replacement at the proper time. Cleaning the old elements is not satisfactory.



56. *AIR CLEANER.*

a. General.

Clean air for combustion is assured by an oil type air cleaner. A heavy screen in the air intake cap (1) prevents large particles from entering the air cleaner. The air then passed to the oil cup (5) where it goes thru a bath of oil. As the air rises to the intake manifold it passes thru a series of oil-bathed screens and the fine dust is removed. As the oil from the screens works back down, it carries the dirt with it and the dirt settles in the oil cup.

b. Refilling Oil Cup.

Loosen clamp screw (7) and remove the cup (5). Then loosen the two wing nuts (6) and turn the tray (4) to the left and lower it for cleaning purposes.

Clean and refill the oil cup every day, or after every ten hours of operation (more frequently when operating under dusty conditions). Refill the oil cup (5) to the oil level bead (capacity 5-1/2 U.S. pints) with the grade of oil specified on page 52 or 52A.

Before replacing the oil cup, clean or wipe any oil or grit from the top bead of the oil cup, oil cup retaining clamp, and the surface under the clamp, to prevent dust or dirt from entering the air cleaner at this point.

c. Washing the Cleaner.

(1) After every sixty hours operation, particularly if operating the engine in an atmosphere heavily laden with dust, chaff, or lint, remove the entire air cleaner from the engine, completely disassemble it, and wash the parts thoroly in kerosene.

(2) Be sure to clean out the air intake pipe.

(3) After all the parts have been thoroly cleaned, replace the air cleaner body on the power unit. Make sure all joints are air-tight.

(4) Replace the air intake cap.

(5) Fill the oil cup (5) to the proper level with the specified grade of oil and replace it on the air cleaner. Be sure it is held securely in place by the cup clamp.

d. Air Intake Cap and Screen.

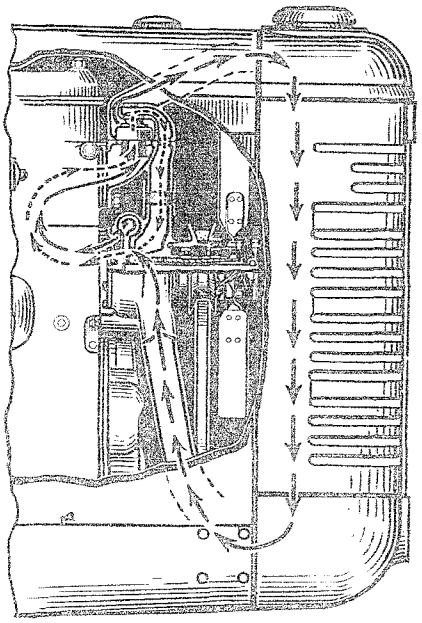
The screen in the air intake cap (1) prevents chaff and other coarse dirt from getting into the air cleaner. This screen should be kept clean and free from all chaff, oil, dust, or paint, as clogged holes in the screen will reduce the power of the engine by restricting the flow of air.

e. General Precautions.

As an added precaution against dirt getting into the engine, frequently inspect the flexible rubber hose connection between the air cleaner and the air cleaner pipe. If it shows any sign of deterioration, replace it. Inspect the air cleaner hose clamps periodically, keeping them in place and drawn up tight.

To eliminate strain on the rubber hose connections be sure the pipes line up.

All joints between the air cleaner and the carburetor, and between the manifold and the cylinders of the engine, should be tight. All gaskets must be in good condition and the bolts should be drawn up tight.



57. *COOLING SYSTEM.*

a. Operation.

The cooling system automatically maintains the most desirable engine temperature under normal operating conditions.

When the engine is started cold, a thermostat of by-pass type prevents circulation to the radiator and allows the coolant to circulate only thru the cylinder head and around the cylinders of the engine, as indicated by the dotted arrow lines shown in photo above. When an efficient operating temperature has been reached, the thermostat is wide open and the by-pass is closed, allowing the coolant to circulate thru the engine block, cylinder head, and radiator, as indicated by the solid arrow lines.

b. Rust Prevention.

Suitable treatment of the water for corrosion prevention will reduce rusting of iron at least 95%. Rust inhibitors for the cooling system are inexpensive and simple to use and should be used in the proportions recommended by their manufacturers. Starting with the system clean, fill it nearly full with fresh water and add the recommended dosage; then operate the engine until it reaches operating temperature, when the thermostat will open and establish circulation thru the radiator and engine block for complete mixing.

Where anti-freeze has been used, drain the solution after freezing weather is past. Flush the system thoroly and clean if necessary. Then install a fresh filling of summer rust inhibitor and water.

In a system that was clean originally, the appearance of rust in the radiator or in solution is an indication the inhibitor is weakened, in which case the solution should be drained, the system flushed, and a fresh filling installed.

c. Cleaning Out Dirt and Sludge.

Open the drains in the bottom of the radiator and in the left side of the crankcase. Allow the system to drain. Close the drains. Fill the cooling system with a solution of six pounds of ordinary washing soda mixed with approximately fourteen U.S. gallons of water.

Leave off the radiator filler cap and operate the engine until the water is hot. Then drain and flush with clean water.

d. Filling Cooling System.

Close the drains in the bottom of the radiator and in the left side of the crankcase.

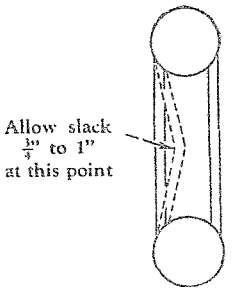
Filling the radiator with water to a level slightly below the bottom of the filler neck will allow for expansion of the coolant under normal operating conditions. Soft, or rain water is recommended as it does not contain alkali which forms scale and eventually clogs the passages.

If the power unit is to be operated in freezing temperatures, refer to "Cold Weather Operation", page 69, paragraph 81.f.

If the engine becomes overheated, refer to "Operating Precautions", page 70, paragraph 82.

e. Radiator Core.

Overheating is often caused by bent or clogged radiator fins. If the spaces between the fins become clogged, clean them with an air or water hose. When straightening bent fins be careful not to injure the tubes or break the bond between the fins and tubes.



Correct Fan Belt Tension

58. FAN BELT TENSION. (UD-14A Engine)

The slack of the fan belt should be checked frequently to assure correct tension. Tension can be determined by depressing the belt with your thumb. If the slack is more than 1 inch, or less than 3/4 inch, adjust as described below.

a. Fan Belt Adjustment.

The tension of the fan belt is adjusted by changing the width of the groove in the fan pulley. Loosen the set screw in the pulley flange, then screw the pulley flange in toward the belt to tighten the belt, or out to loosen it. Retighten the set screw after the correct tension is obtained. After a new belt has been in use approximately sixty hours, check the tension and readjust if necessary.

The belt should at no time contact the bottom of the pulley groove because this will wear it out rapidly. Adjust the pulley for a narrower groove if this is possible without increasing the tension more than allowable. Having "V" belts tighter than the tension specified will result in rapid wear.

b. Fan Belt Removal.

(1) Pull out the "coil-to-distributor" cable from the magneto coil cover end to eliminate any possibility of accidental starting of the engine.

(2) Loosen the lock nut and set screw in the flange on the fan pulley.

(3) Unscrew the flange as far as possible.

(4) Start the belt over the outer flange of the lower pulley by prying out with a light bar.

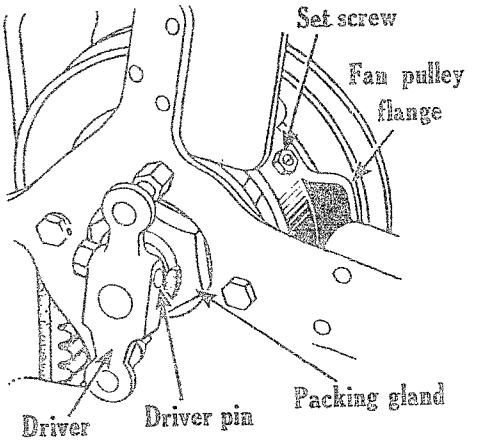
(5) Crank the engine slowly and the belt will work off the pulley.

(6) Remove the starting crank.

(7) Work the belt over the top of the fan blades.

c. Fan Belt Replacement.

The fan belt should be replaced when it becomes soaked with grease or when it is so badly worn that it does not drive the fan at the proper speed. Reverse the procedure for removing the belt. The belt can be started on the lower pulley by hand and slow cranking will run it into position.



59. REPLACING WATER PUMP PACKING. (UD-14A Engine)

If the pump packing leaks, tighten the packing gland just enough to stop the leaking. If tightening the packing gland does not stop the leaking, install new packing as follows:

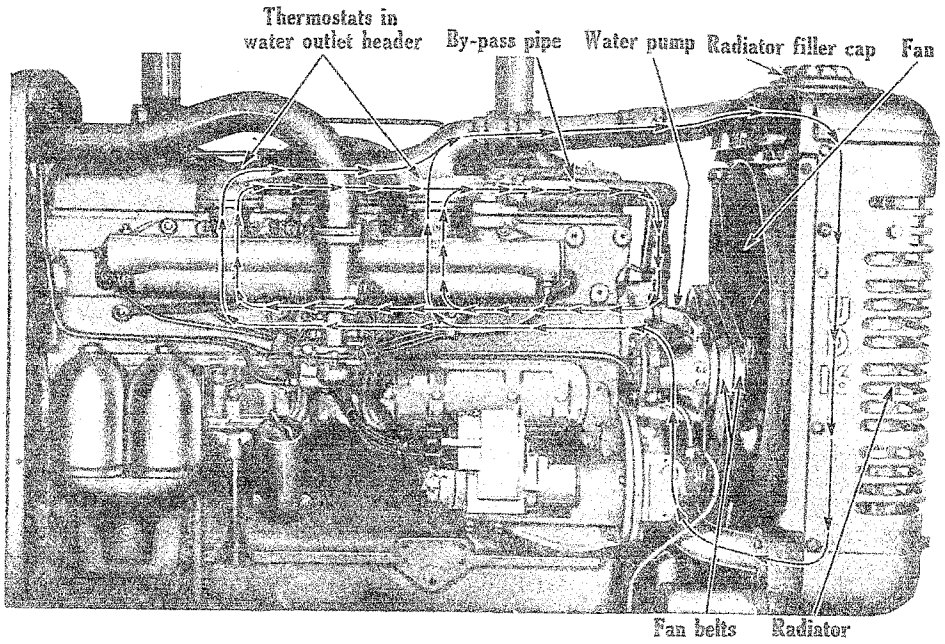
(1) Remove the driver pin.

(2) Remove the driver.

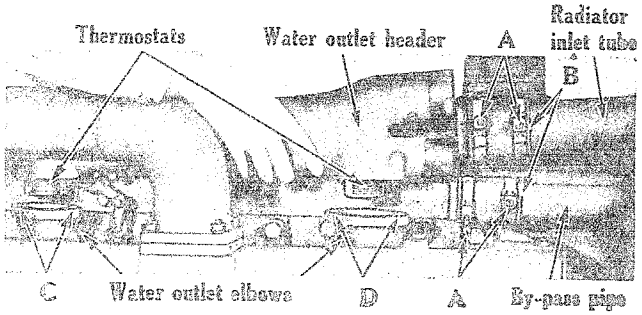
(3) Unscrew and remove the packing gland.

(4) Remove the old packing and place the new packing around the shaft.

(5) Reassemble the packing gland, the driver, and the driver pin. Tighten the packing gland just enough to prevent leaking.



Principal Parts of the UD-16 Engine Cooling System, And Part of Circulation of Coolant in System



Removing the UD-16 Engine Thermostats

59A. THERMOSTATS. (UD-16 Engine)

a. Removal.

(1) Remove the engine hood.

(2) Drain the cooling system. (Refer to page 55, paragraph 57.-c).

(3) Loosen four clamps (A).

(4) Pry the hoses loose and move them forward onto pipes (B).

(5) Remove two bolts each from (C) and (D).

(6) Lift off the water outlet header and gaskets, and remove the thermostats.

b. Installation.

(1) Install the thermostats in their original positions in the water outlet header.

(2) Apply sealer to the gasket surfaces of the water outlet elbows and the water outlet header.

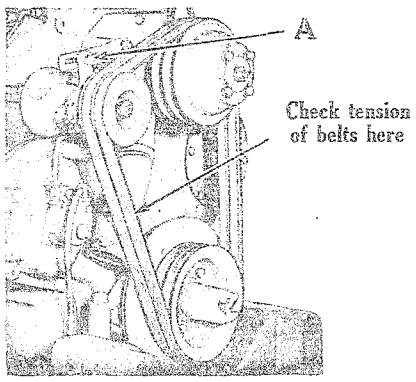
(3) Position the gaskets and water outlet header on the water outlet elbows.

(4) Install and tighten the four cap screws at (C) and (D).

(5) Position the hoses and tighten clamps (A).

(6) Fill the cooling system as described on page 55, paragraph 57.-d.

(7) Install the engine hood.



Adjusting the UD-16 Engine Fan Belts

59B. FAN BELTS. (UD-16 Engine)

a. Adjustment.

To adjust, loosen the nut (A) on the

fan idler pulley bracket. Push the idler pulley toward the water pump to loosen the belts, and pull the idler pulley away from the water pump to tighten the belts. After adjusting the belts to the correct tension, tighten the nut. Also check that the other nuts holding the bracket in place are tight.

After new belts have been in use approximately 60 hours, check the tension and adjust if necessary. Having a "V" belt tighter than the tension specified results in rapid water.

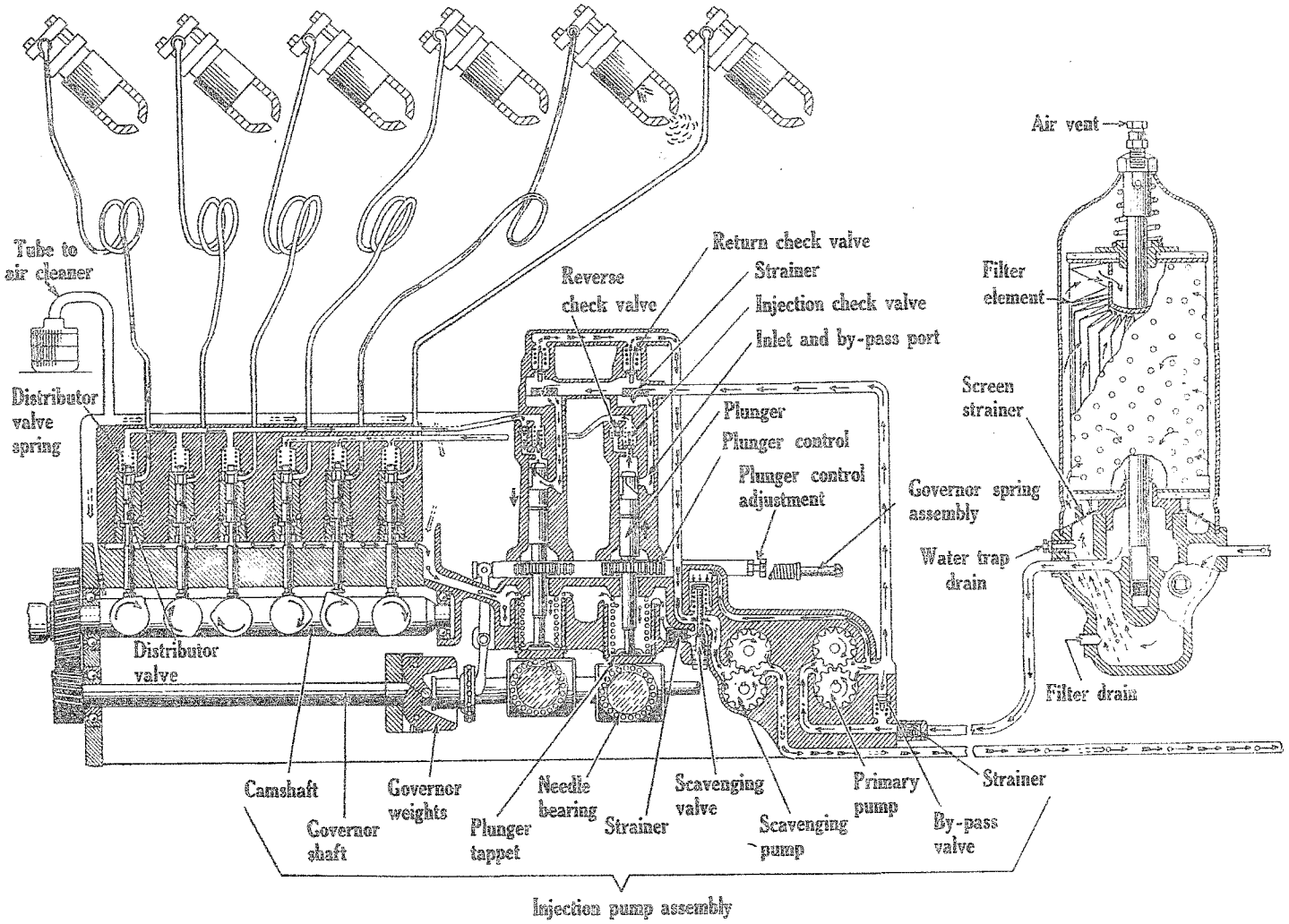
b. Removal.

To remove the fan belts, pull the starting crank out to allow clearance for the belts. Loosen nut (A) on the idler pulley, slack the belts and slip them over the fan drive pulleys and fan blades.

c. Replacement.

Replace the fan belts when they become soaked with grease, or when so badly worn that they do not drive the fan at the proper speed. When old belts become worn, replace them with a pair of new belts.

When replacing the belts, reverse the procedure outlined under "Removal", paragraph 59B.-b.

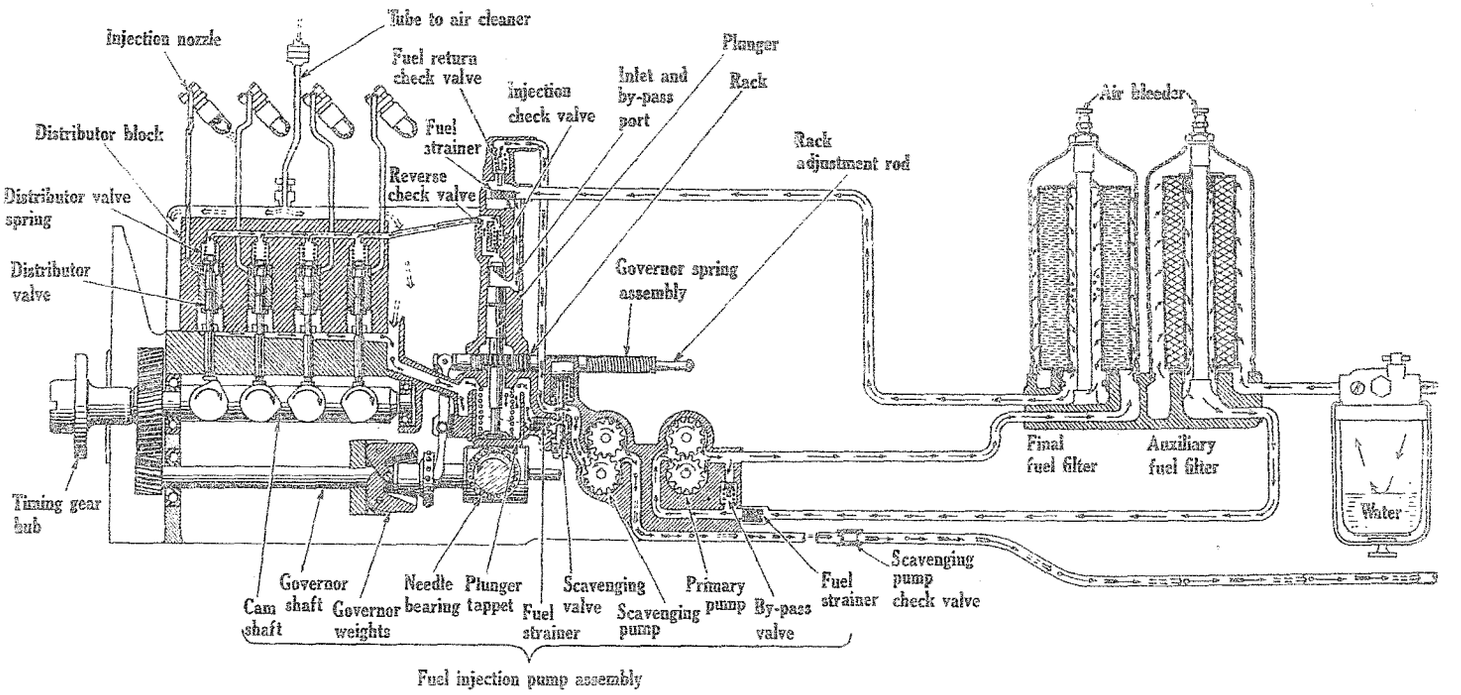


Key to flow of fuel in system

- Low pressure fuel to injection plunger
- By-pass fuel from plunger through scavenging pump
- High pressure fuel
- Leakage fuel, if any
- Reversed fuel
- Water
- Air from air cleaner

NOTE: NEW DUAL FILTERS AND WATER TRAP ARE SIMILAR TO THOSE AS SHOWN ON PAGE 57. (SEE PAGE 59.)

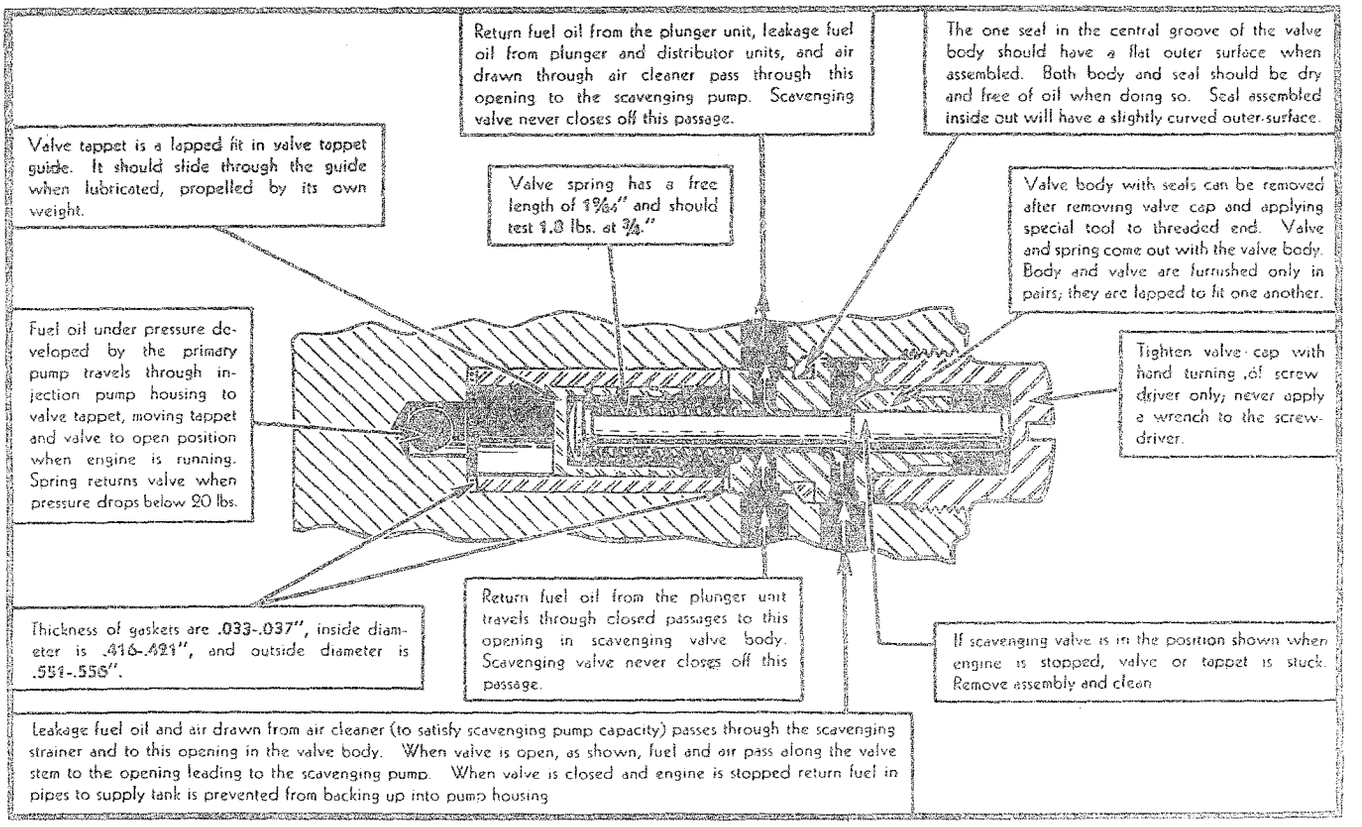
Schematic Drawing of Diesel Fuel System
(For UD-16 Engines Equipped With IHC Twin-Plunger Injection Pumps)



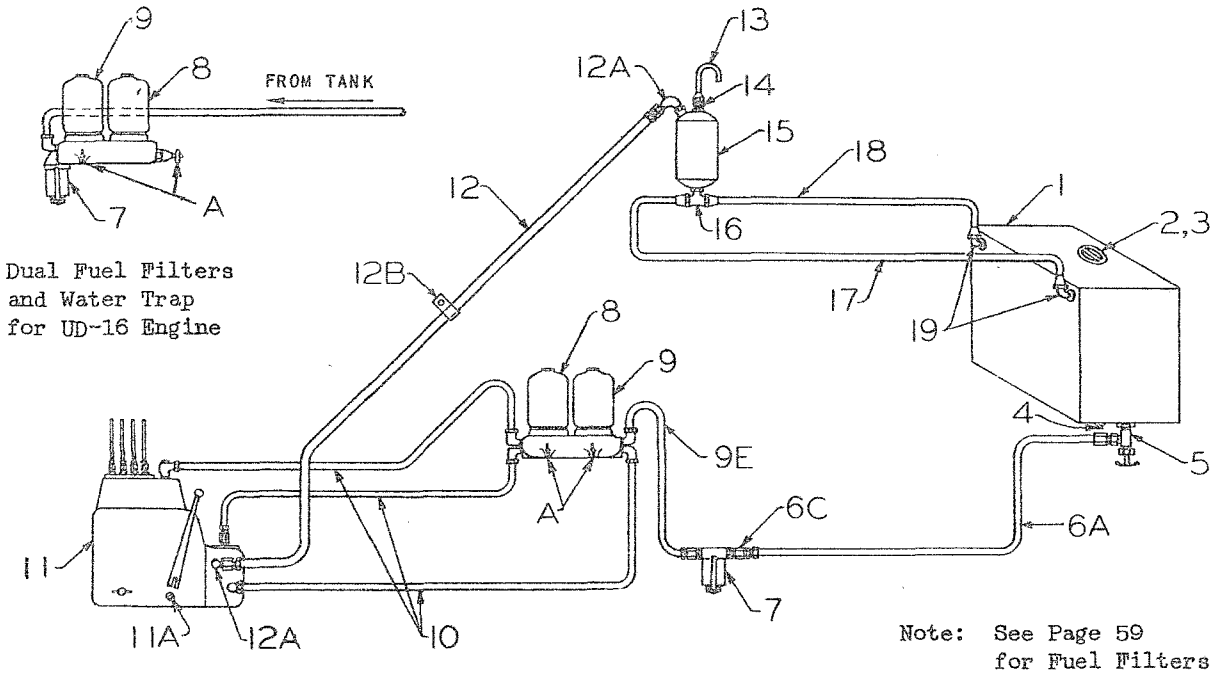
Key to flow of fuel in system

- Low pressure fuel to injection pump
- By-pass fuel from plunger through scavenging pump
- High pressure fuel
- Leakage fuel, if any
- Clean air from engine air cleaner
- Reversed fuel
- Water

Schematic Drawing of Diesel Fuel System (UD-14A Engine)



Cleaning the Scavenging Valve



6o. IHC INJECTION PUMP AND FUEL SYSTEM. (UD-14A and UD-16 Engines)

The fuel flows from the tank (1) to the fuel filter (9). It passes thru a water trap and a replaceable filter element. The fuel then enters the primary pump thru a replaceable close mesh strainer, and is forced under pressure thru the filter (8) into a reservoir above the plunger in the injection pump. Excess fuel from the primary pump is released by a by-pass valve for recirculation thru the primary pump.

From the injection pump reservoir, the fuel is then forced, by the plunger, thru the distributor valve and fuel lines to the injection nozzles and into the combustion chambers of the engine.

a. Water Trap.

Proper servicing of the diesel fuel water trap is of vital importance. If the fuel filter becomes waterlogged, the fuel will not flow freely. The water trap and drain cocks (A) should be drained every ten hours of operation, or more frequently if excessive water is found.

b. Diesel Fuel Storage and Care.

Dirt and water in diesel fuel affect the life of the filters. If dirt is allowed to reach the injection pump, it will act as an abrasive on the closely fitted moving parts, causing rapid wear and shortening the normal life of the pump. Water that is allowed to pass thru the pump may cause corrosion and subsequent scoring of parts.

A storage tank provides the best method of storing diesel fuel. The sediment and water can easily be drained off thru a trap and the fuel can be pumped into the unit with a minimum of handling.

When conditions require the use of drums for storage it is advisable to use a pump to draw the fuel rather than a faucet, as the water and foreign material settle to the bottom of the drum. The suction pipe of the pump should be at least three inches from the bottom of the storage tank or drum.

Drums should be placed under cover or in a horizontal position if left exposed to rain. It is advisable not to disturb the drums after the fuel settles.

At least three inches in each drum or tank should not be used but should be collected into one container and allowed to settle. In this manner the sediment and foreign material can be separated from the fuel and disposed of with no loss of fuel.

Gravity	30 A.P.I. minimum
Flash Point	125°F. minimum, or legal
Pour Point	10°F. lower than minimum anticipated temperature.
Cloud Point	Preferably not more than 10°F. higher than pour point.
Water and Sediment	None
Carbon Residue (on 10% residuum)	0.25% maximum
Ash (by weight)	0.02% maximum
Distillation:	
Initial Boiling Point	325°F. minimum
50% Boiling Point	475°F. minimum
End Boiling Point	610°F. minimum
End Boiling Point	725°F. maximum
Sulphur (by weight)	0.5% maximum
Cetane Number	40 minimum
Copper Strip Corrosion	Pass
Color	3 N.P.A. maximum

The best guide for the engine operator, in selecting fuels for use in his diesel engine, is a set of fuel specifications prepared and recommended by the builders of his engine.

These specifications should permit the operator to select fuels, which will give satisfactory performance in his engine, from the most available stocks of fuel oils.

If the specifications are too restrictive, the availability may be limited and the price high.

On the other hand, too broad a specification may permit the use of a fuel which, though low in price, may lead to frequent overhauls because of poor operation.

Most refiners are now marketing fuel oils designated as diesel fuels to distinguish them from burner and heater oils.

Although similar to the burner fuels, the diesel fuels are usually made from the straight run distillates, while the burner fuels may contain sufficient quantities of the lower ignition quality catalytic cracked distillates to make them unsuitable for satisfactory diesel engine operation.

Some refiners are marketing one grade of fuel for both diesel and burner application.

Many of these fuels can be safely used in IH engines.

However, the quality and suitability of these fuels for IH diesel engines are definitely the responsibility of the supplier.

Diesel fuels for high speed diesel engines are now defined in the United States by the ASTM tentative Diesel Fuel Specification D-975-50T.

Two grades of fuel, namely #1-D and #2-D, are designated for high speed diesel engines in the ASTM specification.

The #1-D fuels are designated as light fuels and #2-D as the heavier fuels.

The ASTM #2-D grade of diesel fuels will give the most satisfactory performance in IH diesel engines when the physical properties are within the limits shown in the preceding table.

When fuels conforming to ASTM #2-D specifications, as shown in table, are not available, the ASTM #1-D (lighter) fuels

may be used.

However, the operator should be advised that the lighter fuels have lower heat content and lower viscosity. Their use may result in loss of power and/or increased fuel consumption, and may result in considerable reduction in injection pump life.

The #1-D fuels may be required in subzero weather where low pour points are essential to maintain pumpability.

Fuels lighter than kerosene will not give satisfactory performance in IH engines.

From time to time, requests from the field for comparatively narrow fuel specifications for IH diesel engines have been received.

Restrictive specifications would definitely reduce the availability and increase the cost because of the complex chemical nature of diesel fuels.

Some fuels meet the ASTM specifications but, because of their composition, will not give satisfactory wear and freedom from deposit forming characteristics in IH engines without assistance from high additive heavy duty type lubricating oils.

Complete knowledge of the characteristics of the fuels marketed in your area, and the types of crankcase oils required for satisfactory performance with them, will avoid service problems (see note on sulphur).

a. Description of Fuel Properties.

Following are some of the fuel characteristics which directly influence the performance and economy of IH diesel engines.

b. A.P.I. Gravity.

Gravity indicates the weight per gallon of a fuel oil. The A.P.I. gravity scale is a special arbitrary scale set up by the American Petroleum Institute and is standard for the petroleum industry in the United States. The heat content of a fuel is related to its weight per gallon.

The following table shows the relationship between the A.P.I. gravity, the weight of the fuel (lb./gal.), and the heat content (B.t.u./gal.) for the whole range of fuels from kerosene to the maximum end point of diesel fuel permitted in this specification (see table following).

The heat content of a fuel is a measure of the available power in it. The table covers practically the whole gravity range of the ASTM #1-D and #2-D fuels.

Note that the heat content of the heaviest #2-D fuels (A.P.I. 30) is 7.2% greater than the lightest #1-D fuels (kerosene).

Factory setting of IH diesel engine fuel pumps is made on 35 A.P.I. gravity fuels. This is near the center of the gravity range.

Relationship of Specific Weight and Heat Content to A.P.I. Gravity

A.P.I.	LB./GAL.	B.T.U./GAL.	
30	7.29	141,800	
31	7.25	141,200	
32	7.20	140,600	
33	7.16	140,000	
34	7.12	139,400	
35	7.07	138.800	(IH engines set at factory on this fuel
36	7.03	138,200	
37	6.99	137,600	
38	6.95	137,000	
39	6.91	136,400	
40	6.87	135,800	
41	6.83	135,200	
42	6.79	134,700	
43	6.75	134,100	
44	6.71	133,500	Kerosene type fuels
45	6.67	132,900	
46	6.64	132,300	

c. Flash Point.

The flash point is not directly re-

lated to engine performance, but is specified to meet insurance and fire regulations.

The flash point defines the temperature at which the fuel vapor will ignite when in contact with open flame.

d. Pour Point.

The pour point is the lowest temperature at which the fuel will pour. It is interrelated with cetane number and volatility.

Low pour point fuels are usually characterized by reduced cetane number and increased volatility.

e. Cloud Point.

The cloud point in a fuel is the temperature at which wax crystals start to form in the fuel, making it cloudy. These crystals will quickly clog the fuel filters.

Ordinarily the cloud point will occur 5° to 10° F. above the pour point, but may occur 15° to 25° above, when pour point improvers are used.

High cloud points may result in plugged fuel filters at low operating temperatures.

f. Water and Sediment.

It is absolutely essential that the fuel shall be free of water, sediment and residue.

It is important that the operator shall buy clean fuel and that he keeps it clean until it is in the engine. Discourage the use of funnels, cans and drums, as it is difficult to keep them clean. Reduce to a minimum the number of times the fuel is to be handled.

Always fill the engine tank at the end of the day.

Daily draining of the water trap is recommended. Water will tend to clog the filters and if it should pass through them, it will corrode the pump plungers and other highly finished parts in the pump and nozzles, thus greatly shortening their lives.

g. Carbon Residue.

Carbon residue is useful for refinery control.

When held within the specifications shown, it will have negligible effect on engine life.

h. Distillation.

The boiling range of distillate oils from which diesel and burner fuels are made extends from approximately 325° F. to 740° F. The boiling range or fuel volatility requirements for optimum performance in diesel engines will depend on the engine type, speed, load, and operating conditions.

A minimum initial boiling point of 325° F. is recommended for IH diesel engines, to avoid blended fuels which may contain low ignition quality and low viscosity materials.

The ASTM-D-975-50T specification for #2-D fuels permits a maximum 90% boiling point of 675° F. However, to avoid extremely high boiling fractions in the fuel, the IH specification limits the maximum final boiling point to 725° F.

The ASTM #1-D and #2-D fuel specifications overlap to some extent. Therefore a minimum final boiling point of 610° F. and minimum 50% boiling point of 475° F. is specified in the IH specification to define the desirable dividing line between #1-D and #2-D fuels.

The boiling range of the #1-D fuels are clearly defined in the ASTM-D-975-50T specification and do not require further definition in the IH specifications.

i. Sulphur.

Sulphur compounds are commonly

found in diesel fuels, to a more or less extent, depending on the source of the crudes used in their manufacture.

Removal of these compounds entails considerable increase in cost.

Crankcase oils unless properly fortified with suitable additives, deteriorate rapidly when exposed to the products of combustion from high sulphur fuels and break down into gum, varnish and sludge.

The gummy varnishes and residue form on cylinder walls, pistons, piston rings, and piston ring grooves, ultimately sticking the rings.

Under certain operating conditions or with some lubricating oils, the products of combustion of high sulphur fuels form corrosive compounds which break down the oil film on cylinder walls and piston rings and cause corrosive wear on these parts.

Fuels with sulphur content not exceeding 0.4% to 0.5%, are now readily available in practically all parts of the United States. Therefore, the recommended sulphur content in this specification is 0.5% maximum.

Additive type crankcase oils are now available which will counteract the effect of sulphur and other injurious properties in the fuel. A number of oils have been developed with different additive levels to meet the requirements of different fuel sulphur contents.

Oils meeting the military MIL-O-2104 engine oil specification are recommended for all operations in IH engines where the fuel sulphur content does not exceed 0.4%.

Recommendation of the U.S. Army Specification 2-104B oils is discontinued.

Practically all oil refiners and marketers supply one or more additive type oils with higher additive content than MIL-O-2104, to be used where fuels with sulphur content up to 1.0% must be burned. Their use will result in increased engine life and is recommended.

j. Cetane Number.

The cetane number is a measure of the ignition quality of a fuel.

The ignition quality of the fuel influences ease of starting, smoothness of operation, and warm-up characteristics of the engine.

Except where cetane improvers have been added to the fuel, the cetane number is to some extent a measure of the paraffinicity of the fuel.

Since cetane value has important influence on engine performance immediately after starting and in cold weather operation, the higher cetane fuels should be used for cold operation wherever possible. When available, use the higher cetane fuels.

k. Corrosion.

The corrosion test will determine the extent the fuel will be corrosive to copper, brass, and other metals in the fuel injection system.

l. Gums and Residues.

Gum in fuel oil is very difficult to determine. Gums and residues may be due to instability of the fuel.

In many cases they do not appear in the fuel until it has been stored for some time.

Since there is no simple test that will determine the gum content or stability of the fuel, it is necessary to depend on the reliability of the supplier and a good knowledge of the type fuels he markets.

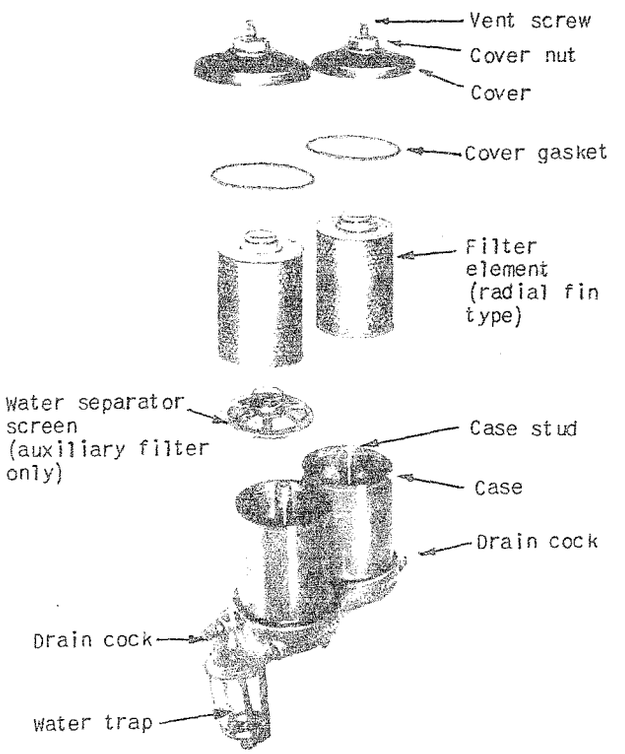
It is absolutely essential that the fuel be free of water, sediment and residue. It is important that the operator buy clean fuel and that he keeps it clean until it is in the engine. Discourage the use of funnels, cans and drums as it is difficult to keep them clean. Reduce the number of times the fuel is to be handled to a minimum.

Always fill the engine tank at the end of the day.

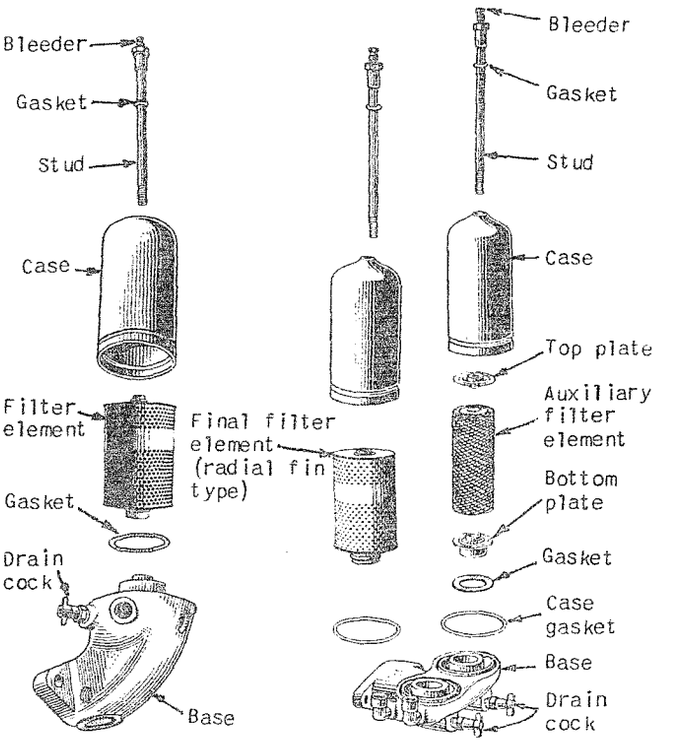
Daily draining of the water trap is recommended. These rules followed will pay dividends. Water will tend to clog the filters and if it should pass through them it will corrode the pump plungers and other highly finished parts in the pump and nozzles, thus greatly shortening their lives.

DO NOT USE DIRTY FUELS. Water, sediment, or gum in the diesel fuel may cause difficulties in engine operation such as clogging of filters, deposits on valve stems, piston rings and nozzles, varnish formation on fuel pump plungers, nozzles, valves and pistons, and may result in costly shut-downs.

NOTE: The supplier should be informed that the fuel is to be used for high speed diesel engines and should assume the responsibility of supplying a fuel with satisfactory ignition qualities and cleanliness.



Fuel Filters (Dual)
Used only on UD-16 engines numbered UDCM-3565 and up



Fuel Filter (Single)

Used only on UD-14A engines numbered UDFM-20001 to 27067 inclusive, also 27074 to 27080. Also UDCM-501 to 3564 inclusive for UD-16 engines

Fuel Filters (Dual)

Used only on UD-14A engines numbered UDFM-27068 and up, except 27074 to 27080

m. Diesel Fuel Filter.

The diesel fuel filter element cannot be cleaned and should not be disturbed except when necessary to replace it. The life of the element depends upon the amount of dirt, water and sediment that it must remove. Therefore it is important to keep the fuel clean and free from water during storage and in handling. To replace the fuel filter element proceed as follows:

(1) Close the shut-off valve (5) page 58, on the fuel line from the tank to the filter.

(2) Clean the outside of the case and base shown in above photos thoroughly with diesel fuel or kerosene.

(3) Open the bleeder valve and remove the drain plug allowing the fuel to drain.

(4) Unscrew the stud and lift the case and stud from the base with the top plate and spring remaining on the stud. Check the plate for tightness on the stud and rotate until it moves freely. (If removing or installing the top plate on the stud, turn the threaded portion of the stud thru the seal ring to avoid damage.)

(5) Remove the filter element and screen. (Check and clean the screen whenever the element is replaced.)

(6) Install the filter screen as shown.

(7) Place the new filter element on the base.

(8) Install the case with the top plate, spring and stud.

(9) Insert the stud thru the element and intc the base. Be sure the boss on the top plate properly enters the element and the spring holds the plate securely to the element.

(10) Draw the case down tight by tightening the stud.

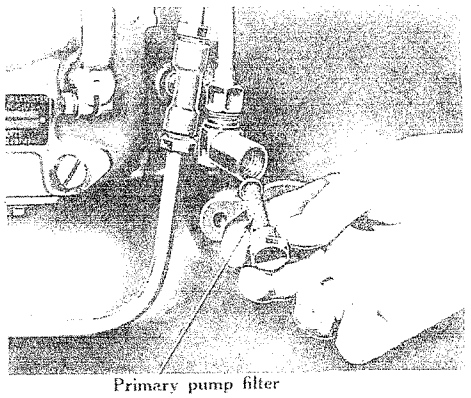
61. DIESEL FUEL INJECTION PUMP AND GOVERNOR.

The fuel injection pump and governor are combined in a mechanism of very fine precision construction and adjustment, and will function for long periods of time under hard operating conditions if properly cared for in the matter of lubrication and servicing.

The governor is sealed at the factory and operates in a bath of oil. Its function is to maintain the engine speed selected by the operator and automatically proportion the fuel to the load.

DO NOT ATTEMPT TO ADJUST THE FUEL INJECTION PUMP OR THE GOVERNOR. In case of unsatisfactory operation of the engine, due to possible trouble in the injection pump, first check over the instructions on pages 56B to 62D for servicing the various units of the whole fuel system. After servicing the other parts of the fuel system, without overcoming the trouble, it may be necessary to replace the fuel injection pump, or refer to your Austin-Western dealer.

NOTE: See page 47 for IHC fuel injection pump repair part number, together with complete test bench calibration specifications.



Primary pump filter

62. PRIMARY PUMP FILTER.

On the IHC fuel injection pump, the primary pump filter screen should be cleaned whenever the fuel filter element is changed. Remove the nut and filter screen assembly from the primary pump filter body and wash in kerosene or clean diesel fuel. Precautions should be taken that no dirt or foreign material enters the filter body upon removal or replacement of the filter screen.

63. IRREGULAR FIRING.

The bleeder valves at the top of the injection nozzles should be opened only in case of irregular firing caused by air in the injection lines, page 63, paragraph 67; or if the engine is continuously noisy in one cylinder. Opening the bleeder valves will locate the noisy cylinder and usually indicate a faulty injector.

64. INJECTION PUMP REMOVAL. (UD-14A Engine)

To remove the fuel injection pump:

(1) Keep all parts clean. Before disconnecting any fuel pipes from the pump, first thoroly clean the pump and connections with kerosene or diesel fuel. When the pipes have been disconnected the discharge fittings and all open connections should be covered to prevent dirt from entering the system.

(2) Close the fuel shut-off valve at the tank. Drain the fuel from the diesel fuel filter. Drain the lubricating oil from the injection pump housing.

(3) Set the compression release lever in the gasoline (starting) position.

(4) Pull the "coil-to-distributor" cable from the coil cover terminal on the magneto.

(5) Disconnect all fuel pipes attached to the injection pump. Install caps on the discharge fittings and cover open connections with tape.

(6) Disconnect the engine speed control rod.

(7) Remove the cap screws which secure the pump gear cover, Fig. 64, to the crankcase front cover, then lift off the pump gear cover.

(8) Crank the engine so the chamfered tooth (D), Fig. 66, on the injection pump gear, lines up with the "DC" mark on the crankcase front cover.

CAUTION: Do not crank the engine while the injection pump is removed or it will be necessary to retime the pump to the engine.

(9) Remove the three cap screws, Fig. 65, which secure the timing indicator and pump gear to the gear hub, then lift off the timing indicator and the gear.

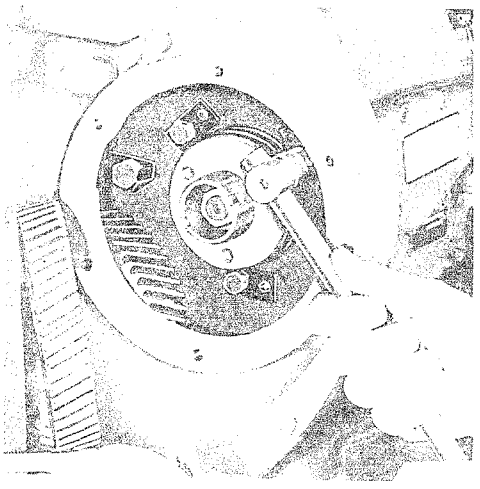


Figure 64. Cap Screws which Secure Pump to Crankcase Front Cover

(10) Remove the three cap screws, Fig. 64, which secure the pump to the crankcase front cover.

(11) Remove the two cap screws which secure the pump mounting flange to the crankcase front cover, then lift off the complete pump assembly, Fig. 65A.

65. *FUEL INJECTION PUMP REPLACEMENT. (UD-14A Engine)*

To replace the fuel injection pump:

(1) If the timing has been disturbed while the injection pump has been removed, crank the engine until the No. 1 cylinder is at top dead center of the compression stroke. This position can be determined by removing the No. 1 spark plug and placing your thumb over the opening and cranking the engine slowly until an outward pressure is felt. Continue cranking slowly until the notch marked "DC" on the front flange of the fan drive pulley is in line with the timing pointer, Fig. 66, on the crankcase front cover.

(2) Assemble a new gasket to the pump mounting flange. Lift the pump into place against the crankcase front cover, inserting the pump gear hub into the pump gear and lining up the notch in the gear hub with the notch on the front face of the gear.

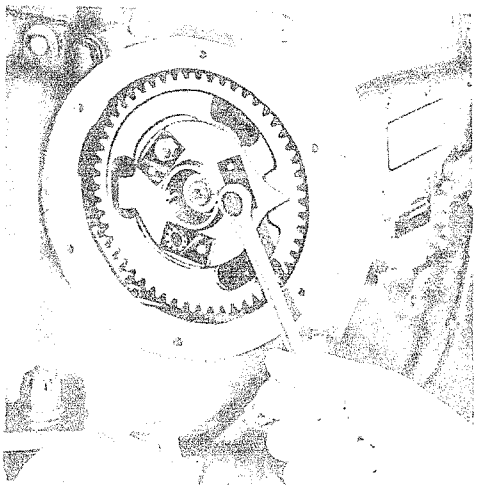


Figure 65. Cap Screws which Secure Timing Indicator and Gear to the Hub

(3) Secure the top of the pump mounting flange to the crankcase front cover with two cap screws.

(4) Assemble the injection pump gear on the gear hub (with the No. 1 cylinder at top dead center of the compression stroke) so that the chamfered tooth on the gear lines up with the "DC" mark on the crankcase front cover, Fig. 66. Under no conditions attempt to retime the engine by matching the "K" marks on the injection pump gear and the idler gear.

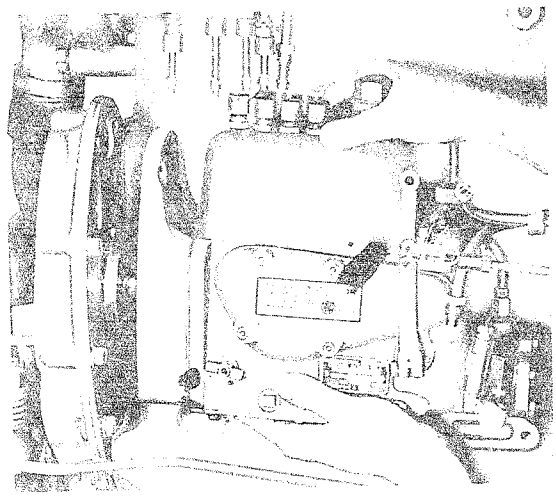


Figure 65A. Removing the Complete Fuel Injection Pump Assembly

(5) Assemble the timing indicator to the gear hub, setting the indicator at "0". Insert and tighten three cap screws which secure the indicator and the gear to the gear hub.

(6) Use hand crank to turn the engine and align three large holes in the pump gear with the cap screw holes behind the gear. Insert and tighten three cap screws which secure the pump to the crankcase front cover. (On IHC injection pumps it is important to insert the short cap screw in the lower hole.)

(7) Assemble the gear cover with a new gasket and secure it to the crankcase front cover with cap screws.

(8) Connect the engine speed control rod.

(9) Reconnect the fuel pipes. Be sure all connections are clean and tightened (one-eighth turn) as per caution instructions on page 122.

(10) Add lubricant as specified on page 52.

(11) Insert the "coil-to-distributor" cable into the terminal in the coil cover of the magneto. Set the compression release lever in the gasoline (starting) position.

(12) Start the engine on gasoline and vent the air from the entire fuel system, page 63, paragraph 67.

(13) Convert to diesel cycle and note engine operation. If engine operates rough, check and adjust timing, paragraph 66.

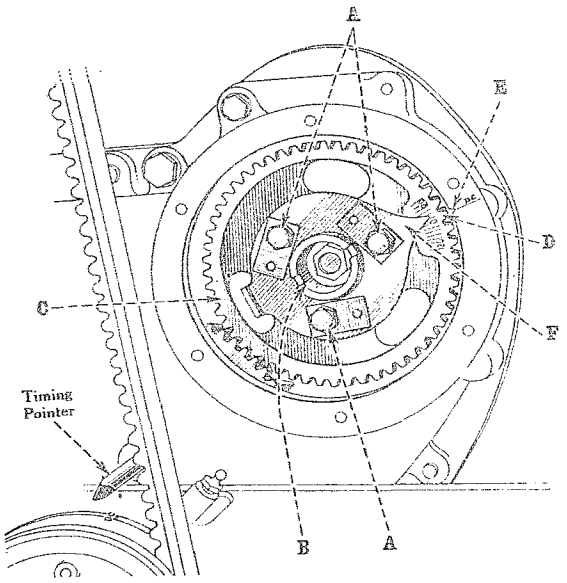


Figure 66. Timing the Fuel Injection Pump to the UD-14A Engine

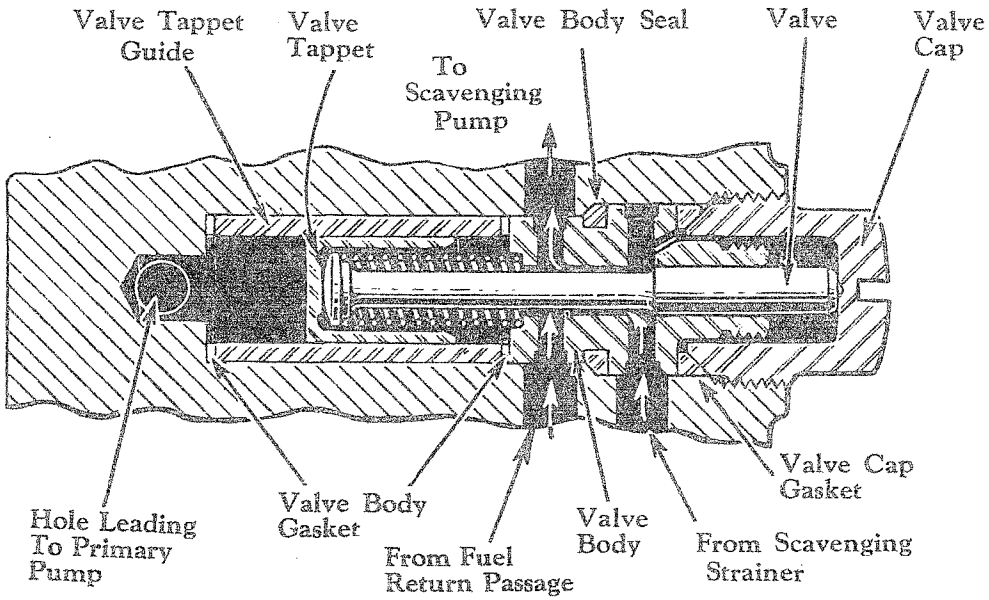
56. *FUEL INJECTION PUMP TIMING. (UD-14A Engine) (See Fig. 66)*

The timing of the fuel injection pump can be adjusted by slots in the pump driving gear where it is bolted to the gear hub, the hub being keyed to the pump shaft.

The adjustment is normally set with the timing indicator on the center mark of the graduations on the pump gear. To be sure of the best operating conditions, the indicator can be tried on either side of the center mark and set at the best operating position.

To change the location of the indicator, loosen the cap screws (A), Fig. 66, which hold the indicator and gear hub to the gear. Turn the gear hub until the indicator is at the desired position; then tighten the cap screws.

To advance the time of fuel injection turn the gear hub clockwise. To retard the injection turn the hub counter-clockwise. The correct adjustment is obtained when the engine speed is maximum for a fixed load and engine operation is smooth, with a clean exhaust.



Cross Section View of Scavenging Valve Assembly

66A. SCAVENGING VALVE UNIT. (IHC Pump)

Faulty operation of the scavenging valve unit can be detected when checking the level of lubricating oil in the sump of the injection pump. An excessive amount of thinned-out lubricating oil in the sump of the injection pump indicates that the valve is not functioning properly. Removal of the scavenging valve cap will show the end of the valve protruding beyond the threaded end of the scavenging valve body if either the valve or tappet are stuck in the open position. The valve body and tappet, with guide, will have to be removed to determine whether they are stuck in the closed position. In either case, these parts will have to be removed, cleaned and installed. Use new seals.

a. Disassembly.

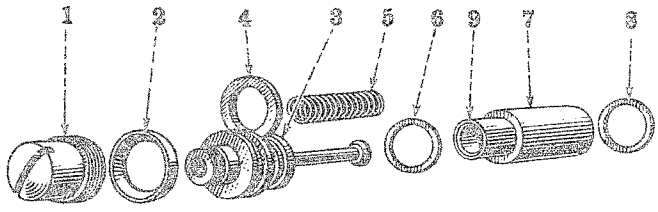
(1) The scavenging valve may be removed quickly, using a screwdriver, a service tool and a wrench. It should be removed only because of faulty operation or during a complete overhaul and general cleaning of the injection pump.

(2) Using a wide-bit screwdriver, the scavenging valve cap may be removed. It is not necessary to remove the injection pump from the engine to make repairs on this unit, but be sure that all external parts of the pump are thoroughly cleaned before proceeding.

(3) Tool SE-1330-1 is available for removing the scavenging valve body. If the tool is not handy, a 1/8 inch pipe coupling, catching one or one and one-half threads of the body, will suffice as a tool for removing the body.

(4) By using a 1/4 inch diameter brass rod, the scavenging valve tappet (9), valve tappet guide (7), and the inner valve body gasket can be withdrawn from pump housing. Tipping the pump on one side may eliminate the use of a rod to remove these parts.

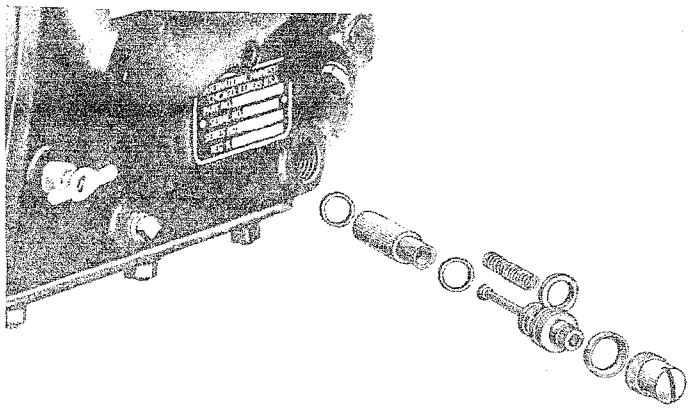
(5) Because of the lacquers and gums frequently found in diesel fuel, the valve tappet guide (7) may be stuck in the bore of the pump housing. In such cases, tool SE-1330-6 is available. A piece of round wood of the right diameter can be used if the necessary caution is used.



Scavenging Valve Disassembled

(1) Valve cap. (2) Valve body cap gasket. (3) Valve body. (4) Valve body seal. (5) Valve spring. (6) Valve body gasket. (7) Valve tappet guide. (8) Valve body gasket. (9) Valve tappet.

(6) All items of the scavenging system are now ready for cleaning, inspection, repair or replacement.



Scavenging Valve Removed from IHC Pump

66B. INSPECTION, RECONDITIONING AND REPLACEMENT OF PARTS.

(1) Before inspecting any of the parts, thoroughly clean them all, using a good solvent. The scavenging valves and valve bodies are lapped to one another, and are furnished only in pairs as service parts. The same is true of the valve tappet guide and the valve tappet.

(2) Gaskets (8) and (6) are the two tappet gaskets and are identical in size and shape. There should be no cause for replacing them unless damaged. They are held in place by the valve body which, in turn, is held in place by the valve body cap gasket and the scavenging valve cap.

(3) The scavenging valve tappet guide (7) is lapped to fit the valve tappet (9). These stainless steel parts are lapped to have a normal clearance of .0004 inch. With parts cleaned and lubricated, the tappet will slide slowly through the guide, propelled by its own weight. The tappet moves to the outside or toward the threaded end of the scavenging valve body when the primary pump starts, and is pushed back by the spring on the scavenging valve when the pump stops. With this infrequent movement, these parts should outlast the life of the pump. Once worn or damaged, they must be replaced in a pair.

(4) The scavenging valve spring has a free length of 1-9/64 inch and should test 1.8 pounds at 3/4 inch. It should seldom need replacement. If it fails to check with these specifications, it should be replaced with one that does.

(5) The scavenging valve body and the scavenging valve are lapped together in manufacture and as such are not furnished individually as service parts. With the limited movement of this valve, there should be no wear on these parts. If damaged, both valve and body should be replaced.

(6) The scavenging valve body cap gasket (2) the single seal valve body (3) and valve cap (1) should be usable many times. The gasket must hold the primary pump pressure. If the gasket is damaged from faulty installation, a new one should be used.

66C. REASSEMBLY.

(1) The scavenging valve assembly should be installed exactly as shown. First, insert a valve body gasket into the injection pump housing, followed by the well-lubricated valve tappet in the valve tappet guide and a second valve body gasket.

(2) The valve body seal (4) is not usable a second time. Any nicks in the outer surface of the seal necessitates replacement with a new seal.

(3) Next, assemble a new seal to the valve body, having both parts free of oil. Use care in assembling the seal in the center groove of the valve body which does not have holes. Be sure that the seal is right side out; a seal with the wrong side out can be recognized by the slightly hollowed out appearance of the outer surface. A properly assembled seal is flat on the outer surface. Next, insert the spring over the scavenging valve, slide the scavenging valve into the valve body, and lubricate all parts of the assembly. Carefully push the scavenging valve assembly into the injection pump housing, rotating it slightly so as not to turn over the edge of the seal. It is recommended that a new valve cap gasket be used. The valve cap gasket and valve cap can now be assembled and tightened with a screwdriver. The valve cap should be tightened only by maximum hand pressure of the screwdriver. Do not use a wrench on the screwdriver as distortion of the assembly will result.

66D. REMOVING THE IHC INJECTION PUMP. (UD-16 Engine)

To remove the fuel injection pump, proceed as follows:

(1) KEEP ALL PARTS CLEAN. Before disconnecting the fuel pipe or fuel hose from the pump, first thoroughly clean the pump and connections with kerosene or Diesel fuel. When the pipe and fuel hose have been disconnected, the discharge

fittings and all open connections should be covered to prevent dirt from entering the fuel system.

(2) Close the shut-off valve on the fuel line between the fuel tank and the fuel filter. Drain the fuel from the fuel filter. Drain the lubricating oil from the injection pump housing.

(3) Set the compression release lever in the gasoline starting position.

(4) Before removing the injection pump, ground the magneto by fastening a wire to the ground terminal. This will eliminate any danger of starting the engine accidentally.

(5) Disconnect all fuel pipes attached to the injection pump. Install caps on the discharge fittings, and cover all open connections with tape to prevent dust and dirt from entering the fuel system.

(6) Disconnect the engine speed control rod.

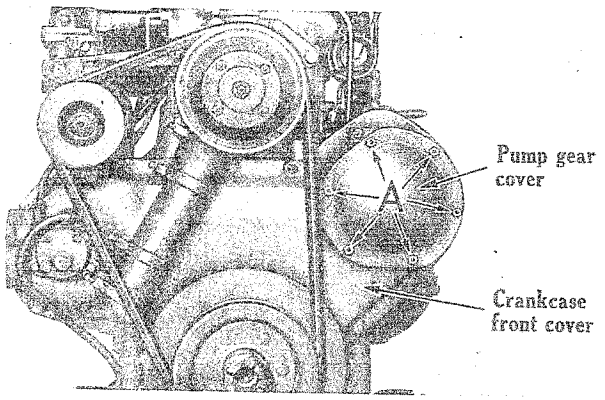


Figure 66D. Cap Screws Holding Pump Gear Cover to Crankcase Front Cover (UD-16 Eng.)

(7) Remove the six cap screws (A), Fig. 66D, which secure the pump gear cover to the crankcase front cover; then lift off the pump gear cover.

(8) Remove three cap screws (A), Fig. 66F, which secure the timing indicator (F) and pump gear (C) to the gear hub (B); then lift off the timing indicator.

(9) Through holes in the pump gear, remove three cap screws (A), Fig. 66E, which secure the pump mounting flange to the crankcase front plate.

(10) Remove two cap screws which secure the pump mounting flange to the crankcase cover.

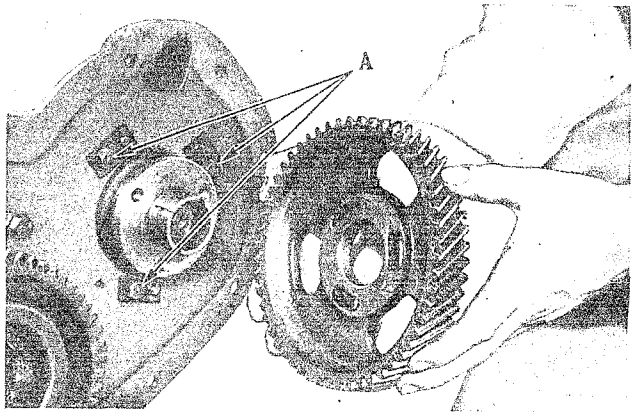


Figure 66E. Cap Screws Holding Pump Mounting Flange to Crankcase Front Plate (UD-16 Engine)

(11) Remove 2 cap screws which attach the bracket to the injection pump base. Lift off the complete pump assembly.

66E. INSTALLING THE IHC INJECTION PUMP. (UD-16 Engine)

(1) Crank the engine until the No. 1 cylinder is at top dead center of the compression stroke. This position can be determined by removing the spark plug, placing a thumb over the opening, and cranking the engine until an outward pressure can be felt by the thumb. Continue cranking slowly until the notch marked (DC) on the damper, Fig. 66F, is in line with the timing pointer in the front crankcase cover.

(2) The pump drive gear cannot be removed through the opening in the front cover, and cannot fall out of mesh with the idler gear. This gear should be supported so it can turn without binding in the gear case during installation.

(3) Assemble a new gasket to the pump mounting flange. Lift the pump into place against the crankcase front cover, inserting the pump gear hub into the pump gear and lining up the notch in the gear hub with the notch on the front face of the gear.

(4) Secure the top of the pump mounting flange to the crankcase front cover with two cap screws. Secure the base to the bracket with two cap screws.

(5) Assemble the timing indicator to the gear hub. Tighten three cap screws which secure the indicator and the gear to the gear hub.

(6) Use a hand crank to turn the engine, and align three large holes in the pump gear with the cap screw holes behind

the gear. Insert and tighten three cap screws which secure the pump to the crankcase front plate. It is important to insert the short cap screw in the lower hole.

(7) Assemble the gear cover with a new gasket and secure it to the crankcase front cover with six cap screws.

(8) Connect the engine speed control rod.

(9) Connect the fuel pipe and fuel hose. Be sure all connections are clean and tight.

(10) Add lubricant as specified on page 52B.

(11) Remove the grounding wire from the ground terminal on the magneto. Set the compression release lever in the gasoline starting position.

(12) Start the engine on gasoline, and vent the air from the entire fuel system. Refer to "Venting Air From Fuel System" on page 63, paragraph 67.

(13) Convert the engine to the diesel cycle, and note the engine operation. If the engine operates rough, check and adjust the timing.

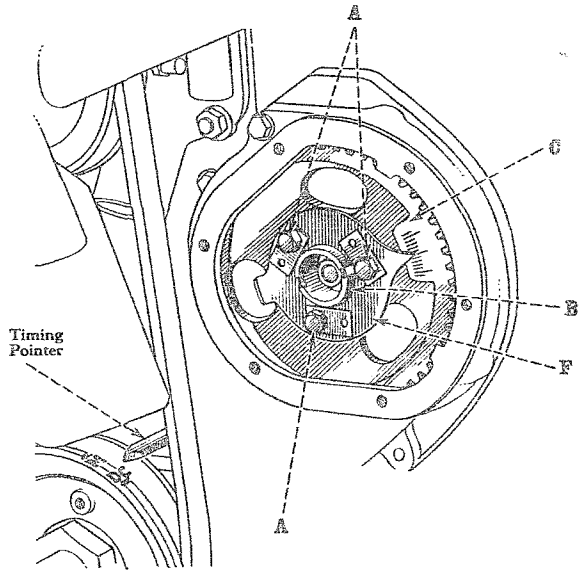


Figure 66F. Timing the Fuel Injection Pump to the UD-16 Engine

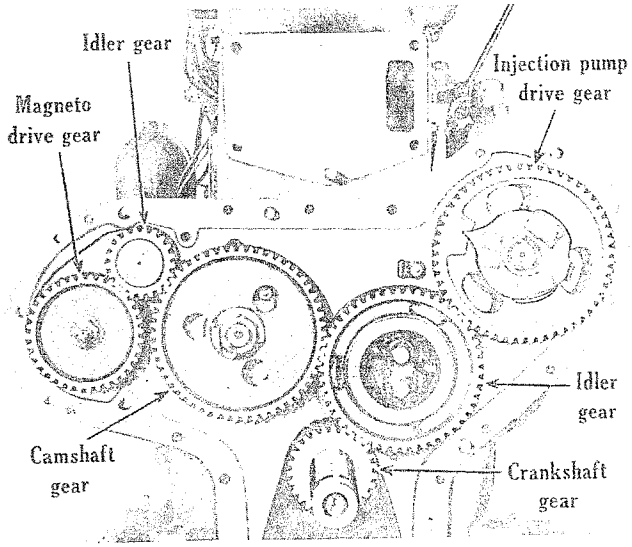
66F FUEL INJECTION PUMP TIMING. (UD-16 Engine) (See Fig. 66F)

(1) The injection timing may be advanced or retarded by means of the slots in the gear. This adjustment must be made when the engine is not operating. The injection pump is fitted with a timing adjustment. The pump timing indicator is bolted through the slots in the injection pump gear to the gear hub. The gear hub is keyed to the injection pump cam shaft. The pump gear timing indicator can be seen by removing the pump gear cover.

(2) The adjustment is normally set with the point of the indicator on the center mark of the graduations on the pump gear. In order to be sure of the best operating conditions, the indicator can be tried on either side of the center mark and set at the best operating position.

(3) To change the location of the point of the indicator (F), Fig. 66F, loosen the cap screws (A) holding the indicator and the gear hub (B) to the gear (C), and turn the gear hub (B) until the point of the indicator is at the desired position; then tighten the cap screws (A).

(4) For advanced position, turn the gear hub clockwise and, for retarded position, turn the gear hub counterclockwise. The correct adjustment has been obtained when the engine speed is maximum for a fixed load and the engine operation is smooth with a clean exhaust.



Gear Train Assembly (UD-16 Engine)

66G. SETTING THE TIMING GEAR.

On the UD-16 engine, assemble the idler gear so the space with one punch mark corresponds with the tooth on the crankshaft gear having one punch mark, and teeth having two punch marks correspond with the spaces having two punch marks on the injection pump gear and camshaft gear.

67. *VENTING AIR FROM FUEL SYSTEM.*

If the fuel filter has been drained, if the fuel pipes have been disconnected, or if air has entered the system for any reason, it will be necessary to vent the system before the engine will operate properly on the diesel cycle. To remove the air it is necessary to vent the system by successively opening the vent cocks on the fuel filter and injection nozzles.

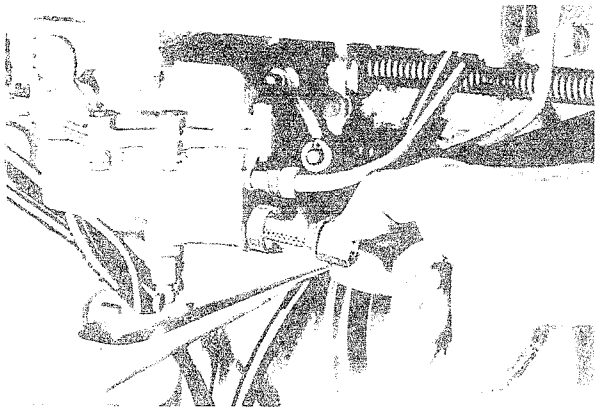
(1) Be sure the main tank is full of fuel.

(2) Stop the engine. Open the fuel filter vent. When fuel flows free from air, close the vent.

(3) With the engine operating on the gasoline cycle, advance the engine speed control lever slightly (do not move the compression release lever). Open the nozzle vents individually; then close the vents as the fuel flows from them free from air.

68. *STARTING CARBURETOR.*

The carburetor is used only in the gasoline starting cycle. The gasoline level is controlled by a float valve mechanism when starting and operating on gasoline. The float valve is locked into its seat, shutting off the flow of gasoline to the fuel bowl, when engine is changed over to operate on diesel.



69. *CLEANING THE STRAINER.*

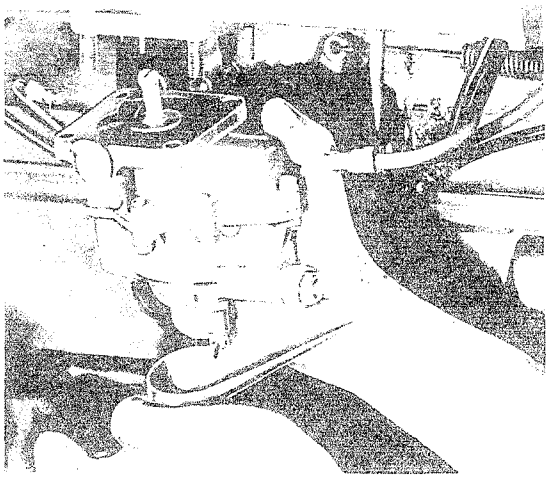
The float valve is protected against dirt and foreign matter by a strainer. The strainer screen should be removed occasionally and cleaned.

(1) Close the gasoline shut-off valve at the gasoline tank.

(2) Disconnect the gasoline supply pipe at the carburetor.

(3) Unscrew the strainer fitting from the carburetor and wash it in kerosene.

Present day grades of gasoline have a tendency to form gum. Therefore it is necessary that the gasoline tank and carburetor fuel bowl be completely drained of fuel when the engine is to be out of service for more than two weeks. These gum deposits can be dissolved with a mixture of one part alcohol and one part benzol, or with acetone.



Removing the Carburetor

70. *CARBURETOR REMOVAL.*

The carburetor has only one external adjustment, the choke lever, which regulates the air and gasoline mixture when starting. In case of possible internal trouble, the carburetor should be removed and taken to your Austin-Western dealer for servicing.

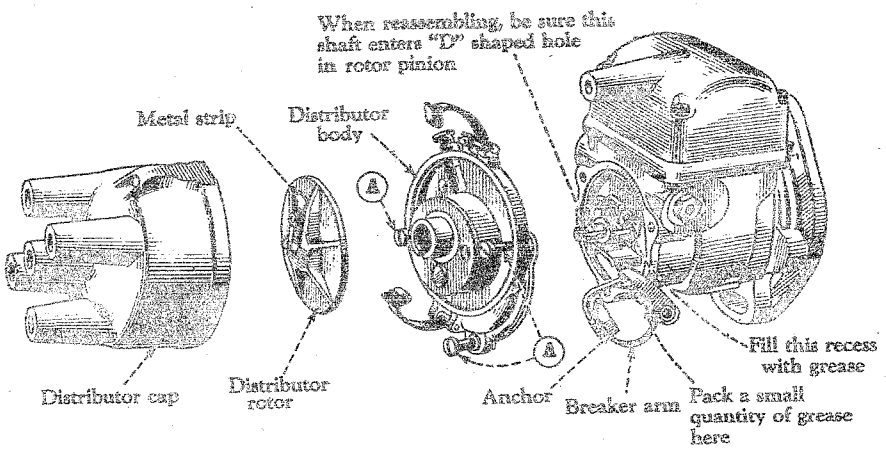
(1) Close the gasoline shut-off valve at the gasoline tank.

(2) Disconnect the gasoline supply pipe at the carburetor.

(3) Remove the pin which secures the yoke to the shut-off rod.

(4) Remove the clip on the drip tube by taking out the cap screw which secures the clip to the oil filler.

(5) Remove four nuts which secure the carburetor to the manifold, and remove the carburetor complete with drain trough and drip tube.



Magneto Taken Apart for Cleaning and Greasing

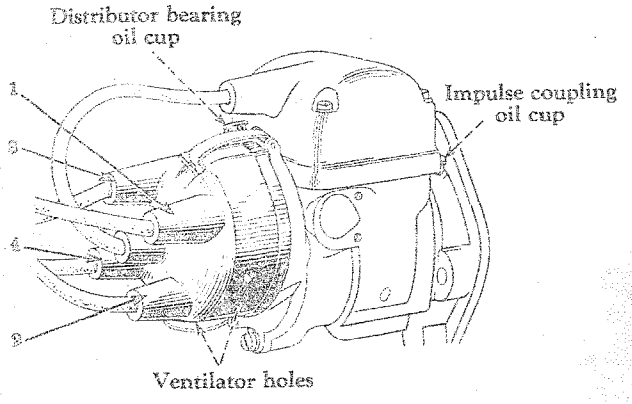
72. *MAGNETO. (UD-14A Engine)*

a. Lubrication.

(1) Every week, or after every sixty hours of operation, oil the impulse coupling liberally with light electric motor oil, or SAE-10. Use kerosene when temperature is below 10° F.

(2) After every two hundred and fifty hours of operation check the magneto drive chamber and clean if necessary. Remove the magneto as shown on pages 65 and 66. Flush with kerosene and replace.

(3) After every five hundred hours of operation, fill the distributor bearing oil cup with light electric motor oil, or SAE-10. Do not oil oftener, as excessive oil might work into the breaker point chamber and cause rapid point wear.



Counter-clockwise Rotation in the Magneto (viewed from the distributor end)

b. Greasing Breaker Mechanism and Checking Points.

(1) This magneto requires little attention other than lubricating the oil cups as specified. It is important, however, to keep the breaker arm chamber clean, as oil on the breaker points will cause rapid point wear. Overlubrication of the distributor bearing oil cup might cause a dirty breaker point chamber.

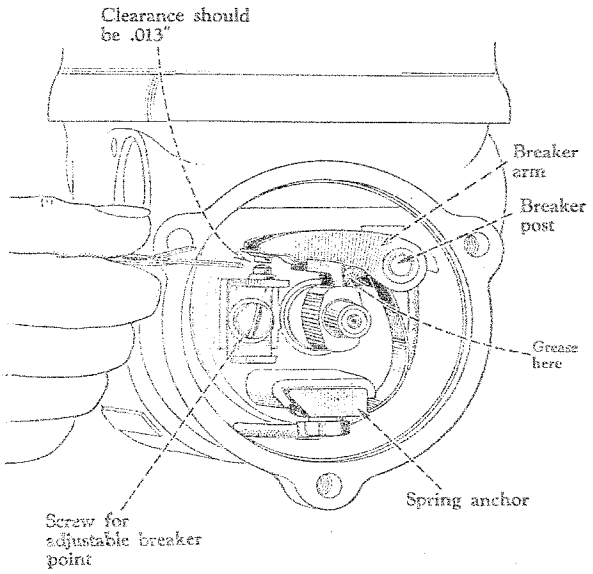
(2) After every two hundred and fifty hours of operation the breaker point chamber should be inspected to be sure it is clean. See that the points are in good condition and have proper clearance. If the chamber is clean, no attention is necessary other than checking the clearance of the points; but if the chamber is dirty, all parts must be thoroly cleaned, the points dressed, point clearance checked, and breaker arm regreased as outlined below.

(3) To reach the breaker mechanism, remove the distributor cap and crank the engine slowly until the metal strip on the distributor rotor points toward the No. 1 terminal on the distributor cap and the impulse coupling just trips. Remove the distributor rotor. Take off the distributor body by removing the three screws (A). Do not crank the engine while the distributor body is removed, or it might be necessary to retime the magneto to the engine.

(4) Pry the breaker arm and anchor from the chamber and clean all parts. Inspect the breaker points, and if necessary dress them with a sharp fine file. If the points are worn excessively, replace both points.

(5) Fill the recess in the breaker post with grease and pack a small quantity of magneto grease in back of the breaker arm rubbing block. See your Austin-Western dealer for the proper grease to use.

(6) Assemble the breaker arm, leaving the spring anchor projecting one-eighth to three-sixteenths inch above the top of the slot, so it is pushed into place by the distributor body. Be sure the points line up after the breaker arm is pushed into place.



Checking Breaker Point Clearance

(7) Check the gap between the breaker points using the gauge furnished. The point opening should be 0.013" when the rubbing block is on the high part of the cam. If the gap is not correct, adjust it by loosening the screw which holds the adjustable point and by moving the point up or down until the gauge slips snugly into the opening. After the proper adjustment has been made, tighten the screw.

(8) Line up the distributor rotor key with the keyway in the spindle and press the rotor loosely on the spindle. Crank the engine to the top dead center of the No. 1 compression stroke. The compression stroke can be determined by removing the No. 1 spark plug, placing your thumb over the opening, and cranking the engine until an outward pressure is felt. Continue cranking slowly until the notch marked "DC" on the fan drive pulley is in line with the pointer on the crankcase front cover. Turn the distributor rotor until the metal strip on the rotor points to the No. 1 terminal on the distributor cap. Place the distributor body on the magneto and be sure the rotor shaft enters the D-shaped hole in the rotor pinion. Remove the distributor rotor to tighten the three screws (A), page 64. Replace the distributor rotor and distributor cap.

c. Greasing Rotor Bearing and Distributor Gear Case.

After every two thousand hours of operation, or at least every two years, the rotor bearings, distributor gear case, and distributor gear bearing should be cleaned and repacked with magneto grease. We recommend this be done by your Austin-Western dealer.

72. DISTRIBUTOR CAP.

Both inside and outside of the distributor cap should be kept free from dust, moisture and oil deposits. Every three or four months remove the cap, thoroly clean the inside and outside, and wipe dry. To assure long life to the distributor, care must be taken to keep the two small ventilator holes, page 64, open at all times. The distributor rotor should also be kept clean.

Removing the Magneto

73. *MAGNETO REMOVAL. (UD-14A Engine)*

a. Take off the ignition switch cable by removing the fillister-head screw and lock washer which attach the cable to the magneto terminal.

b. Pull the spark plug cables from the sockets in the distributor end of the magneto.

c. Remove the cap screws and washer which hold the magneto to the bracket. Take off the magneto assembly.

74. *INSTALLING AND TIMING THE MAGNETO TO THE UD-14A ENGINE.*

a. Pull the "coil-to-distributor" cable from the coil cover end. This will prevent accidental starting.

b. Set the compression release lever in the gasoline (starting) position.

c. Crank the engine to the top dead center of the No. 1 compression stroke. The compression stroke can be determined by removing the No. 1 spark plug, placing your thumb over the opening, and cranking the engine until an outward pressure is felt. Continue cranking slowly until the notch "DC" on the fan drive pulley is in line with the pointer on the crankcase front cover.

d. Remove the distributor cap and turn the magneto coupling in a clockwise direction (as viewed from the coupling end) until the metal strip on the distributor rotor points toward the No. 1 terminal on the distributor cap.

e. Assemble the magneto on the engine. Make sure the lugs on the impulse couplings engage in the slots on the magneto drive coupling. Assemble the magneto so the top is as far away from the crankcase as possible.

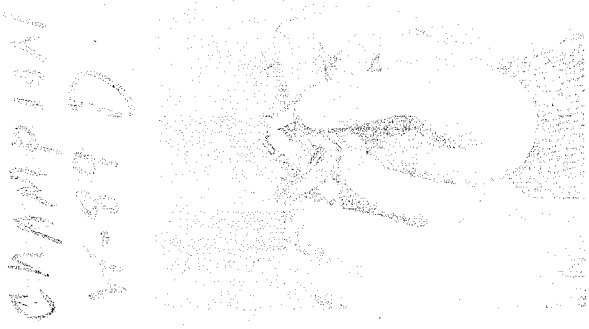
f. Insert the magneto mounting bolts loosely in the magneto flange, just enough to hold the magneto in place. Then crank the engine one complete revolution to the next top dead center. Now push the upper part of the magneto toward the engine until the impulse coupling just trips.

g. Tighten the mounting bolts securely. Attach the spark plug cables to the engine and magneto. First connect the No. 1 cylinder spark plug to the socket marked "1" on the distributor block; then the No. 3 cylinder with No. 3 socket; then No. 4; then No. 2. (See page 67.)

h. Connect the ignition switch cable to the magneto terminal.

i. To check the timing, crank the engine slowly to the top dead center of the No. 1 compression stroke, at which time the impulse coupling should just trip.

j. The magneto is now correctly wired and timed. Push the "coil-to-distributor" cable back into the socket in the coil cover.



Checking Spark Plug Gap

75. *SPARK PLUGS. (UD-14A Engine)*

The spark plugs selected after careful tests as best suited for this engine are Champion No. 44 or AC-18 and should be used ordinarily. Use only a complete set of either type of spark plug.

a. Spark Plug Cleaning.

(1) Sand blasting is the recommended method of cleaning spark plugs. Never scrape or clean the insulator with anything which will scratch the porcelain. Scratched porcelain allows carbon and dirt to accumulate faster.

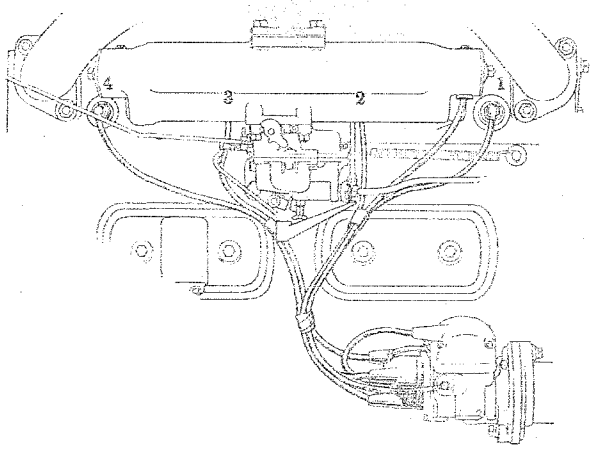
(2) Spark plugs should be removed after every two hundred and fifty hours of operation, or oftener if necessary, for cleaning and checking the gaps between the electrodes. A gap of 0.035 to 0.040" should be maintained (a gauge of this thickness is furnished).

When making this adjustment always bend the outer electrode. Never bend the center electrode, as it may damage the insulator. If the gap between the electrodes is too great, due to improper setting or burning off the ends, the engine will misfire and be hard to start.

(3) Always use a spark plug wrench when removing or replacing plugs to prevent cracking the porcelain.

(4) Be sure the spark plug gaskets are in good condition.

(5) Replace defective plugs.



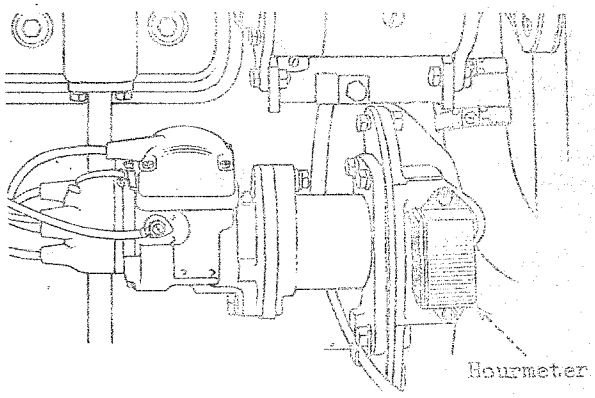
Spark Plug and Magneto Wiring Chart

76. *SPARK PLUG CABLES. (UD-14A Engine)*

If spark plug cables are removed for any reason note the position of each cable on the magneto (see above for correct wiring).

There should be one quarter inch minimum clearance between the spark plug cables and the cylinder head. By maintaining this clearance, shorting out the spark plugs will be prevented and the cables will be away from the extreme heat of the cylinder head. If a cable touches the head, heat soon causes the rubber to become soft and ruins the cable.

Never allow cables to become oil soaked.



77. *HOURMETER ATTACHMENT.*

With an hourmeter a check can be kept on the hours the engine has been operating. It makes possible accurate computation of fuel consumption or other operating cost per hour or per job and is especially useful in recording hours of service performed by each engine where several are used.

78. *VALVE CLEARANCE ADJUSTMENT. (UD-14A and UD-16 Engines)*

Check the valve clearance after every four hundred hours of operation and adjust the clearance if necessary. A clearance of 0.018" is necessary between the valve levers and the valve stems when the valves are closed and the engine is hot.

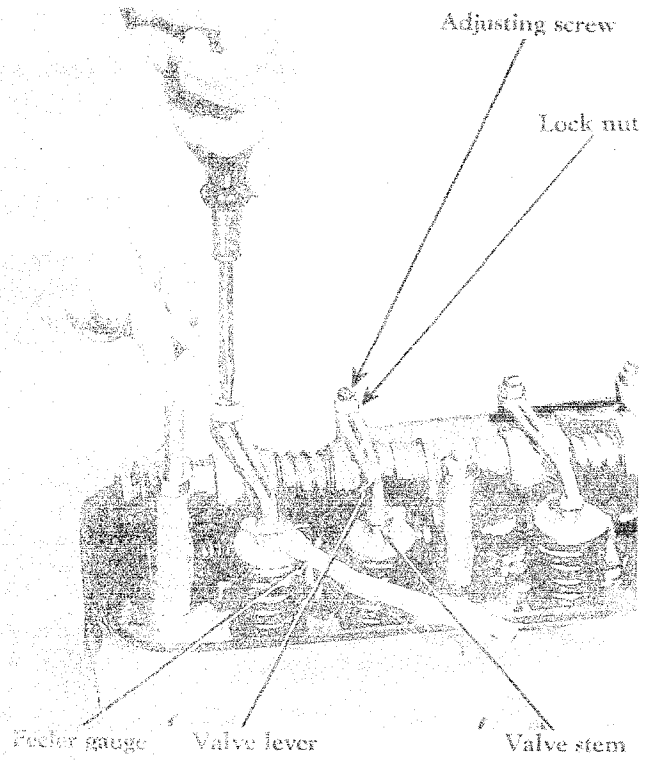
(1) Before checking the valve clearance, "cut-out" the magneto by pulling the "coil-to-distributor" cable from the magneto coil cover. This will prevent accidental starting.

(2) Set the compression release lever in the gasoline (starting) position. (page 49, paragraph 45.-c.)

(3) Remove the valve housing.

(4) Remove the spark plug from No. 1 cylinder (the cylinder next to the radiator). Place your thumb over the spark plug opening and slowly crank the engine until an outward pressure can be felt. Pressure indicates the No. 1 piston is moving toward top dead center of the compression stroke. Continue cranking slowly until the notch marked "DC" on the fan

drive pulley is in line with the timing pointer on the crankcase front cover. Both valves are now closed on the compression stroke of No. 1 cylinder



Adjusting Valve Clearance with Feeler Gauge

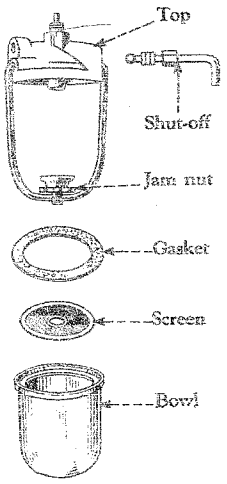
(5) Loosen the adjusting screw lock nut on both the No. 1 intake and exhaust valve levers. Insert the 0.018" feeler gauge between the valve lever and valve stem. Turn the adjusting screw in or out as necessary to hold the feeler gauge snugly. When the correct clearance is secured, hold the adjusting screw in place with a screw driver and tighten the lock nut. Adjust both the intake and exhaust valve levers in this manner.

(6) Crank the engine one-half revolution at a time and check the clearance of the valves for each cylinder, and adjust if necessary. Do this on each set of cylinder valves in succession according to the firing order of the engine, which is 1-3-4-2, on UD-14A engine.

(7) When setting UD-16 valve clearances, continue this same procedure, turning the engine one-third revolution at a time, and measuring and adjusting the clearances of each cylinder's valves in succession according to the firing order of the engine, which is 1-5-3-6-2-4.

(8) Replace the valve housing. Check to see that the valve housing gasket makes an oil-tight seal with the cylinder head. Use a new gasket if necessary.

(9) Replace the "coil-to-distributor" cable in the magneto coil cover socket from which it was removed.



79. *GASOLINE STRAINER.*

The gasoline strainer under the gasoline tank acts as a combination water trap and sediment bowl. It should be cleaned after every two hundred and fifty hours of operation. Close the shut-off valve. Loosen the jam nut below the glass bowl and swing the bail aside. The wire screen should come away with the bowl but if it sticks to the cork gasket it can be removed with the fingers. Clean and wash the bowl and screen. When reassembling the strainer be sure that the cork gasket between the bowl and the main body is in good condition and does not leak.

79A. *IGNITION SYSTEM. (UD-16 Engine)*

a. *Firing Order.*

The engine firing order is 1-5-3-6-2-4, beginning at the water pump end of engine.

b. *Description of Magneto.*

The International model F-6, inductor type, high tension magneto is regular equipment on the UD-16 engine. This magneto develops three sparks per crankshaft revolution, rotates at three-quarters of the engine speed, and is fully protected against entrance of dust, dirt and moisture. It is equipped with an automatic impulse coupling which makes possible the production of a spark at cranking speed equal to the spark produced when the engine is operating.

The magneto operates continuously when the diesel engine operates on the gasoline starting cycle and also on the diesel fuel cycle. It is permanently engaged, but the spark is eliminated by means of a ground (cut-out) switch which is operated automatically when operating on the diesel cycle.

c. *Lubricating the Magneto.* *(See Figs. 79A, 79B and 79C)*

(1) AFTER EVERY 60 HOURS OF OPERATION: Oil the impulse coupling oil cup (5) liberally with a light electric motor oil (viscosity - SAE-10). Use kerosene when the temperature is below 10°F.

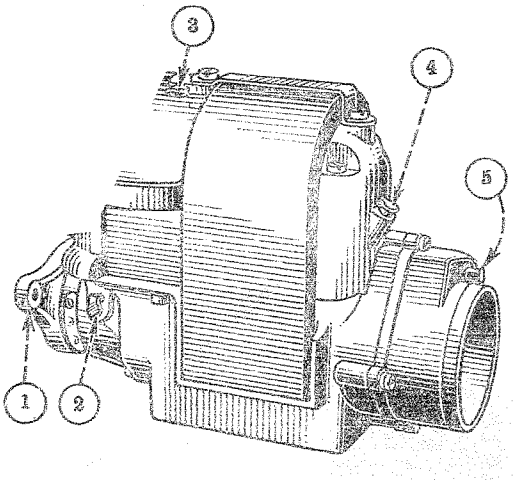


Figure 79A. IHC Model F-6 Magneto

(1) Breaker housing cover. (2) Rotor bearing oil cup. (3) Distributor bearing oil cup. (4) Rotor bearing oil cup. (5) Impulse coupling oil cup.

(2) AFTER EVERY 240 HOURS OF OPERATION: Remove the distributor block, Fig. 79B, and clean the inside of distributor block and the face of the distributor disc with a clean cloth moistened with kerosene; then wipe dry. Moisten a cloth with engine oil and apply a light coating on the surface of the distributor disc.

NOTE: Be careful not to damage the carbon brush.

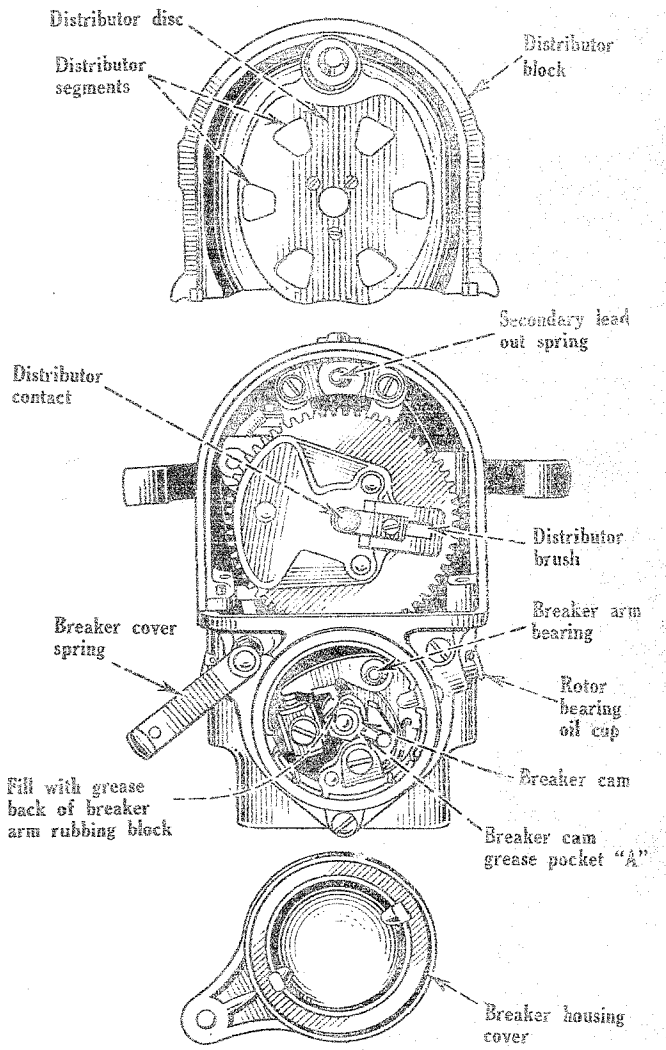


Figure 79B. Detail of Magneto Distributor and Breaker Mechanism

(3) AFTER EVERY 480 HOURS OF OPERATION: Take off the breaker housing cover (1) and remove the circuit breaker assembly (9). Wipe all parts clean of old grease. Apply a thin film of magneto grease on the cam surface, and pack a small quantity on the breaker arm post (7) in pocket of breaker cam (8), and on the breaker arm rubbing block (10). Wipe the breaker arm spring (11) with a cloth dampened with engine oil to prevent rust.

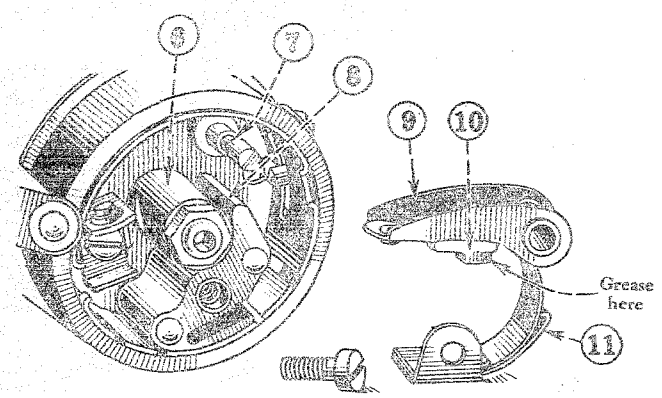


Figure 79C. Circuit Breaker

(6) Breaker cam. (7) Breaker arm post. (8) Breaker cam felt. (9) Breaker arm. (10) Breaker arm rubbing block. (11) Breaker arm spring.

(4) AFTER EVERY 480 HOURS OF OPERATION: Fill the distributor bearing oil cup (3) with a light electric motor oil (viscosity - SAE-10).

(5) AFTER EVERY 960 HOURS OF OPERATION: Apply several drops of a light electric motor oil (viscosity - SAE-10) to rotor bearings (2) and (4), Fig. 79A.

d. Breaker Points.
(See Fig. 79E)

The breaker points should be inspected after every 240 hours of operation for adjustment and general conditioning. The point opening should be .020 inch when the rubbing block is on the high point of the cam. A gauge of this thickness is furnished. It is important to keep the breaker point chamber clean, as oil on the points will cause them to burn rapidly.

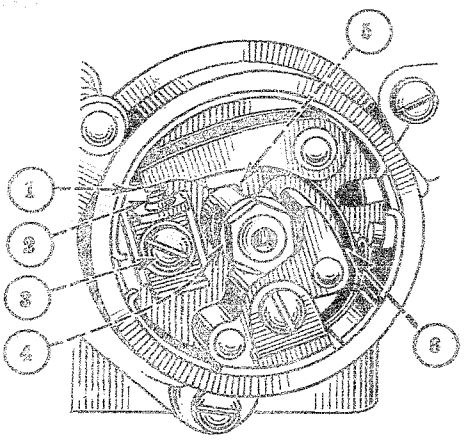


Figure 79D. Breaker Mechanism

(1) Breaker arm point. (2) Adjustable breaker point. (3) Point support screw. (4) Cam. (5) Rubbing block. (6) Breaker arm spring.

e. Adjusting the Points.

(1) Remove the breaker housing cover (1), Fig. 79A. Disengage the coupling by inserting a rod or wire in the coupling oiler, and lifting the pawl, Fig. 79F. Crank the engine until the rubbing block is on the high point of the cam.

(2) Insert the gauge between breaker points (1) and (2), Fig. 79D. If the points are too wide, or too close, loosen the screw (3) slightly. Adjust so a gauge will slip snugly into the opening. Tighten screw (3) and recheck the opening. Use a screwdriver as a pry to move the point support.

f. If Points Are Rough Or Pitted.

Remove both points and dress them with a sharp point file. If they are worn excessively, replace both points with new ones and adjust them as described above.

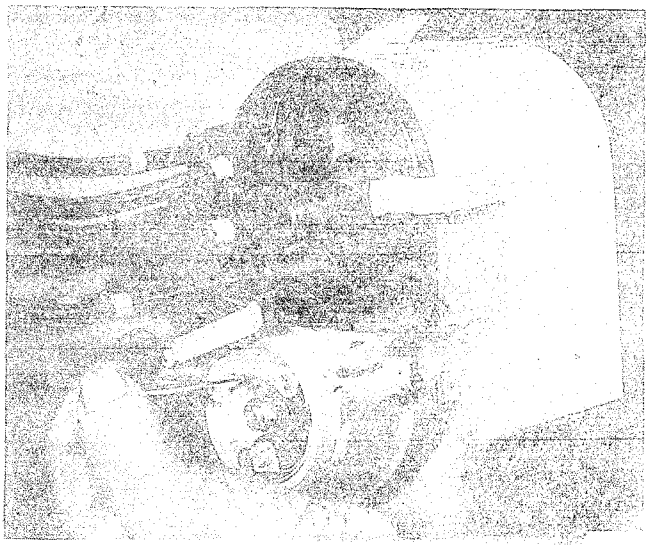


Figure 79E. Checking Breaker Point Gap

g. Removing the Magneto.

(1) Remove the bolt in the magneto drive cover. Take off the ground switch cable by removing the fillister-head screw and lock washer attaching the cable to the magneto terminal.

(2) Pull the spark plug cables from the sockets in the distributor cap.

(3) Remove the cap screws that hold the magneto coupling and coupling block together, Fig. 79G.

(4) Remove the cap screws and washers holding the magneto to the bracket. Remove the magneto assembly from the bracket,

h. Timing The Magneto To The Engine.

If the magneto has been removed, follow the instructions below when installing the magneto on the engine.

(1) Pull the compression release lever into the starting position for gasoline operation.

(2) Crank the engine until the No. 1 piston (the piston nearest to the radiator) is on the upper dead center of the compression stroke. (The compression stroke can be determined by removing the No. 1 spark plug, placing a thumb over the opening, and having the engine cranked until an outward pressure is felt by the thumb.) Continue cranking until the DC 1-6 mark on the flywheel is in line with the pointer on the right side of the flywheel housing. The pointer can be seen by removing the plate on the right-hand side of the flywheel housing.

(3) Fully retard the spark by rotating the link end of the breaker housing cover counterclockwise as high as it will go, and removing the cover. To do this, remove the nut (A) and link (B), Fig. 79H; then remove the breaker housing cover carefully to avoid moving the breaker assembly.

(4) Lock the impulse coupling out of engagement by inserting a rod or wire into the oiler hole and lifting the pawl, Fig. 79F.

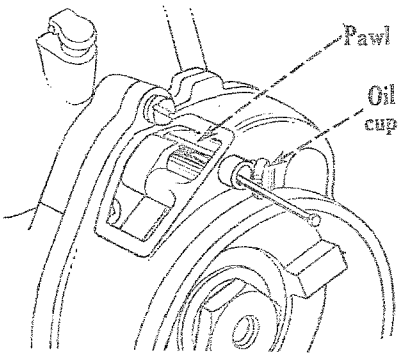


Figure 79F. Method of Disengaging The Impulse Coupling

(5) Rotate the magneto clockwise (as viewed from coupling end) until the rubbing block in the breaker assembly is on the high point of the cam. Check or adjust the breaker points for the correct gap setting of .020 inch as described.

(6) Place the magneto into position on the magneto bracket, engaging the lugs on the impulse coupling with the slots in the coupling block spacer. Insert the magneto base screws loosely into the magneto.

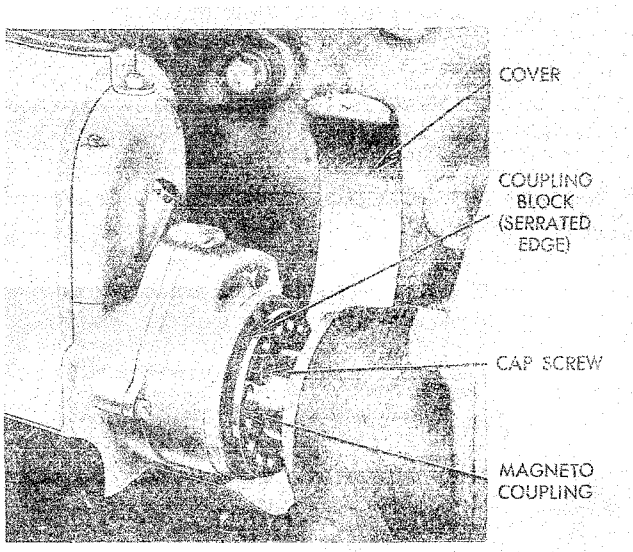


Figure 79G. Installing the Magneto

NOTE: Do not use screws which are longer than the originals as they will damage the magneto.

(7) Remove the distributor cap and hold it close to the magneto, as shown in Fig. 79K. Grasp the magneto half of the adjustment block and rotate it clockwise (as viewed from the coupling end), Fig. 79J, until the brush in the distributor disc is under the distributor cap terminal marked "No. 1," and the breaker points are just beginning to open, Fig. 79K.

(8) With the magneto in this position, locate the two holes in the adjustment coupling that align. Insert the shims between the two halves of the coupling so the cap screws will pass through the holes in the shims and enter the holes in the tapped half of the adjustment coupling, Fig. 79G.

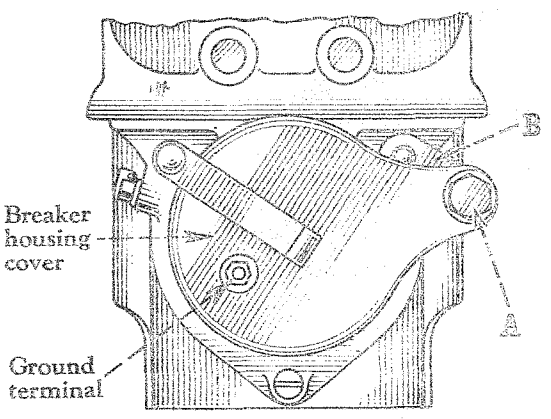


Figure 79H. Breaker Housing Cover with Timing Link

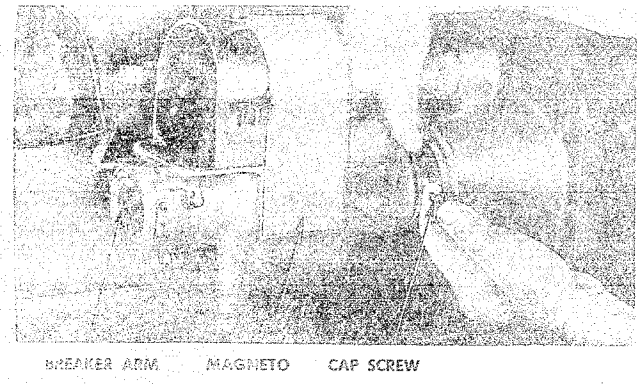


Figure 79J. Rotating Magneto Half of Adjustment Block

NOTE: The holes in the adjustment coupling are so spaced that only one pair of holes will line up exactly. Do not force the cap screws as the setting will be incorrect.

(9) Tighten the magneto base cap screws, and install the breaker housing cover and the distributor cap. Be careful not to damage the brush or contact spring. The magneto should now be correctly timed to the engine.

(10) Install the distributor cap on the magneto. If the spark plug cables have been removed, insert them into the correct terminals. When installing the impulse cover, be sure the joint is lapped. The impulse cover should always be assembled so the hole is on the bottom, to facilitate drainage in damp or rainy weather.

NOTE: When operating under extremely dusty conditions, the flap over the hole in the impulse cover should be partially closed to prevent the entrance of excessive amounts of dust.

i. Checking The Timing Of The Magneto.

The magneto timing can be checked, with the magneto mounted in position, in either of two ways.

(1) By Breaker Point Opening.

(a) Fully retard the spark by removing the breaker housing cover.

(b) Disengage the magneto impulse by inserting a rod or wire into the coupling oiler and lifting the pawl, Fig. 79F.

(c) Crank the engine until the breaker points are just beginning to open.

(d) If the timing is correct,

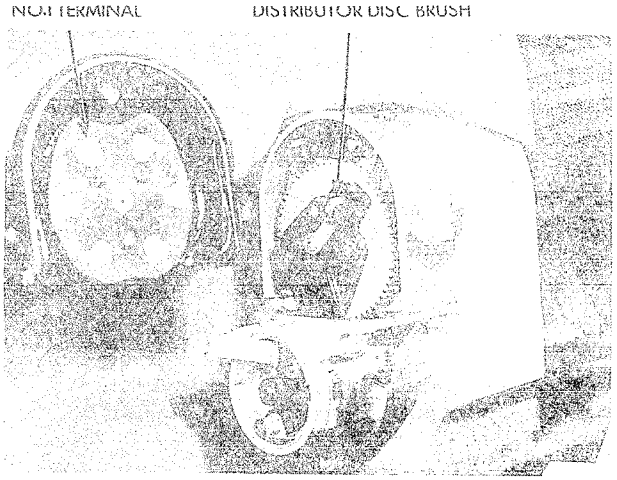


Figure 79K. Showing Position of Distributor Disc Brush

one of the three DC marks on the flywheel will align with the timing pointer on the right side of the flywheel housing.

(e) Remove the distributor cap and note if the brush on the distributor disc is under the correct distributor cap terminal to match the DC mark shown on flywheel. (The three DC marks are numbered 1-6, 2-5 and 3-4.) The terminals on the distributor cap run in a clockwise rotation and correspond to the firing order of the engine, which is 1-5-3-6-2-4.

(f) If the magneto timing is not correct, refer to page 68C, paragraph 79A.-h, and time the magneto to the engine.

(2) By Impulse Coupling Tripping.

(a) Crank the engine slowly until the impulse just trips.

(b) If the timing is correct, the DC mark on the flywheel will be in line with or not more than eight degrees past (one inch on flywheel rim) the timing pointer on the right side of the flywheel housing. The DC mark should never be above the timing pointer. If the magneto timing is not correct, refer to page 68C, paragraph 79A.-h, and time the magneto to the engine.

j. Spark Plugs. (UD-16 Engine)

The spark plugs selected after careful tests as best suited for this engine are Champion No. 49 or AC No. 18A, and they should be used ordinarily. Use only a complete set of either type of spark plug.

Spark plugs should be removed after every 240 hours of operation, or oftener if necessary.

80. HOT WEATHER OPERATION.

a. Fuel System.

(1) Keep the gasoline and diesel fuel tanks well filled to avoid condensation of moisture within the tanks (which may happen if much air is allowed to enter the tanks).

(2) Be sure the vents in the gasoline tank filler cap are open and the cap is on tight.

b. Lubrication.

Be sure to use correct grade of lubricant in the engine crankcase, air cleaner, and injection pump. Refer to engine lubrication chart on page 52 or 52A and 52B.

c. Batteries.
(Located Back of Operator's Seat)

Inspect the batteries frequently to see that the electrolyte is at the correct level and of the correct specific gravity.

d. Cooling System.

Check the tension of the fan belt frequently; check the coolant level frequently and be sure the radiator filler cap is on tight; clean and flush the internal parts of the cooling system frequently; keep the external parts of the radiator free from bugs and dirt.

81. COLD WEATHER OPERATION.

a. General.

If the engine is to be operated in temperatures of 32° F. or lower, observe the following precautions:

b. Fuel System.

(1) Use only a high test winter grade gasoline for starting. Always keep your supply in a tightly closed container so that the more volatile portion does not evaporate.

(2) Fill the diesel fuel tank at the end of the day's operation to avoid condensation of moisture in the tank.

c. Lubrication.

Be sure to use the correct grade of lubricant in the engine crankcase, air cleaner, injection pump and magneto impulse coupling. Refer to engine lubrication chart on page 52 or 52A and 52B.

d. Magneto Impulse Coupling.

Keep the magneto impulse coupling free from dirt and gummy formation. When hand cranked, the impulse coupling should trip (click) two times for each revolution of the engine. Failure to do so may indicate need for flushing. Remove the magneto as described on page 66 or 68B. Flush the impulse coupling end and drive chamber with kerosene, and replace.

e. Batteries.
(Located Back of Operator's Seat)

Check the specific gravity of the electrolyte frequently to determine the charged condition of the batteries. It is important to keep the batteries fully charged in cold weather for two reasons: (1) to maintain the operating efficiency, and (2) to avoid freezing.

f. Cooling System.

(1) When the temperature is likely to be 32° F. or lower, there is danger of the water freezing in the cooling system. To prevent freezing, use one of the recommended anti-freeze solutions in the table on the following page.

(2) Before filling the cooling system with anti-freeze, drain and clean the system as described on page 55, paragraph c. Refill and check the radiator, water pump, all gaskets and hose connections. If any leaks are found make repairs before filling with anti-freeze.

(3) Drain the cooling system by opening the drains in the bottom of the radiator and in the left side of the crankcase. Remove the radiator filler cap. See that the drains are not plugged and that the water drains out completely.

(4) Anti-freeze solutions.

(a) Never mix anti-freeze solutions, as it will be difficult to deter-

mine how much protection against freezing the solution has.

(b) Never use honey, salt, kersoene fuel oil, glucose or sugar, calcium chloride, or any alkaline solution as an anti-freeze.

(c) Do not use denatured alcohol as an anti-freeze if other materials are available, because it boils at 173° F. If it is necessary to use alcohol, check the solution frequently with the hydrometer to be sure you have adequate protection for the prevailing temperature.

(d) The table below shows the quantity of anti-freeze used for various temperatures.

Freezing Point (Fahrenheit)	Quarts of Anti-Freeze Required		
	Ethylene Glycol	Distilled Glycerine	Denatured Alcohol
10°	17	22½	20½
0°	22½	27	25
-10°	27	32	29
-20°	30½	36	34
-30°	34	40	39
-40°	37	—	44
-50°	39½	—	49
-60°	42	—	53
-70°	44	—	—

(5) IF NO ANTI-FREEZE IS AVAILABLE drain the cooling system completely after operation. Before refilling, cover the radiator completely, start the engine, and fill the system immediately with water. This will prevent the radiator from freezing during the warm-up period.

82. OPERATING PRECAUTIONS.

a. SAFETY FIRST! Never fill the gasoline tank when near an open flame or when the engine is operating. When pouring in the gasoline keep the funnel and container in contact with the metal of the gasoline tank to avoid the possibility of an electric spark igniting the gas. Never light matches near gasoline, as the air within several feet is permeated with a highly explosive vapor.

> CAUTION: When hand cranking the engine the operator should stand in a position that will eliminate any possibility of being struck by the starting crank if there is a reversal of the direction of the engine. Crank the engine by using quick up-strokes; do not spin it.

b. Never operate the engine under load until it is thoroly warmed up.

c. The engine speed control lever should be adjusted to suit the load to be handled.

d. Never operate the engine at more than the regular governed speed. Excessive speeds are harmful.

e. Operate an engine with a light load for the first thirty to thirty-six hours at about three-quarter throttle.

f. The gasoline supply tank has a filler cap provided with air vents. These vents should be kept open to assure the proper flow of the gasoline.

g. Check to see that the magneto is securely mounted in place and was not damaged in shipment. Check the spark plug cables to make sure they are securely connected in the magneto distributor cap and at each spark plug.

h. If trouble is experienced in starting the engine in cold or damp weather, the spark plugs should be removed and wiped off, removing any condensation. At the same time check the spark plug gap, which should be 0.035 to 0.040".

i. Immediately after the engine starts, check the oil pressure indicator to see if it is registering the proper pressure, page 51, paragraph 51. If it is not, stop the engine and inspect the oil system to find the cause of failure. If unable to find the cause, be sure to consult your Austin-Western dealer before operating the engine.

j. Check the tension of the fan belt. Tension is correct when the belt can be depressed by your thumb 3/4 to 1" midway between the pulleys. If belt tension is not correct, adjust as outlined on page 56 or 56A.

k. For the most efficient operation, the heat indicator needle should be near 180° F.

l. Be sure to clean the air cleaner and to replace the lubricating oil filter element at regular intervals, as specified on page 54, paragraphs 56.-c. and d.; and page 53, paragraph 55.-b.; and in the lubrication chart on page 52 or 52A.

m. Never operate the starting motor (if your engine is so equipped) more than twenty seconds at a time. Allow the starting motor to cool a few seconds and repeat the starting operation.

n. Never pour cold water into the radiator if the engine is very hot unless conditions make it absolutely necessary. Under such conditions start the engine and let it idle while slowly pouring the water into the radiator.

83. STORING AND HOUSING ENGINE.

When your engine is not to be used for a period of time it should be stored in a dry and protected place.

Leaving equipment outdoors exposed to the elements will result in materially shortening its life.

The procedure below should be followed when your engine is placed in storage for thirty days or more, and the lubrication precautions should be repeated every six months thereafter.

We also recommend caution in starting an engine that has been in storage (see instructions following).

84. PREPARATION FOR STORING.

a. Thoroly wash or clean the engine.

> CAUTION: Because of the fire hazard, do not use gasoline for cleaning parts, at least when service is performed indoors. Observe the insurance regulations and use a less inflammable fluid, such as Stoddard solvent or kerosene.

b. Completely lubricate the engine. (See page 52 or 52A and 52B).

c. Drain the lubricating oil from the diesel injection pump and governor, and refill with approved flushing oil.

d. Close valve (5), page 58 at the fuel supply tank.

(1) Disconnect the fuel supply tank line (6).

(2) Disconnect the fuel supply and fuel return lines (9) and (11) at the injection pump.

(3) Drain all fuel from tank (1). Store the drained oil as shown on page 58, paragraph b.

e. Drain the fuel filter (8). (Open the air vent at the top of the fuel filter to assure draining.)

f. Tighten the drain at the bottom of the fuel filter base (8) when the fuel has been drained.

(1) Connect the fuel supply and fuel return lines (9) and (11) at the injection pump.

g. Attach the valve end of tubing (6) to a can of clean approved flushing oil.

h. Close the air vent at the top of the fuel filter when the flushing oil appears.

i. Start and operate the engine on gasoline for five minutes; then shut down.

(1) Start up again and operate for one minute; then shut down.

(2) Start up again and operate for four minutes.

(3) Do not drain this flushing oil from the fuel pump mechanism as it is to act as a rust preventative of the inner pump parts.

(4) Do not drain the flushing oil from the injection pump base as it acts as a rust preventive.

j. Drain the flushing oil from the fuel filter (8). Reattach line (6) to valve (5). (Do not open valve (5).) The coating of flushing oil in these parts acts as a rust preventive.

k. Drain all water from the engine.

l. Drain gasoline from the gasoline tank and starting carburetor.

m. Drain all lubricating oil from the crankcase pan and oil filters. Clean the filter base and attach "OIL DRAINED" tag.

n. Flush the engine with SAE-50 lubricating oil as outlined below:

(1) Remove the spark plugs and put the compression release lever in the gasoline (starting) position so that all starting valves are open.

(2) Spray about one ounce of SAE-50 lubricating oil thru the spark plug opening in each cylinder, using an air gun attached to an oil can.

(3) Replace the spark plugs and put the compression release lever in the diesel position.

(4) Remove the valve housing cover and spray oil over the rocker arm and starting valve assembly.

(5) Replace the cover.

NOTE: The engine must not be operated after the flushing operation.

o. Put a tin cap over the top of the exhaust pipe. Remove the air cleaner cap and put a can over the pipe. Do this so moisture, dirt, etc., will not enter the engine.

85. STARTING DIESEL ENGINES THAT HAVE BEEN IN STORAGE.

a. Remove the spark plugs and put the compression release lever in the gasoline (starting) position. Pour a mixture of half gasoline and half SAE-10 engine oil into each cylinder (two tablespoonsful per cylinder is sufficient).

b. Remove the valve housing cover and flush the valves and valve operating mechanism with the same mixture.

c. Crank the engine rapidly until the excess oil has been blown out of the spark plug holes. (This operation will loosen any tight piston rings and wash old grimy oil from the valves and pistons.)

d. Flush out the magneto impulse coupling with the same grade of oil as used for lubrication, and lubricate the magneto as specified on pages 52 and 64, or 52A and 68A.

e. Flush out the crankcase with diesel fuel, dry cleaning solvent, or kerosene, and fill with the grade of lubricating oil specified on page 52 or 52A.

f. Drain the flushing oil from the injection pump and refill to the proper level with the specified lubricating oil.

g. Before starting the engine, be sure the fuel filter has a new element. Then open valve (5), page 58.

h. Install the spark plugs.

i. Fill the cooling system and fuel tanks.

. Fill the fuel filter as described under "Venting Air From Fuel System", page 63, paragraph 67.

k. Start the engine and operate it slowly. Observe if any of the valves are sticking. If they are, pour a small quantity of diesel fuel, dry cleaning solvent, or kerosene, on the valve stems until valves become loose.

l. Assemble the valve housing cover.

m. Do not accelerate the engine rapidly or operate at high speed immediately after starting.

CHECKING MECHANICAL PROBLEMS

(UD-14A AND UD-16 ENGINES)

PROBLEM	PROBABLE CAUSE	PROBABLE REMEDY
ENGINE WILL NOT TURN	A. Starting motor inoperative	A.
	(1) Batteries faulty.	(1) Recharge or replace batteries if necessary.
	(2) Cables and terminals faulty.	(2) Inspect ground cable and "battery-to-starter-switch" cable for any faults which may cause shorting; replace cables if necessary.
	(3) Starting switch defective.	(3) Replace starting switch.
	(4) Starting motor defective.	(4) *
	B. Compression release lever in Diesel position.	B. Pull compression release lever back into gasoline starting position.
	C. Internal seizure.	C. Hand crank engine with spark plugs removed, clutch disengaged, and compression release lever in starting position. If engine does not turn easily, internal damage is indicated.*
ENGINE TURNS BUT WILL NOT START	A. Gasoline fuel system faulty.	A.
	(1) No gasoline in tank.	(1) Fill small tank with gasoline.
	(2) Gasoline shut-off valve closed.	(2) Open gasoline shut-off valve.
	(3) Gasoline strainer screen clogged.	(3) Clean gasoline strainer.
	(4) Water in gasoline.	(4) Drain gasoline tank, strainer, and carburetor.
	B. Ignition system faulty.	B.
	(1) Moisture on spark plugs.	(1) Remove spark plugs, wipe off moisture and dry plugs. Check gap, which must be .020 to .025 inch.
	(2) Magneto grounding switch inoperative.	(2) Disconnect grounding switch cable from magneto. Attempt to start engine. If engine starts, switch in manifold or cable is inoperative and should be inspected.
	(3) No spark from magneto.	(3) Remove distributor block from magneto and crank engine to see if distributor rotor turns. (a) If distributor rotor does not turn, remove magneto. (b) If rotor turns but engine does not start, remove a spark plug cable from spark plug. Hold cable terminal 1/4 inch from cylinder head and crank engine. If spark appears, plugs may be fouled or need replacement. If no spark appears, check breaker points in magneto.
	C. Carburetor choked too much.	C. Push the choke all the way in.

Note: * Consult Your Austin-Western Distributor

CHECKING MECHANICAL PROBLEMS—Continued

(UD-14A AND UD-16 ENGINES)

PROBLEM	PROBABLE CAUSE	PROBABLE REMEDY
ENGINE WILL NOT OPERATE AS A DIESEL ENGINE	A. Injection pump does not deliver fuel.	A.
	(1) Air trap empty, or supply tank shut-off valve closed.	(1) Open shut-off valve.
	(2) Fuel supply system air-bound.	(2) Vent the fuel system.
	(3) Water in Diesel fuel.	(3) Drain entire Diesel fuel system including water trap and filters. Refill with Diesel fuel, and vent system.
	(4) Fuel filters or strainers clogged.	(4) Disassemble and clean.
	B. Starting mechanism not functioning.	B.
	(1) Starting valves warped.	(1) *
	(2) Starting control linkage out of adjustment.	(2) Check linkage for broken parts, missing cotters and pins.
	(3) Butterfly valves in manifold not functioning.	(3) Remove manifold end covers, and operate starting control lever to see if butterfly valves are functioning.
	C. Faulty timing of injection pump.	C. Retime pump to engine.
MISSING AND BACKFIRING (Gasoline Cycle)	A. Water in the gasoline.	A. Drain gasoline tank, strainer and carburetor.
	B. Air leaks around intake manifold.	B. Tighten manifold stud nuts.
	C. Improper firing order.	C. Check spark plug cables for correct installation at spark plugs and magneto distributor cap.
	D. Magneto not correctly timed to engine.	D. Check and adjust timing.
	E. Starting valves not properly seated.	E. *
ENGINE DOES NOT IDLE PROPERLY (Diesel Cycle)	A. Injection pump control lever shaft sticky, sluggish, or stuck.	A. Remove injection pump.
	B. Injection pump plunger spring broken, or plunger stuck.	B.
	C. Injection pump plunger and bushing worn.	C.
	D. Surging at any idle speed.	D.
	E. Injection nozzles faulty.	E. Remove, and repair or replace.*
LOSS OF OIL PRESSURE	A. Low oil level.	A. Add sufficient oil to bring up to specified mark on level gauge.
	B. Oil pressure indicator or line defective.	B. Replace.*
	C. Main or connecting rod bearings worn.	C. Replace.*
	D. Dirt in regulating valve, or regulating valve spring broken.	D. Clean, or replace spring.*
	E. Oil pump worn.	E. Remove, and repair or replace.*
	F. Camshaft bearings worn excessively.	F. Install new bearings.*

Note: * Consult Your Austin-Western Distributor

CHECKING MECHANICAL PROBLEMS—Continued

(UD-14A AND UD-16 ENGINES)

PROBLEM	PROBABLE CAUSE	PROBABLE REMEDY
LACK OF COMPRESSION	A. Improper valve clearance.	A. Adjust valve clearance.
	B. Valves sticking.	B. Clean valve guides and stems. Grind valves if necessary.*
	C. Worn pistons, sleeves, piston rings, and sticking piston rings.	C. Replace.*
	D. Starting valves warped.	D. Replace.*
ENGINE DOES NOT DEVELOP FULL POWER, AND UNEVEN OPERATION	A. Injection nozzles dirty or sticking.	A. Open vent screw on each nozzle to determine which is defective. Remove, and clean or replace.*
	B. Insufficient air to engine.	B. Service the air cleaner.
	C. Injection pump not operating properly, or not properly timed.	C. *
	D. Poor fuel.	D. Use good grade Diesel fuel.
	E. Faulty valve action.	E. Adjust valve clearance. If valves are burned or warped, replace.*
	F. Worn piston rings and pins, or sleeves.	F. *
SMOKY EXHAUST	A. Poor fuel.	A. Use good grade Diesel fuel.
	B. Injection pump not properly timed.	B. Retime pump to engine.
	C. Injection nozzle not functioning properly.	C. Opening pressure not correct, or nozzle leaks.*
ENGINE OVERHEATS	A. Insufficient water in the cooling system.	A. Check level of water in radiator and add water if necessary. NOTE: Do not pour cold water in an overheated engine or possible cracking of the cylinder head may result.
	B. Fan belt slipping.	B. Check belt tension and adjust.
	C. Cooling system clogged.	C. Flush out radiator and engine.
	D. Dirt and trash on outside of radiator core.	D. Clean all dirt and trash from between the radiator tube fins with air or water pressure.
	E. Thermostat inoperative.	E. Remove and replace if necessary.
	F. Lack of lubricating oil.	F. Add sufficient oil to bring up to specified mark on level gauge.

Note: * Consult Your Austin-Western Distributor

CHECKING MECHANICAL PROBLEMS—Continued

(UD-14A AND UD-16 ENGINES)

PROBLEM	PROBABLE CAUSE	PROBABLE REMEDY
EXCESSIVE LUBRICATING OIL CONSUMPTION	A. Oil leaks.	A. Check and service where necessary—at valve lever housing, valve cover, side plates, dust seal at rear of oil pan, crankcase front cover, oil seals at front and rear of crankshaft, oil pan, oil filter, and oil pressure indicator tube.
	B. Worn valve guides, worn piston rings, sleeves, pistons, and clogged oil control rings.	B. Excessive smoke coming from the breather pipe on the side of the crankcase indicates that an excessive amount of oil is being used.*
	C. Improper lubricant.	C. Use only the lubricant specified in the Lubrication Guide.
	D. Overheated engine.	D. Refer to "ENGINE OVERHEATS."

ENGINE NOISES

(UD-14A AND UD-16 ENGINES)

NOISE	PROBABLE CAUSE	PROBABLE REMEDY
A. Sharp rap at idling speed.	A. Loose piston pin. The pin at fault can be found by short-circuiting spark plugs until the noise stops.	A. Replace pin.*
B. Flat slap when advancing engine speed under load.	B. Piston slap.	B. Replace piston and sleeve.*
C. Metallic knock when idling and retarding engine speed, but disappears under load.	C. Worn or loose connecting rod bearings. The bearings at fault can be found by short-circuiting spark plugs until the noise stops.	C. Replace bearings.*
D. Constant rapid clicking.	D. Incorrect valve clearance.	D. Adjust valve clearance.
E. Combustion knock in one or two cylinders.	E. Leaky injection nozzle valve.	E. Replace nozzle valve.*

Note: * Consult Your Austin-Western Distributor

86. *PERIODIC INSPECTIONS. (UD-14A and UD-16 Engines)*

Every engine operator should practice preventive maintenance for continued good operation of his engine. Periodical preventive inspection and maintenance are the only sure means of keeping the engine in proper working order. Prompt detection and correction of minor irregularities will prevent engine failure and expensive repairs. Be systematic; inspect at the intervals outlined below.

AFTER EVERY 10 HOURS OF OPERATION

Point of Inspection:	*Remarks:*
Water trap (in fuel filter base)	Drain off water and sediment (page 58; paragraph 60a.; also see page 59)
Lubrication points	(See lubrication charts on page 52 or 52A and 52B)

AFTER EVERY 60 HOURS OF OPERATION

Air cleaner	Remove and clean (page 54; paragraph 56c.)
Flexible rubber connection between air cleaner and air cleaner pipe	Inspect for loose fit or damage (page 54; paragraph 56e.)
Fan belts	Check tension; replace if necessary (page 56 or 56A)
Radiator fins	Clean spaces (page 55; paragraph 57e.)
Fuel transfer pump strainer	Remove screen and clean (page 60; paragraph 62.)
Lubrication points	(See lubrication chart on page 52 or 52A)

SPECIAL INSTRUCTIONS

Lubricating oil filters	Replace filter elements (see special instructions for changing elements, pages 52D and 53)
Engine crankcase	Drain and change oil (see lubrication chart on page 52 or 52A; also pages 52D and 53)

AFTER EVERY 250 HOURS OF OPERATION

Gasoline strainer and sediment bowl	Take apart and clean (page 68; paragraph 79.)
Spark plugs	Remove and clean; check gap (page 66 or 68D)
Magneto breaker points and chamber	Clean chamber and check gap (page 64 or 68B)
Magneto drive chamber and impulse coupling	Check and clean if necessary (page 69 or 68A
Lubrication points	(See lubrication charts on pages 52A and 52E

AFTER EVERY 400 HOURS OF OPERATION

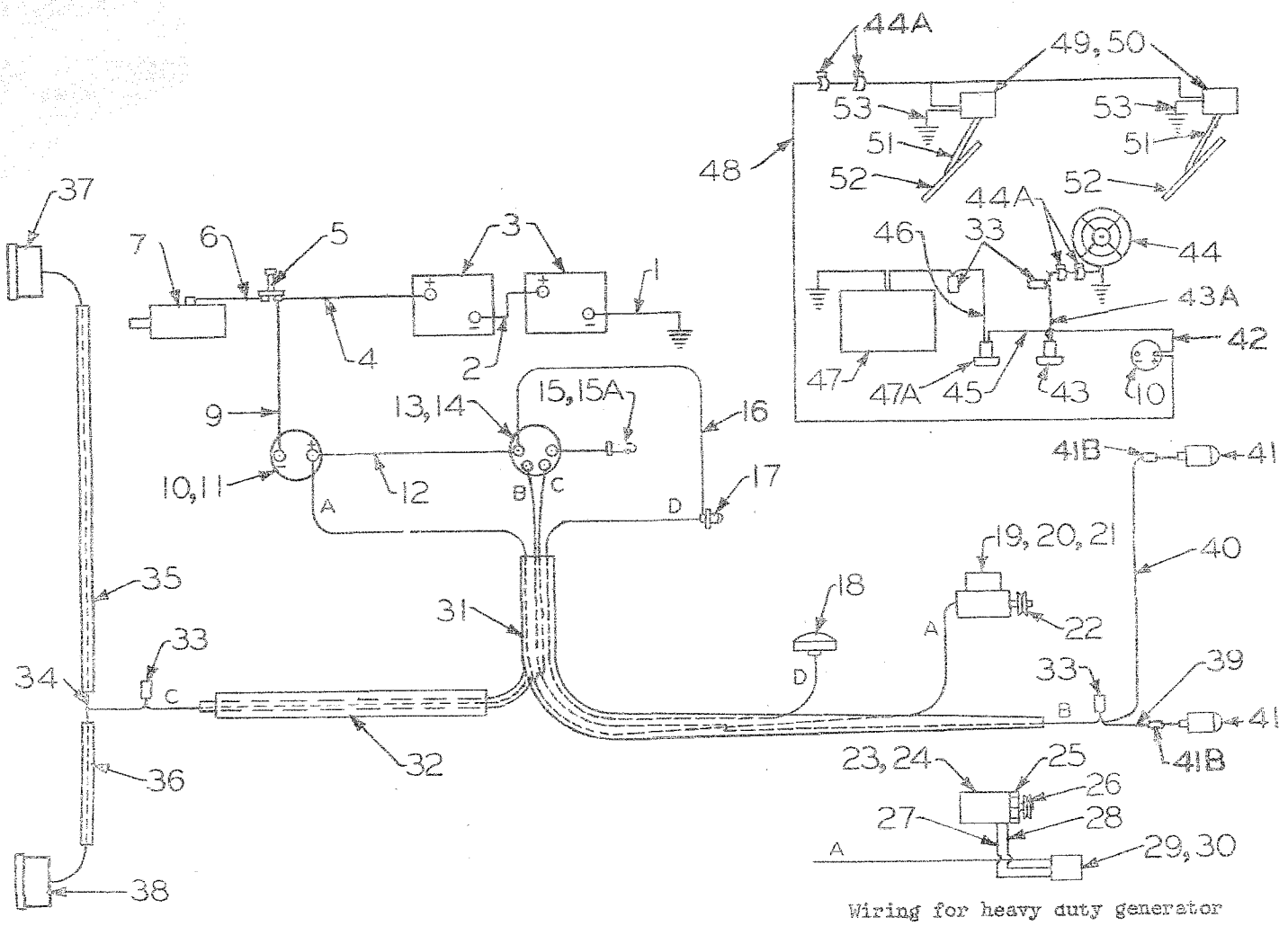
Carburetor gasoline strainer screen	Remove and clean (page 63; paragraph 69.)
Cooling system	Clean (page 55; paragraph 57.)
Engine valves	Check for clearance (page 67; paragraph 78.)

AFTER EVERY 500 HOURS OF OPERATION

Lubrication points	(See lubrication chart on page 52 or 52A)

PERIODICALLY

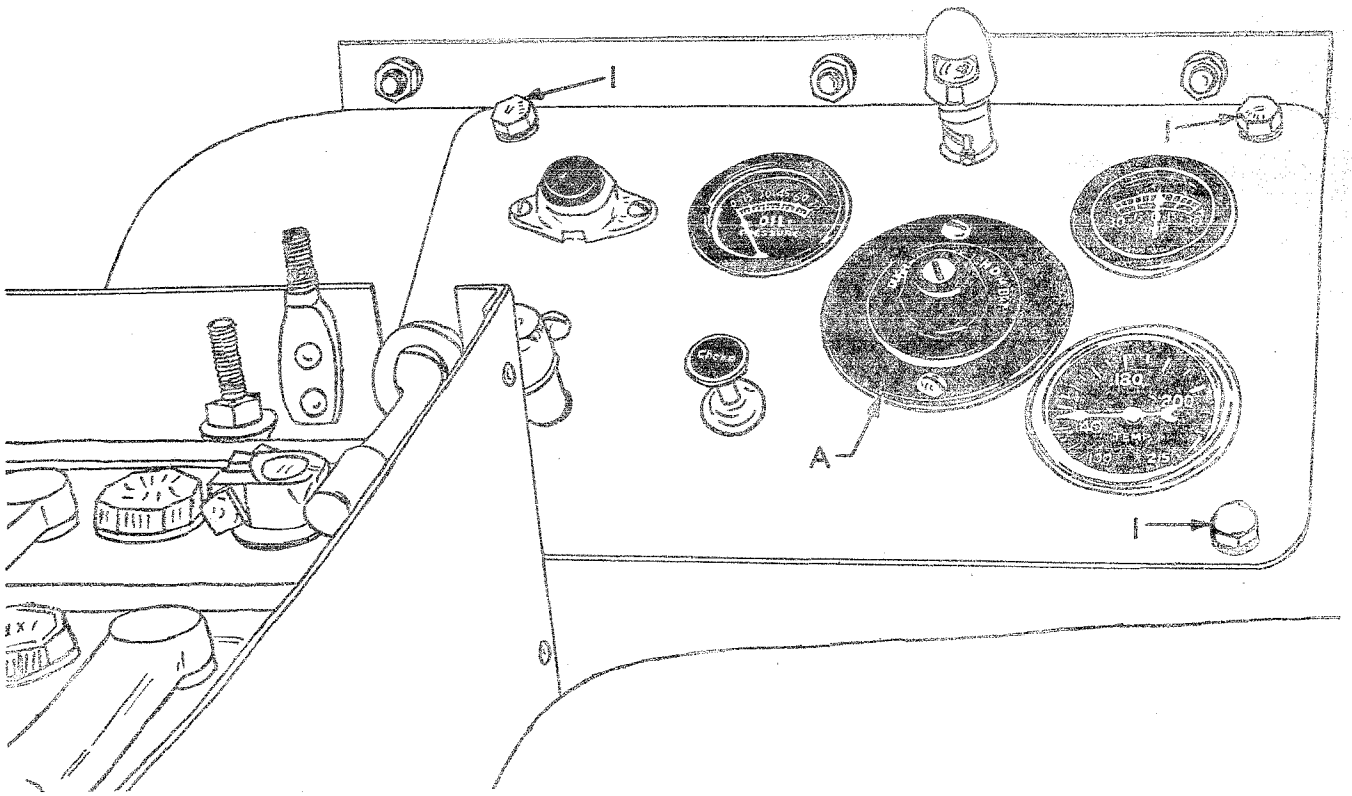
Fuel filters	Replace elements when necessary (page 59; paragraph 60Cm.)
Primary pump filter screen (in IHC injection pump)	Remove and clean (page 60; paragraph 62.)
Magneto distributor cap	Remove and clean (page 65 or 68A)



Wiring for heavy duty generator

Wiring Diagram for UD-14A and UD-16 Engines (12 volt system)

REF.	DESCRIPTION	REF.	DESCRIPTION	REF.	DESCRIPTION
1.	Cable-ground	20.	Generator bracket	39.	Wire
2.	Cable-jumper	21.	Generator brace	40.	Wire
3.	Battery	22.	Generator pulley	41.	Tail light
4.	Cable	23.	Generator (heavy duty)	41B.	Connector
5.	Starter switch	24.	Generator support	42.	Wire
6.	Cable	25.	Generator fan	43.	Defroster switch
7.	Starting motor	26.	Generator pulley	43A.	Wire
9.	Wire	27.	Wire	44.	Defroster fan
10.	Ammeter	28.	Wire	44A.	Wire clip
11.	Ammeter gasket	29.	Voltage regulator	45.	Wire
12.	Wire	30.	Regulator support	46.	Wire
13.	Ignition switch	31.	Wiring harness	47.	Heater
14.	Switch gasket	32.	Loom	47A.	Heater switch
15.	Dash light	33.	Connector	48.	Wire
15A.	Dash light bulb	34.	Wire	49.	Windshield wiper
16.	Wire	35.	Loom	50.	Wiper spacer
17.	Horn button	36.	Loom	51.	Wiper arm
18.	Horn	37.	Headlight-right hand	52.	Wiper blade
19.	Generator (standard)	38.	Headlight-left hand	53.	Wire



87. *INSTRUMENT PANEL.*

To replace the 15 amp. fuse under switch (A), remove the four cap screws (1), after which the panel may be lifted up and tipped over, exposing the fuse block.

88. *DELCO-REMY ELECTRICAL EQUIPMENT. (12 volt system)*

a. Adjustment.

Improper adjustment of any of the electrical units may result in serious damage to the equipment. It is recommended that unless the operator is familiar with the operation and adjustment of the units, he make no attempt to do this work. If repair or adjustment is required, it is suggested that the operator contact his nearest Austin-Western distributor, or United Motors Service Station, as they will have the necessary testing equipment and technical information required to perform this job.

Before working on any part of the electrical system, first disconnect the battery ground cable. Do not reconnect the cable until all other equipment has been connected. This will avoid shorting and causing damage to any of the electrical units.

Be sure all terminals are clean and securely fastened and that there are no broken wires anywhere in the electrical system.

DANGER: The generator will burn out if operated with battery cables or battery circuit cables disconnected or broken. To operate the generator without the battery, remove the connection from the "GEN" terminal on the relay and ground on the relay mounting screw; or remove the generator field cable from the "F" terminal on the generator frame.

b. Cleaning Commutators.

(1) If the commutator of the starting motor or of the generator is greasy, dirty, or slightly burred, it can be polished with No. OO sandpaper. Never use emery cloth. After the polishing operation, all dust must be blown from the commutator.

If a commutator is very rough or out of round, refer to your nearest Austin-Western dealer.

(2) When polishing the starting motor commutator, first pull the "coil-to-distributor" cable from the coil cover end. Then remove the spark plugs and the commutator cover band. With the starting switch depressed and the starting motor operating, place the piece of No. 00 sandpaper over the commutator.

(3) When polishing the generator commutator remove the cover band and place the piece of No. 00 sandpaper between a brush and the commutator while the armature is revolving.

89. *GENERATOR.*

The generator on this machine is a third brush type with cut-out relay and voltage control. This control automatically inserts a resistance into the generator field circuit as the battery reaches a charged condition, and removes it as the battery becomes discharged. In effect, it provides a two stage generator, delivering either a high or a low output, depending upon the battery voltage.

The third brush can be adjusted to vary the charging rate for various conditions.

NOTE: Heavy duty generators are available on special order only. These have a combination voltage and current regulator which prevents overcharging the battery. Therefore, no adjustment of charging rate is provided or needed.

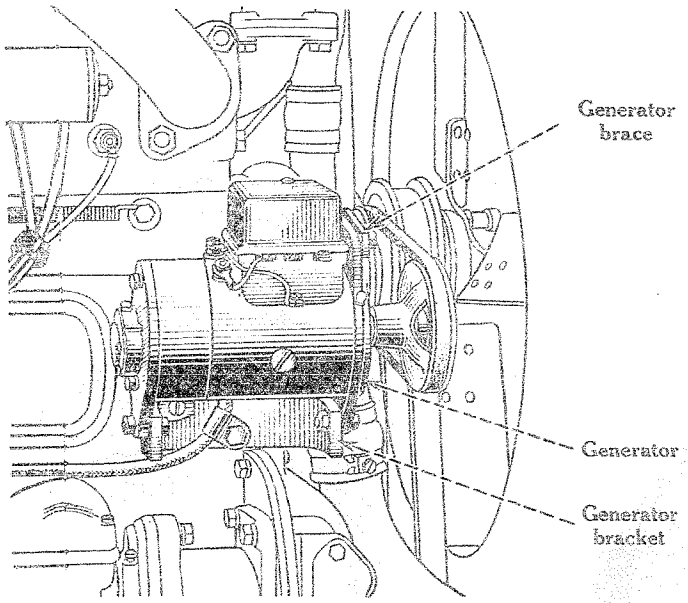


Figure 89. Generator

a. *Adjusting the Generator (See Figures 89A and 89B)*

(1) The generator output (charging rate) may have to be adjusted to meet various conditions, in order to maintain a fully charged battery. To obtain the best performance and life of the battery, do not undercharge or overcharge. Unless you are familiar with this equipment and know how to adjust generators, it is advisable to have the charging rate adjusted, when necessary, by the nearest Austin-Western distributor.

(2) The maximum output should be 3 to 6 amp. with the generator hot, and 8 to 10 amp. when cold. DO NOT SET THE CHARGING RATE BEYOND THESE LIMITS. To determine the actual maximum charging rate of the generator at any time, check at the ammeter. To do this, a fully charged battery should be used. With the engine operating and with no electrical load, remove the voltage regulator cover and slip a match between the armature and the core of the regulator, in order to hold the contact points closed, thus grounding the generator field and maintaining the maximum charging rate. The ammeter needle should show 3 to 6 amp. with the generator hot, or 8 to 10 amp. with the generator cold.

(3) To adjust the charging rate by the third brush:

(a) Remove the cover band.

(b) Loosen the round head screw on the commutator end bearing casting until the lock washer tension is released. DO NOT TRY TO REMOVE THE SCREW.

(c) The charging rate is changed by moving the third brush. This brush is the one mounted on the movable carrier.

(d) The charging rate is increased by moving the third brush in the direction of rotation of the armature. To decrease the rate of charge, move the third brush in the direction opposite to the armature rotation.

IMPORTANT: The third brush should never be set closer than three commutator bars from the main brush.

(e) When the above adjustment is completed, be sure to tighten the round head screw which locks the third brush carrier in place.

(f) Reassemble the cover band with the joint on the bottom of the generator so that the joint is not over any opening.

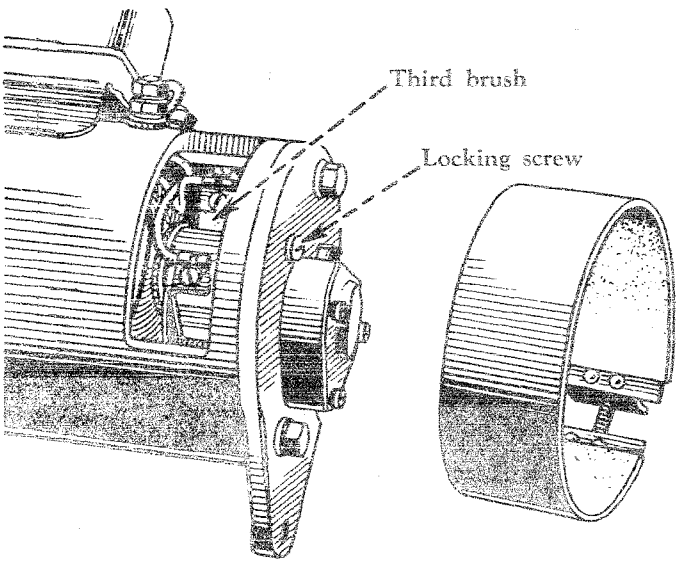


Figure 89A. Generator Cover Band Removed Showing Brushes

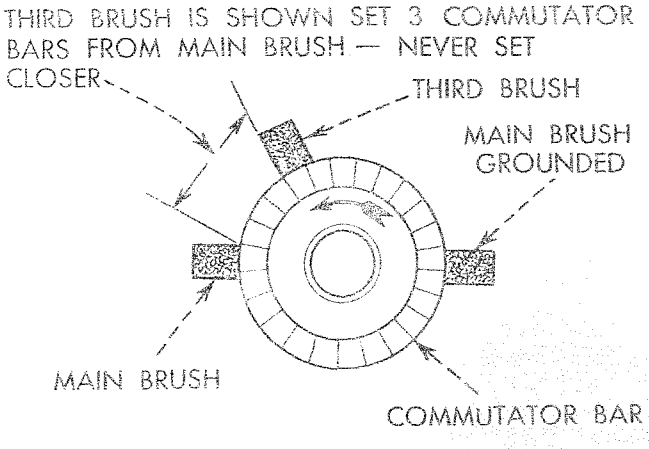


Figure 89B. Generator Third Brush Setting

90. *STARTING MOTOR.*

The starting motor cranks the engine when the circuit between the battery and the cranking motor is closed.

The Bendix drive type cranking motor employs a pinion mounted on a threaded sleeve. When the armature revolves, the threaded sleeve turns within the pinion, moving it endwise and into mesh with the flywheel ring gear, cranking the engine. A spring takes up the shock of meshing. When the engine starts, the flywheel drives the pinion at a higher speed and the pinion is backed out of mesh with the flywheel ring gear.

a. Lubrication.
(Generator and starting motor)

After every 60 hours of operation, put 8 to 10 drops of SAE-20 oil in each of the two cups on the generator. Do not lubricate excessively, since excessive lubrication may cause oil and grease to gum on the commutator and cause a reduction of the generator output. NEVER OIL THE COMMUTATOR!

Occasionally put a few drops of SAE-20 oil in the oil cups on the starting motor.

b. Storage Battery.
(Located back of operator's seat)

(1) The storage battery should be registered with the nearest factory battery service station.

(2) Battery for Export. Complete instructions are included with battery.

(3) Clean Terminals. Battery cable terminals must be clean and tight. Use hot water for removing terminal corrosion and for cleaning top of battery. Brighten terminal contact surface with wire wool, apply a light coat of vaseline, and reassemble. Be sure terminals are clamped tightly and that battery is fastened securely in the battery box.

(4) Vent Holes. Keep vent holes in battery filler caps open.

(5) Electrolyte Level. The electrolyte in each cell should be 3/8" above the separators. Keep the electrolyte up to this level at all times to prevent battery failure. When the electorlyte falls below this level, pure distilled water should be added. Never use hydrant water or any water which has been in a metal receptacle. Keep pure distilled water in a glass jar on hand for battery use only. To put water in a cell, use a clean syringe. When adding water to the battery in temperature near the freezing point (32° F.), always operate the engine long enough to mix the water and the electrolyte, or damage to the battery from the water freezing will result.

> CAUTION: Acid or electrolyte should never be added except by a skilled battery man. Under no circumstances add any special battery "dopes", solutions or powders.

(6) Specific Gravity of Electrolyte.

(a) The battery must be maintained at full charge for satisfactory performance and for safety of the battery. The specific gravity of the electrolyte indicates the relative condition of the battery charge and warns when it may be necessary to increase the generator charging rate or to recharge the battery.

(b) Inspect the battery once a week or more often to maintain correct specific gravity. Specific gravity reading of at least 1.250 corrected to 80° F. should be maintained (see chart).

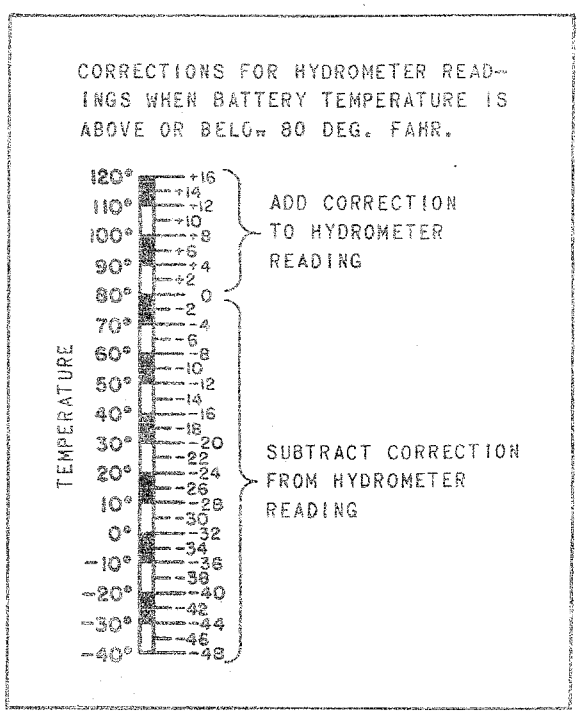
(c) If the specific gravity of the electrolyte is less than the required figure in the chart, the generator charging rate should be increased (see "Adjusting the Generator", page 76, paragraph a.) or the battery should be recharged with standard auxilliary battery recharger.

(d) When testing for specific gravity, use both a battery hydrometer and thermometer. Remove the filler caps. With the thermometer test the temperature of the electrolyte. Then insert hydrometer in each cell and determine the specific gravity reading.

(e) Specific gravity readings should not be made immediately after water has been put into the battery. Take readings either before the water is added or after the battery has been on charge for sometime.

(f) All cells should show approximately the same specific gravity reading. Wide variation indicates something wrong. See your Austin-Western distributor.

(7) Battery Voltage. With the battery fully charged, and on charge at the normal rate, the average cell voltage at 80° F. ranges between 2.5 and 2.7 volts; at 100° F., between 2.4 and 2.6 volts.



Hydrometer Reading Correction Chart

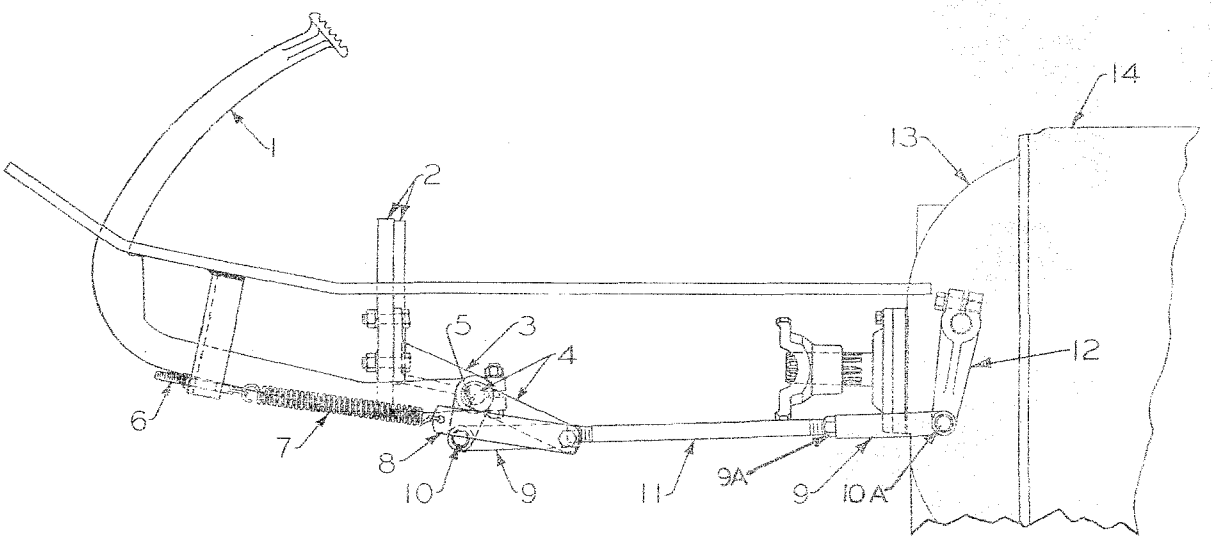


Figure 91. Clutch Operating Linkage

91. *MAIN CLUTCH ADJUSTMENT.* *(See Fig. 91)*

a. General.

(1) First inspect the clutch pedal linkage.

(2) Spring (7) must have sufficient tension of its own to lift the pedal (1) clear up to the floorboard without pulling it up with your hand. If you can lift the foot pedal (1) upward against the floorboard with your hand, then the tension of the spring (7) should be made tighter, or the linkage parts (3), (4), (5), (9) and (10) may be binding and require oiling to loosen them up.

(3) Make certain this return action is positive even with a slow foot action.

(4) Be sure the clutch shaft lever (12) is located on the shaft so that it does not strike the transmission bell housing either in released or full engaged position of clutch. The pin end of lever (12) slants toward the foot pedal (1) when the pedal is in highest position. This is shown above, and the pedal (1) is in the raised and released position.

(5) The clutch itself, however, is in fully engaged position, and there is ample clearance between the clutch throwout bearing (22), Fig. 94, and the clutch fingers (12), Fig. 92, to permit the clutch to operate satisfactorily, unless abused.

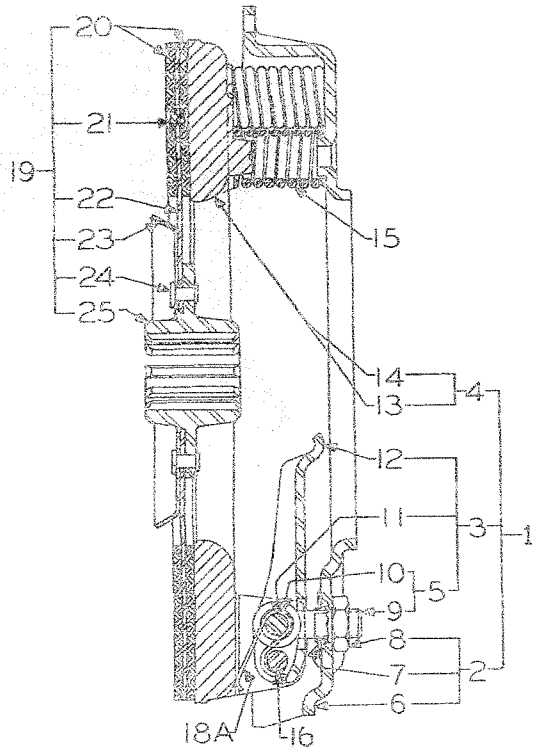
b. Clutch Adjustment.

(1) To adjust clutch, first loosen lock nut (9A), Fig. 91, remove pin (10A), screw forked yoke onto the rod (11) about two turns, and reinstall pin (10A). Do not reinstall the cotter pin thru pin (10A) or tighten the lock nut (9A) at this time. Instead depress foot pedal (1) and observe if the first free easy movement is about 2-1/2". If it is 2-1/2", then replace the cotter pin and tighten lock nut (9A), because it is adjusted correctly.

(2) If the first free easy movement is more than 3", then you have shortened the rod (11) too much, and the clutch will not disengage properly. This will result in gear clashing.

(3) To test and find out if the clutch is disengaging properly, stop the engine, have someone depress the clutch pedal to within 3" of the floorboard. Then try to turn the propeller shaft yoke (9), Fig. 94, with your hands. If it turns freely you can consider the clutch linkage is adjusted correctly and that the clutch is properly disengaging.

NOTE: When the clutch pedal is depressed to the floorboard, you cannot turn the yoke (9), Fig. 94, easily, because the transmission clutch brake is applied. Raising the clutch pedal about 3 inches will release the transmission clutch brake. (See page 82 for clutch brake.)



Section C-C

Figure 92. 15" Clutch (sectional view) (UD-14A and D-471 Engines)

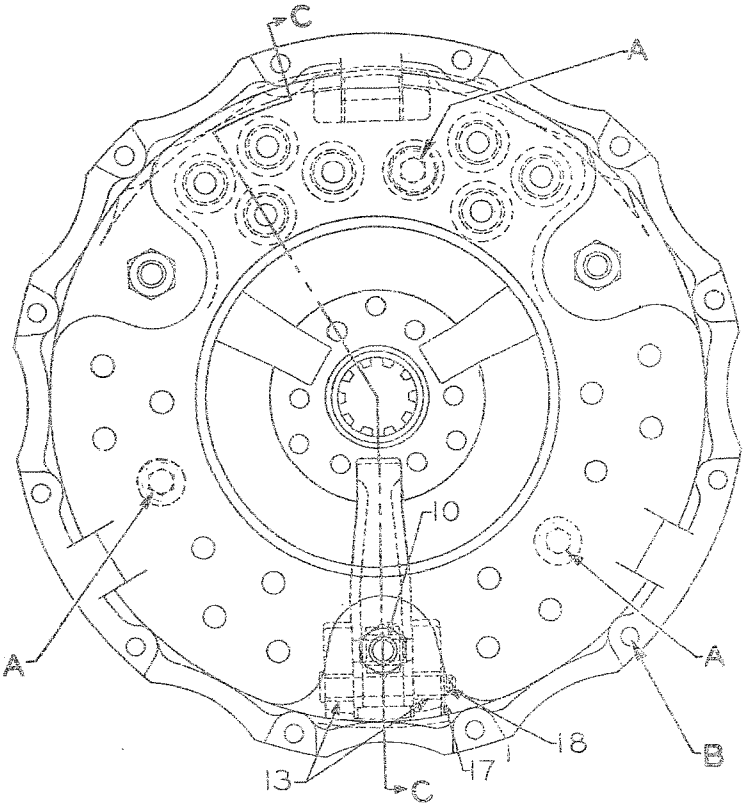


Figure 93. 15" Clutch (back view) (UD-14A and D-471 Engines)

c. Clutch Adjustment Warning.

Do not disturb the factory setting of the three nuts (8), Fig. 92, inside the clutch housing, as these have been properly set at the factory, and without special tools it is impossible to obtain perfect alignment and adjustment. The only field adjustment necessary is in the outside linkage (rod and fork (11) and (9), Fig. 91). Never make any adjustment of the three nuts (8), Fig. 92.

d. Clutch Abuse.

Abuse consists of slipping the clutch, such as, trying to move the grader in soft ground in high reverse speed or any forward speed which the engine cannot pull. In such cases, shift the transmission gears to a lower speed which the engine can pull. Do not slip the clutch unnecessarily, lest you be burdened with costly repairs and the grader not available for work.

Riding the clutch pedal with your foot, or over-lubrication of the clutch release and pilot bearings, constitutes other forms of abuse.

e. Clutch Lubrication.

(1) Clutch throw-out bearing (22), Fig. 94, is lubricated thru the exposed high pressure fitting (19), extending thru the plate (20). Do not over-lubricate this clutch throw-out bearing. Usually it only takes one, and not more than two strokes or pressure gun to replenish grease.

(2) Clutch pilot bearing (25), is lubricated thru an inspection opening (C), located at the front side of the flywheel housing. Rotate flywheel until lubrication fitting (B), in the flywheel, is visible. Consult lubrication chart, page 10, for frequency of servicing operation.

(3) Warped and cracked pressure plates and prematurely worn facings indicate excessive heat, and are generally caused by excessive clutch slippage, or over-greasing. In cases where too much lubricant has been applied accidentally, causing temporary slippage, wash the entire clutch compartment with kerosene to remove all traces of grease.

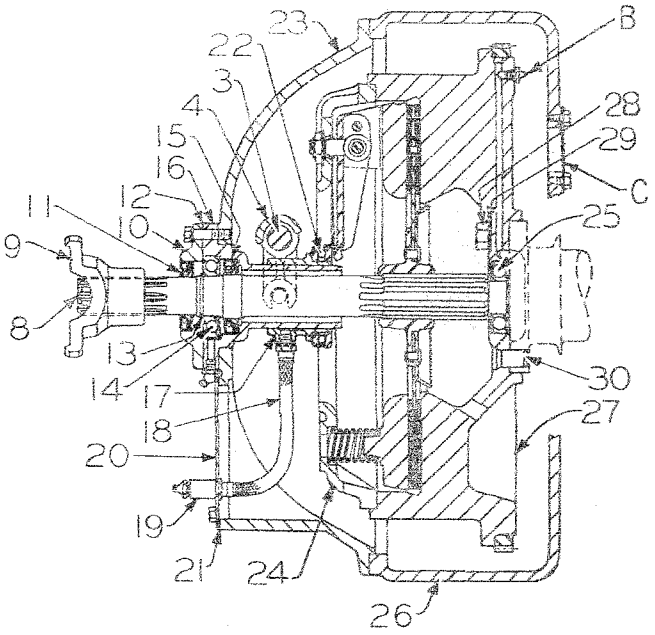


Figure 94. Clutch Compartment (UD-14A Engine)

f. Clutch Removal.

(1) General:

The clutch may be easily removed from the 99-H power grader in approximately 20 minutes. The engine or transmission will not be removed or disturbed in any way. This likewise applies to the cab, seat box, fuel tank, dash, hood, air cleaner, and battery box.

Ordinary hand tools, such as socket wrenches, is all that is required. One man can do the job easily.

(2) To Remove Clutch: (See Fig. 94)

(a) Remove the eight cap screws at both yokes (9). Next remove the clutch to transmission propeller shaft group.

(b) Remove the cotter and pin at the lower end of lever (12), Fig. 91.

(c) Remove the inspection door (20), Fig. 94. Remove nipple (19) from hose (18). Unscrew hose (18) from shifter yoke (17).

(d) Remove the cap screws from bearing cover (10). The shaft (8), with (10), (16) and (17), may be pulled straight out toward the transmission.

(e) Remove the cap screws from cover (23) and lower it to the ground.

(f) Packed in the tool box will be found three, 3/8" x 2-1/2" N.C. cap screws with plain washers, and these should now be screwed into the three holes located in the pressure plate at (A), Fig. 93. These screws will compress the twenty-four clutch springs (15), Fig. 92, and keep the clutch group assembled during clutch removal.

(g) The 12 cap screws at (B), Fig. 93, may now be removed, after which the clutch drive member group may be lifted out of the bell housing.

g. Clutch Installation.

(1) General:

After new clutch linings (20), Fig. 92, are rivetted to the driven disc (22), the outside diameter of the disc should run true with the splined hole at hub (25). To check this, proceed as follows:

(a) The driven member (19), Fig. 92, with shaft (8), and parts (23), (16), (10) and (14), Fig. 94, may be temporarily assembled to the bell housing. The clutch group (1), Fig. 92, should not be assembled to the flywheel at this time. The hub (25) may be held solidly to the splined shaft if it is tapped slightly on the spline taper farthest away from the flywheel.

(b) A dial indicator may be attached to the flywheel with one cap screw (B), Fig. 93. The dial indicator may be read thru cover opening (20), Fig. 94.

(c) When the shaft (9) is rotated by hand, the outside face of the lining should run true; that is, within .010"dial indicator reading. Install a new straight disc if necessary.

(2) To Install Clutch:

(a) Replace clutch pilot bearing (25), Fig. 94, if worn, keeping the bearing seal away from the crankshaft flange. Lubricate the bearing at point (B).

(b) Clean out the flywheel of all dust and lining material.

(c) Install the driven disc into the flywheel, with the short end of the splined hub toward the crankshaft.

(d) Install the clutch (24), leaving the cap screws loose. Insert the shaft (8) thru the driven disc hub and clutch pilot bearing. Then tighten the clutch solidly to the flywheel. Remove shaft (8).

(e) Install and tighten the bell housing (23) to the housing.

(f) Assemble shaft (8) to sleeve (16). (Replace seals (11) and (15), keeping seal lips turned as shown. Replace bearing (14) if worn or damaged; then install snap ring (13).)

(g) Enter shaft (8) with sleeve (16) into bell housing. Slip cap (10) over shaft (8) and install cap screws in cap (10). Remove the cap screws (A) Fig. 93.

(h) Lubricate all bearings (14), (22), and (25)

(i) Readjust clutch linkage, page 79, paragraph 91.-b.

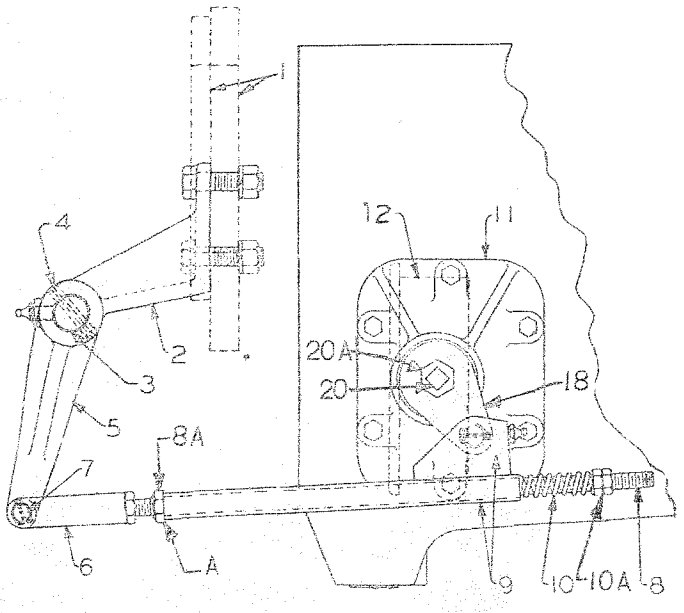


Figure 95. Clutch Brake

92. *CLUTCH BRAKE. (See Fig. 95)*

a. Function of Clutch Brake.

(1) The powerful Austin-Western clutch brake provides a speed retarding effort to the clutch driven member and transmission gears, when shifting gears.

(2) The internal brake consists of a drum (12), 5" in diameter, which is spline driven. A lined brake shoe and internal screw arrangement (18), together with external linkage, is interconnected to the clutch foot pedal (1), Fig. 91. When the foot pedal is pressed to the floorboard, the linkage moves lever (18), Fig. 95, to the left, and the threaded screw moves the lined shoe against the internal drum.

(3) When the engine is running full throttle and brake properly adjusted, and pedal (1), Fig. 91, is depressed to the floorboard, the transmission gears will come to a rolling stop in about three seconds.

b. Clutch Brake Adjustment.

NOTE: Levers (5) and (18), Fig. 95, and interconnecting linkage are shown in released brake position.

(1) First adjust the main clutch, page 79, paragraph 91.-a. and b.

(2) With clutch pedal (1), Fig. 91, in fully raised position, the overall length of spring (10), Fig. 95, should be adjusted to about 2". Then lock the two nuts (10A) together as shown.

(3) Run the engine at wide open throttle. Then have an assistant depress and hold the foot pedal (1), Fig. 91, to the floorboard.

(4) Loosen lock nut (20A), Fig. 95, and adjust the screw (20) in order to establish about 1/16" space between the end of tube (9) and nut (8A). (Nut (8A) is welded to rod (8) and will move to the left about 1/16" when adjusting screw (20) is properly set and lock nut (20A) tightened.)

Move the clutch pedal upward and downward full distance several times and observe at (A) for proper 1/16" spacing.

NOTE: The main clutch must be adjusted as shown on page 79, paragraph 91-a. and b., before the above adjustments are made.

92A. *MAIN CLUTCH ADJUSTMENT. (UD-16 Engine)*

a. General.

The UD-16 Engine is fitted with a 16" clutch having 4 release levers and 24 compression springs.

NOTE: The adjustment of the 16 inch clutch as used on the UD-16 Engines is the same as shown on the complete page 79.

b. Clutch Lubrication.

(1) Clutch throw-out bearing (22), Fig. 94, is lubricated thru the exposed high pressure fitting (19), extending thru the plate (20). Do not over-lubricate this clutch throw-out bearing. Usually it only takes one, and not more than two strokes of pressure gun to replenish grease.

(2) Clutch pilot bearing lubrication for UD-16 engines, effective after serial No. UDCM-3255, is the same as shown in paragraph e. (2), page 80.

Before the bearing is installed into the flywheel, the lubricant compartment back of the bearing is packed one half full with lubricant having the following specifications:

"High temperature, smooth texture premium ball bearing grease, #2 grade consistency, soda soap base."

This grease may be easily secured from any responsible lubricant supplier such as:

Standard of
New Jersey.....Andoc (Grade "C") Grease
Shell.....Nerita #2 Grease
Standard of
Indiana.....Stanobar #2 Grease
Texas.....Marfak #2 Heavy Duty Grease

(3) Warped and cracked pressure plates and prematurely worn facings indicate excessive heat, and are generally caused by excessive clutch slippage, or over-greasing. In cases where too much lubricant has been applied accidentally, causing temporary slippage, wash the entire clutch compartment with kerosene to remove all traces of grease.

c. Clutch Adjustment Warning.

Do not disturb the factory setting of the four nuts (8), Fig. 92, inside the clutch housing, as these have been properly set at the factory, and without special tools it is impossible to obtain perfect alignment and adjustment. The only field adjustment necessary is in the outside linkage (rod and fork (11) and (9), Fig. 91). Never make any adjustment of the four nuts (8), Fig. 92.

d. Clutch Abuse.

Abuse consists of slipping the clutch, such as, trying to move the grader in soft ground in high reverse speed or any forward speed which the engine cannot pull. In such cases, shift the transmission gears to a lower speed which the engine can pull. Do not slip the clutch unnecessarily, lest you be burdened with costly repairs and the grader not available for work.

Riding the clutch pedal with your foot, or over-lubrication of the clutch release and pilot bearings, constitutes other forms of abuse.

e. Main Clutch Removal and Installation.

The removal and installation of the 16 inch clutch is the same as shown on pages 81 and 82, except (during removal and installation operation) 4 cap screws (A) should be screwed into place at (A) before the cap screws (B) are removed from the flywheel. (A new spare clutch will have 4 cap screws (A) in place and these hold the clutch fingers and clutch springs in place during shipment and storage.)

NOTE: When installing the clutch disc into the flywheel, be sure to place the long end of the splined hub toward the crankshaft.

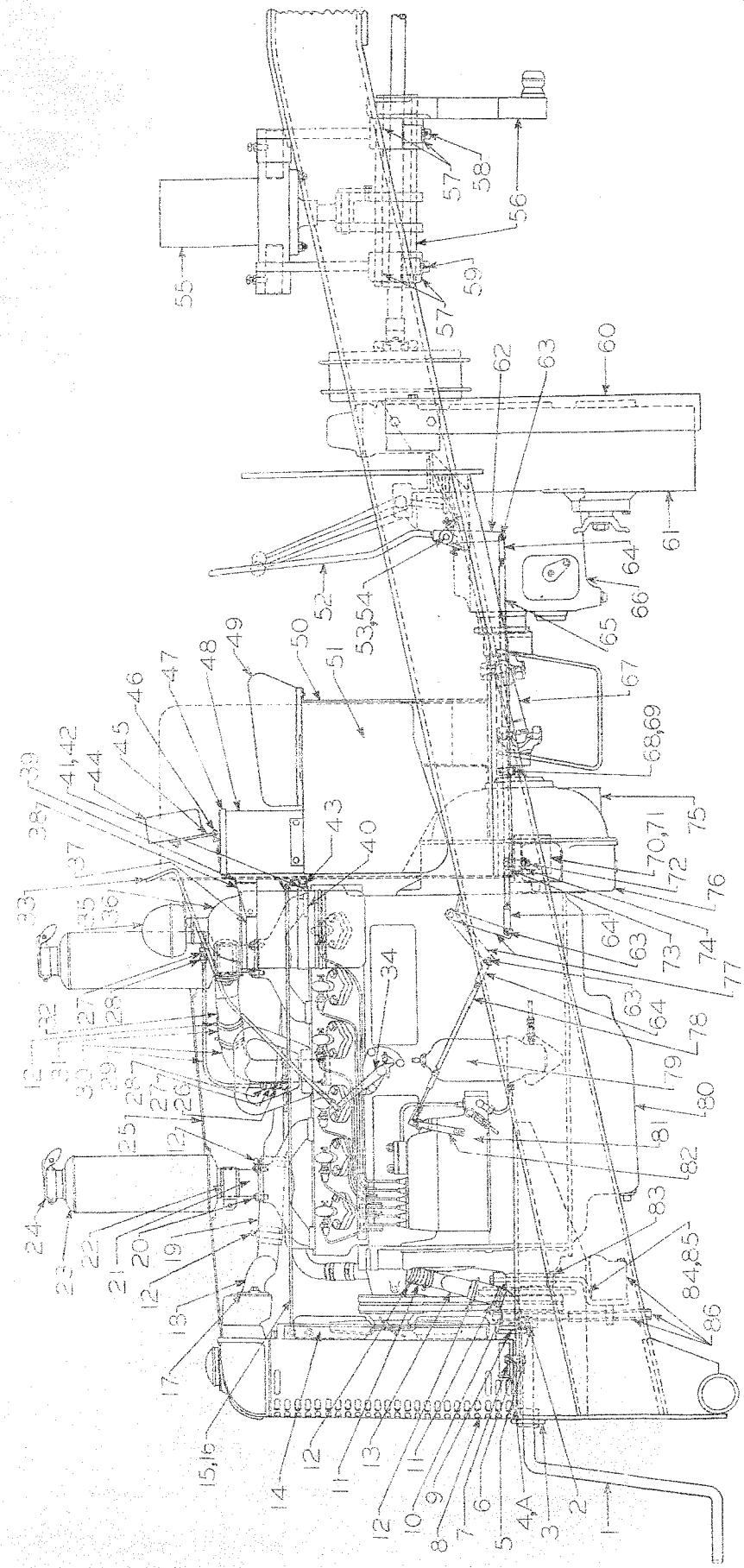


Figure 95A. UD-16 Power Plant and Drive

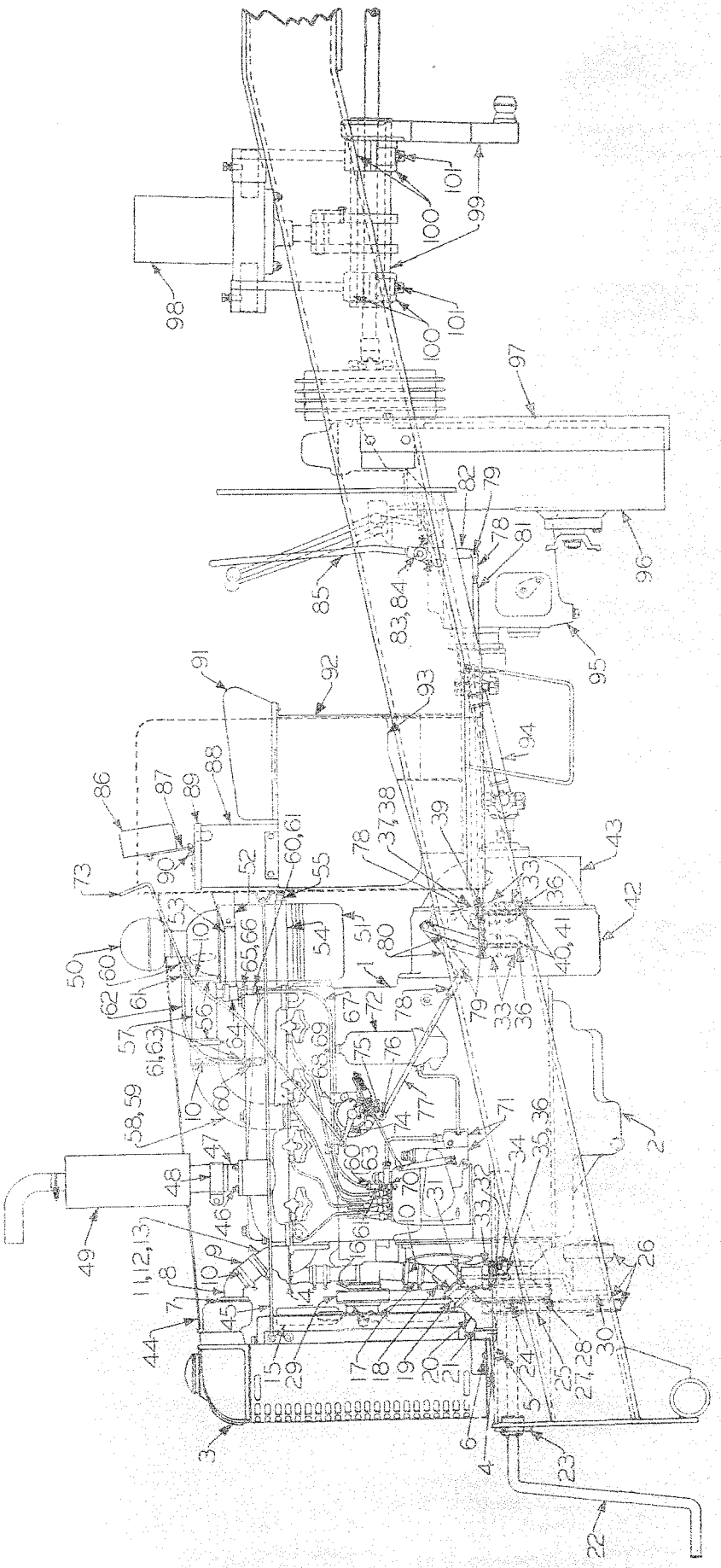


Figure 96. UD-14A Power Plant and Drive

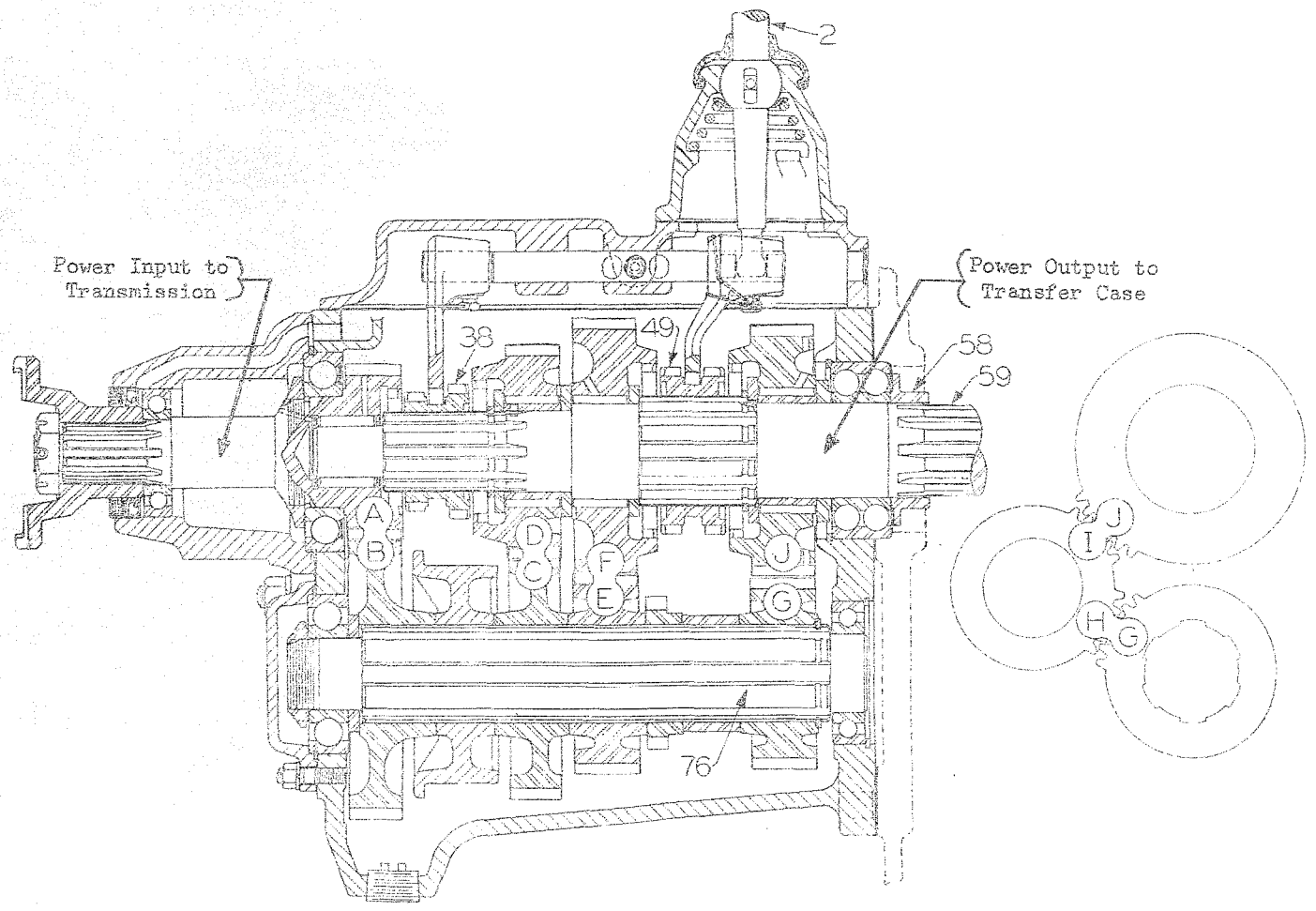


Figure 97. "Constant Mesh" Transmission (Gear Diagram)

SPEEDS	MAIN TRANSMISSION	AUX. TRANS.	M.P.H.	SPEEDS	MAIN TRANSMISSION	AUX. TRANS.	M.P.H.
1	1, N	LOW, N	1.7	5	N, 2	N, HIGH	9.4
2	N, 2	LOW, N	2.78	6	3, N	N, HIGH	15.
3	3, N	LOW, N	4.06	R	N, R	LOW, N	1.74
4	1, N	N, HIGH	5.8	R	N, R	N, HIGH	5.87

Figure 97A. Gear Shift Chart

93. *AUSTIN-WESTERN "CONSTANT MESH" TRANSMISSION. (See Fig. 97)*

a. General.

(1) The 99-H power grader is equipped with a "Constant Mesh" transmission.

(2) "Constant Mesh" means that all the gear teeth at (A), (B), (C), (D), (E), (F), (G), (H), (I) and (J) are constantly in mesh when in neutral, low, second, high, or reverse speeds.

(3) To make a change in speed it is necessary to move shift lever (2) forward or backward, and one male jaw shifter (38) or (49) will be shifted either right or left, from neutral, into a female gear opening.

(4) The A-W transmission in the 99-H is very compact and substantial. Sliding jaw gears have not less than fourteen teeth simultaneously entering into engagement when shifting is done, instead of two teeth making engagement, as in conventional transmissions.

NOTE: In a transmission of other design, having sliding gears, two teeth only are simultaneously engaged when a gear shift is made.

b. Power Input to Transmission.

(1) Shaft and gear (A) is the main drive from engine to transmission.

(2) Gear (A) constantly rotates gear (B). (B) constantly rotates all parts on splined shaft (76), including floating gears (D) and (F).

(3) Gear (G) constantly rotates reverse gear (H), which in turn constantly rotates floating gear (J), at (I).

NOTE: The floating gears (D) and (F) always rotate in same direction (around shaft (59)) as drive shaft (A). The floating reverse gear (J) always rotates in opposite direction to drive shaft (A).

c. Power Output from Transmission to Transfer Case.

(1) Upper shaft (59) is the power output shaft to transfer case (to both front and rear axles). In neutral it, and the two shifting jaw clutches (38) and (49), do not rotate.

d. To Shift to High Gear.

Hand shift lever (2) moves shifter (38) into female gear opening near (A).

NOTE: Shafts (A) and (59) now will rotate at the same speed and direction as the engine crank shaft. Now shift back to neutral.

e. To Shift to Second Gear.

Hand lever (2) moves shifter (38) into female gear opening near (D).

NOTE: Shaft (59) now will rotate slower than driver (A), but in the same direction. Now shift back to neutral.

f. To Shift to Low Gear.

Hand lever (2) moves shifter (49) into female gear opening near (F).

NOTE: Shaft (59) now will rotate still slower than driver (A), but in same direction. Now shift back to neutral.

g. To Shift to Reverse Gear.

Hand lever (2) moves shifter (49) into female gear opening near (J).

NOTE: Shaft (59) now rotates still slower and in opposite direction to driver (A). Now shift back to neutral.

93A. "CONSTANT MESH" TRANSFER CASE GEARS. (See Fig. 98)

a. Gears (33) and (60) are always in constant mesh. This likewise applies to the three gears (12), (36) and (12).

b. Jaw shifters (63) and (35) are shown in neutral position.

c. To shift into low transfer case speed, shifter (63) is moved into full mesh in the female opening of gear (60). Shifter (35) is in neutral position.

d. To shift into high transfer case speed, shifter (35) is moved into full mesh in female opening of gear (36). Shifter (63) is in neutral position.

94. *TRANSMISSION AND TRANSFER CASE GEAR SHIFTING.*

Gear shifting in this transmission and transfer case is accomplished thru shift levers (2), Fig. 97, and (73), Fig. 98.

> CAUTION: The high reverse speed (5.87 M.P.H.) is provided for backing up under normal operating conditions. When backing up in extreme operating conditions (soft ground, bulldozer, snow plow, or when grader is stuck), be sure to use the low reverse speed (1.74 M.P.H.). The low forward speed (1.7 M.P.H.) should be used in hard pulling operating conditions.

Do not slip the main clutch. Do not overload the engine; instead shift to lower gear speed.

Damage to the transmission gears will surely result if the main clutch driven disc is not allowed to stop when shifting from one gear to another, or reverse. Allow about three to three and one-half seconds before completing each gear shift. This will save many dollars in repairs and replacements.

Care must also be taken to be sure the gear shift lever is moved full distance so the gear teeth are shifted into complete engagement.

Get the "feel" of all shifting positions and be sure to "feel" the spring loaded balls (78), Fig. 98, and (22), Fig. 99, drop down into the notch in the shifter rails. Then, and only then, will you know that complete tooth engagement has been obtained.

There are no adjustments necessary, as on this transmission all operating mechanisms have been properly set at the factory, and by proper lubrication and a reasonable amount of care exercised in shifting, you should experience no difficulty with the transmission and transfer case.

a. Lubrication.

The 99-H power grader constant mesh transmission oil level and filler plug is located on the left side of the transmission. Use a good grade of transmission lubricant, SAE-140 for summer and SAE-90 in the winter. See lubrication chart, page 10, and approved list of lubricants, page 9, for special instructions.

95. *TRANSMISSION AND TRANSFER CASE REMOVAL.*

a. General.

If internal repairs are to be made, then the assembled transmission and transfer case should be removed as a group from the grader frame.

Before dismantling, if the machine is in operating condition, it is best to drain the gear oil from the transmission and transfer cases and refill them with flushing oil (kerosene or diesel fuel) and run the machine slowly backward and forward for several minutes. It is best to drain this first washout; refill with clean flushing oil, and repeat. In this way, the second washing will usually get everything clean and free of oil.

> CAUTION: Do not use gasoline, as there is danger of explosion and fire.

b. Transmission and Transfer Case Group Removal.

The engine, radiator, and engine accessories, need not be disturbed. This likewise applies to the cab, operator's seat, battery box and dash. One hydraulic line (61), Fig. 153, page 120, must be disconnected.

Certain equipment, such as a chain hoist of not less than one-half ton capacity and the necessary wood blocking, jacks, etc., is needed before starting the operation.

Follow the procedure outlined as follows:

(1) Remove the four cap screws at the following yokes: (28), page 94; (51) and (21), page 88; (2), page 98, Fig. 110. The center section of front propeller shaft (1), Fig. 109, may now be removed after removing the four bearing housing to frame bolts (B).

NOTE: Shaft (1) may have to be shifted forward slightly within the bore of bearing (6A).

(2) Remove shift lever group with cover, after removing the nuts at (26), Fig. 99. Also remove the sheet metal cover over transmission.

(3) Remove pin (7). Then remove rod group, after removing the cotter pin near (18), Fig. 95, page 82.

(4) Remove brake cable at hand lever.

(5) Remove hydraulic brake hose at master cylinder end, Fig. 100, page 93.

(6) Remove bracket (69), with shift lever (73), Fig. 98. Also remove guard (97), Fig. 96, under the transfer case.

(7) Remove the two bolts (92) and (97), Fig. 98.

(8) Place suitable blocking under transmission.

(9) Remove brake drum (23), flanged yoke (21), and backing plate (15).

(10) Use one chain hoist and attach chain end over stud (X). (Balance of hydraulic piping need not be removed.)

(11) Remove support (91) and shift the transfer case forward slightly; then remove breather (87). (Be sure to reinstall this breather at the correct moment when sliding transmission and transfer case into frame hangers.)

(12) Transmission and transfer case may now be shifted forward about 4 inches and carefully lowered to the ground by means of chain hoist and chain. (Remove blocking progressively as transmission and transfer case is being lowered to the ground.)

Reassembly is reversal of above procedure.

NOTE: Replace washers (93) and (94) with bolt (97), as shown. Also washer (93) with bolt (92).

96. *TRANSFER CASE DISASSEMBLY.*
(See Fig. 98)

To remove the transfer case from the transmission, it is necessary to first follow the procedure outlined in paragraph 95.

The 2-speed transfer case attached to the machined rear face of the transmission is the power division gear case and contains five spur gears. This case pilots over the outer race of the end bearing (57), Fig. 102, top transmission shaft. Eight large studs (16), Fig. 98, hold the transmission and transfer cases together with an oil tight gasket in between.

After these two units are out of the power grader, proceed as follows:

(1) Remove cover (1) and oil guard (3).

(2) Remove nut (26) on upper drive shaft (27), also universal joint brake flange (21). Remove the nuts from the studs (9) and (16). Bearing cap (7) may now be pulled out, after which the shaft (27) can be driven toward the splined end of the shaft. (Use light hammer and bronze drift on the opposite end when driving it out.) The brake plate (15) shims (18), with Timken bearing and cup, will come out with the shaft. Keep the shims wired to plate (15) while in dismantled state.

The upper gear (12) may now be lifted upward and out of the case, together with the rear timken cone (11).

(3) The two set screws (79), with lock wires (80), may be removed, permitting the removal of shifter shafts (81) and (82). Also remove two springs (77) and two balls (78).

(4) Remove the nuts from studs at cap (44). The snap ring (41) should now be removed. Next remove the nuts from the studs and pull out the bearing housing (42). The gear (36) may now be pulled off shaft (28), together with the three ball bearings (37), and thick spacer (39), and thin spacer (40). Slip the shifter (35) off the shaft. (Lift out fork (84) when dismantling. Insert this fork into slot

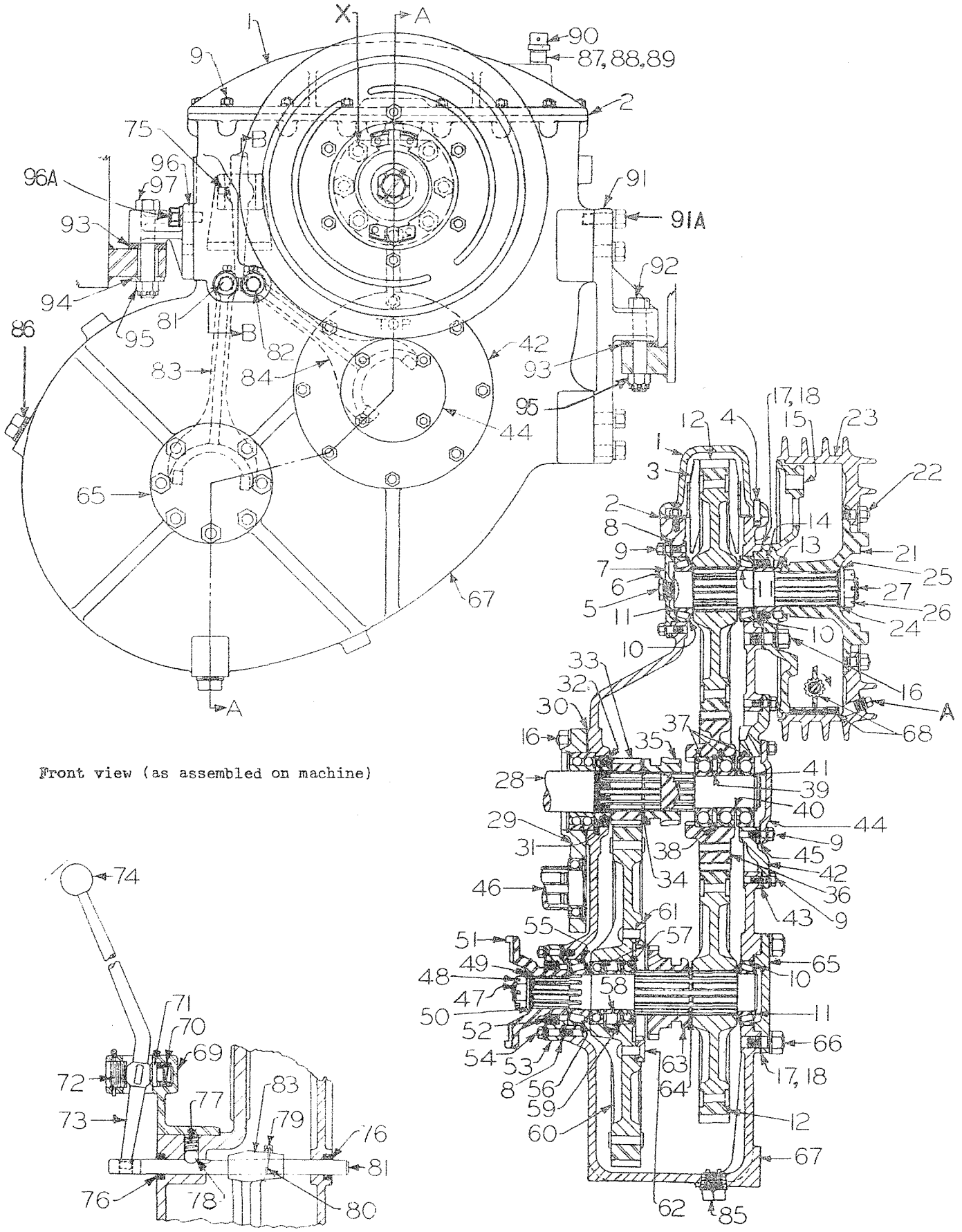


Figure 98. Transfer Case

in shifter when reassembling.) Then expand the snap ring (34) and slip it, with gear (33), off the shaft.

(5) The transfer case (67) may now be removed from the transmission case, after all nuts have been removed from the studs (16).

(6) Expand the snap ring (64) and move it and the shifter (63) toward large gear (60). Remove cap (65), with shims (18). Keep the shims wired to cap (65).

(7) Next remove the nut (48) and yoke (51) from shaft (47). Use a medium weight hammer and drive against a bronze drift on the left or yoke end of the shaft, driving it out toward the right. The Timken cup and cone (11) will come out with the shaft.

(8) The gear (12), snap ring (64), shifter (63), gear (60) and cone (56) may now be lifted up and out of the case.

97. *TRANSFER CASE REASSEMBLY.*

a. For reassembling reverse the above procedure.

b. Before reassembling shaft (47), clean, inspect, and replace (if necessary) all parts, such as seals (52), gaskets (8) and (17), Timken bearings (55), (56), (10) and (11) and spacer (58).

c. Clean the complete transfer case and parts carefully, inside and out.

d. Place Timken cone (11) (taper outward) over the stub end of the shaft, and pass the yoke end of shaft (47) thru the right lower hole in the case; then thru parts as follows: (12), (64), (63), (with shifter groove nearest to gear (12)), gear (60), with spacer (58) between bearings (57). Timken cone (56), with taper outward. (Be sure snap rings (64) and (59) seat solidly in the grooves). Tighten cap (53) solidly to the case (67), after being sure Timken cone (55) is in place. Assemble and tighten solidly the yoke (51), using washer with nut (48). Test gear (60) as it should turn freely on bearings (57). (Snap rings (59) are spaced to provide about .006" gear hub end clearance over the outside diameter of the two bearings (57).)

e. Next install cup (10) with taper inward, then a new gasket (17), together with shims (18), as required, and cap (65). (Shaft (47) should not have any end clearance.)

f. When a new gasket (30) is installed between the transfer and transmission cases, care must be used in evenly and alternately tightening the nuts on studs (16), otherwise the transfer case may be tipped slightly, later presenting difficulty in entering the last or outer ball bearing (37), nearest to cover (44).

We strongly recommend the use of a dial indicator attached to the right end of shaft (28) and indicating in the bore of the transfer case at the point where the outer ball bearing (37) is located.

The indicator reading must not exceed .002" eccentricity. If it is greater than .002", then loosen the nuts on studs (16) and retighten them alternately until all are tight, then dial indicate the bearing bore again for final alignment. (Both faces of the transmission case and transfer case must be clean and smooth. A new gasket (30) should always be installed.)

NOTE: Nut (31) must be on the shaft with the small diameter toward the right and seal left out entirely.

g. Slip gear (33) over shaft (28). Be sure the snap ring (34) is locked in the shaft groove. The shifter fork slot in shifter (35) should be nearest to gear (33). (Insert the fork (84) into the shifter slot before moving the shifter onto the spline of shaft (28).) Install the rear ball bearing (37) and the snap ring (38) in gear (36), and slip it over shaft (28). Next slip the following parts on the shaft in order shown; namely, spacer (39), bearing (37), washer (40), bearing (37), then securely locate the snap ring (41). Covers (42) and (44) may now be attached to the case.

NOTE: The location and end clearances of all gears, bearings and spacers are

controlled by the snap rings as follows: (34), (38) and (41). All snap rings should be concentric and the circular tension should solidly lock the rings in the snap ring grooves.

h. Install new seals (76). (Turn lips in.) Reinstall shift fork (83), together with shifter shafts (81) and (82), locking the two set screws (79) by means of lock wires (80), as shown. Replace the springs (77), balls (78) and bracket (69).

i. Lower the gear (12) into position, after installing the left cone (11) (taper outward) with cup (10), together with cover (7).

Next insert shaft (27) and right cone (taper outward), with cup (10). Then brake plate (15) (seal lip turned inward) with all shims (18). Add or remove shims as required in order that the shaft (27) will not have any end clearance. (The Timken bearings should not be preloaded or binding.) Next install spacer (13) and flange (21), with brake drum (23). Securely tighten and cotter the nut (26).

j. Install oil guard (3).

k. Reinstall cover (1). Cap (90) has a drilled vent for ventilation purposes. Pipe (87) extends downward into the transfer case about 2-1/2". Its lower end is cut on a 45° bias and the long side of the tube should be turned toward gear (12).

Never attempt to dismantle or make repairs to the transfer case without thoroly studying the cross section diagram shown in Fig. 98.

98. *TRANSMISSION SHIFTING COVER.* *(See Fig. 99)*

a. It is not necessary to remove the transmission or seat box to inspect the shift rails (15) and (11). It is only necessary to remove the nuts at studs (26) and lift off the shift lever group.

b. Then remove the nuts at studs (26A), after which the rail case cover may be lifted upward and turned over on its back, and removed from the right side of the grader. (Mechanic stands on the ground to do this.)

c. Remove the expansion plugs from the cover, also the three wired set screws from the shift rod ends.

d. Remove the two cap screws (19) with washers (20). The two outer springs (21) and balls (22) will now fall out.

e. Shift both rails into neutral, then either rail may be slid out of the cover hole. The three center balls will now fall out. Remove the other rail.

f. Reassembly is reversal of the above procedure.

g. The tension of springs (21) should not be too tight, otherwise hard shifting will be the result.

h. When installing the cover to the transmission, be sure the lower ends of both shift forks (12) and (16) slide into the shift grooves of shifters (38) and (49), Fig. 102.

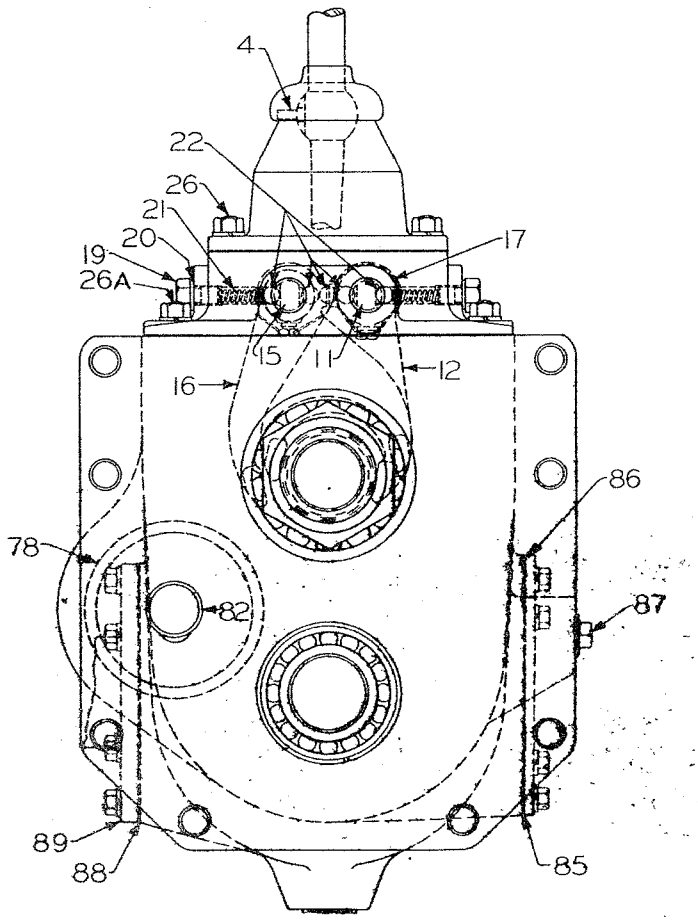


Figure 99. Transmission

99. *HYDRAULIC BRAKE SYSTEM.*

a. General.

The powerful hydraulic "Bendix Duo Servo" brake utilizes a standard hydraulic actuating system, having a compensating type master cylinder operated by a foot pedal, and a brake actuating cylinder at brake drum, together with the required piping, hose, and operating fluid. When a push is exerted on the foot pedal, pressure is created within the master cylinder, causing the column of fluid contained in the master cylinder, piping, etc., to move the drum cylinder pistons, which in turn forces the brake shoes into contact with the brake drum.

When the foot pedal is released, the brake shoe return springs retract the brake shoes and return the drum cylinder pistons to their normal or "off" position, thereby reversing the movement of the column of fluid within the system so that it flows back into the master cylinder.

b. Foot Pedal Adjustment.

The foot pedal should be adjusted so that there is approximately 1" of free movement at the tread portion of the pedal before the pressure stroke begins. Should the master cylinder link be adjusted so that there is no backlash in the foot pedal, the master cylinder piston and cup may not return sufficiently to uncover the master cylinder compensating port, which may cause failure of the brake to fully release. If the brake does not fully release the frictional drag will cause the fluid to further expand as its temperature is raised. This expansion of fluid will cause an increase in brake drag and may, in extreme cases, result in self-application of the brake to the point where the grader cannot be moved until the pressure is relieved by bleeding, or allowing the fluid to cool. Adjust pedal clearance.

c. Bleeding the Hydraulic Brake System.

Whenever the hydraulic line is disconnected from the master cylinder, it is usually necessary (after reconnecting the line) to bleed the entire hydraulic system at drum cylinder, to expel any air that may have been taken into the system. Fill the master cylinder reservoir with genuine Lockheed or Delco brake fluid before bleeding the line. Keep the reservoir at least half full of fluid at all times.

To bleed the line, unscrew the hex shouldered portion of bleeder screw three-quarters of a turn to the left and push pedal down slowly. This produces a pumping action which forces fluid through the tubing and drum cylinder, carrying with it any air that may be present in the line.

When air bubbles cease to appear, and the fluid stream is a solid mass, hold the brake pedal down and have a mechanic close the bleeder screw.

Fluid drained out of the system during the bleeding operations should not be used again as it may contain dirt or foreign matter which may be injurious to the system. After drum cylinder is bled the supply of fluid in the reservoir should be replenished.

> CAUTION: Be sure to keep the reservoir half full of brake fluid when bleeding the brake system. Should the reservoir be drained during the bleeding operations, air will again enter the system and rebleeding will be necessary.

d. Brake Adjustments.

Do not adjust brake when drum is hot. If brake is adjusted when drum is hot and expanded, the shoes may drag when the drum cools and contracts.

There are two points for adjustment in a brake system of this type to compensate for normal brake lining wear. These points are the adjusting screw (6) and the anchor pin (15), Fig. 101. The adjusting screw takes up the clearance between the brake lining and the brake drum. The anchor pin serves to centralize the shoes.

e. To Adjust Brakes to Compensate for Wear. (See Fig. 101)

(1) Jack up both rear wheels and one front wheel clear of the floor.

(2) Remove the four 3/8" pipe plugs from brake drum (23) at (A), Fig. 98.

(3) Release brake. Revolve wheels, causing brake to rotate until arrow that is cast into the brake drum (23), Fig. 98, points down.

(4) Thru lower right hand 3/8" pipe plug hole in brake drum, insert a pry between the lining of the shoe (2) and the brake drum, and move the shoe assembly until the other shoe (2) is against the drum.

(5) Insert a .015" feeler gauge between the lining and the drum at lower end of shoe (2). Turn the adjusting screw with a screw driver, which causes the adjusting screw to force the brake shoes against the drum until .015" clearance between lining and drum is obtained. Check the clearance at the upper end of the shoe (2). .015" clearance at each end of this shoe indicates correct anchor pin position and insures proper brake lining contact with drum.

(6) In the event .015" clearance at each end of shoe (2) is not found in checking, it will be necessary to move the anchor pin to the correct position.

(7) To adjust the anchor pin, loosen the anchor pin nut (16) just enough to permit turning the anchor pin with a screw driver (inserted thru adjusting hole in the upper face of the drum). To decrease clearance between the drum and lining at the anchor pin end of the shoe (2), turn the screw driver to the right. With the shoe (2) against the drum, turn the adjusting screw and anchor pin in the necessary direction to obtain .015" lining to drum clearance at both ends of shoes (2).

(8) Tighten anchor pin nut securely with a wrench while holding the anchor pin with a screw driver. Again check the shoe clearance to be certain the anchor pin has not moved.

(9) Install the four 3/8" pipe plugs into brake drum.

f. Precautions.

Use only alcohol to clean rubber parts and the inside of master and drum cylinders. Kerosene or gasoline may cause damage to or failure of the hydraulic system.

Do not allow grease, oil, paint, brake fluid, or foreign matter to come in contact with the brake lining.

If brake shoes are not properly lined, poor braking will result. It is better to install new brake shoe and lining groups when linings are badly worn.

100. HAND BRAKE.

The hand brake lever and interconnecting cable actuates lever (25), Fig. 101.

Periodic mechanical adjustments are not required to the hand brake mechanism.

Lubricate weekly the hand lever pins and internal cable, using SAE-10W oil.

101. HYDRAULIC FOOT BRAKE MASTER CYLINDER. (See Fig. 100)

The master cylinder and interconnecting parts require no periodic adjustment.

Do not allow the master cylinder reservoir to become less than one-half full of brake fluid at any time.

Keep filler cap (3) clean on master cylinder to prevent air vent being plugged with dirt.

Use only genuine Lockheed or Delco brake fluids. Substitutes may do considerable damage to the hydraulic system.

> CAUTION: Be sure to keep the reservoir half full of brake fluid when bleeding the brake system. Should the reservoir be drained during the bleeding operations, air will again enter the system and rebleeding will be necessary.

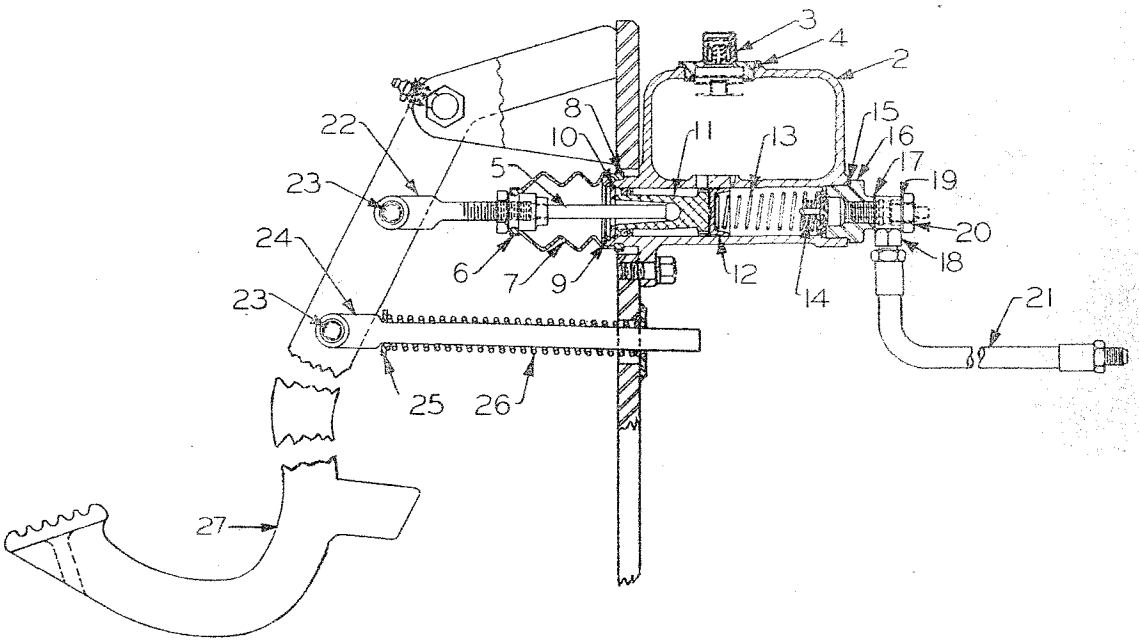
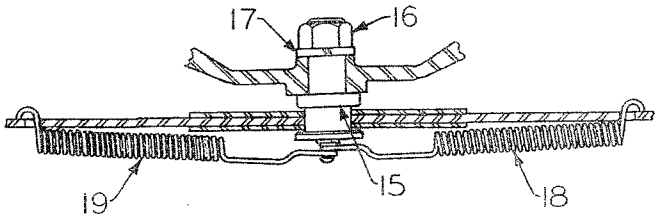
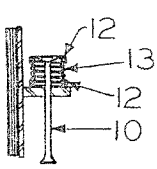


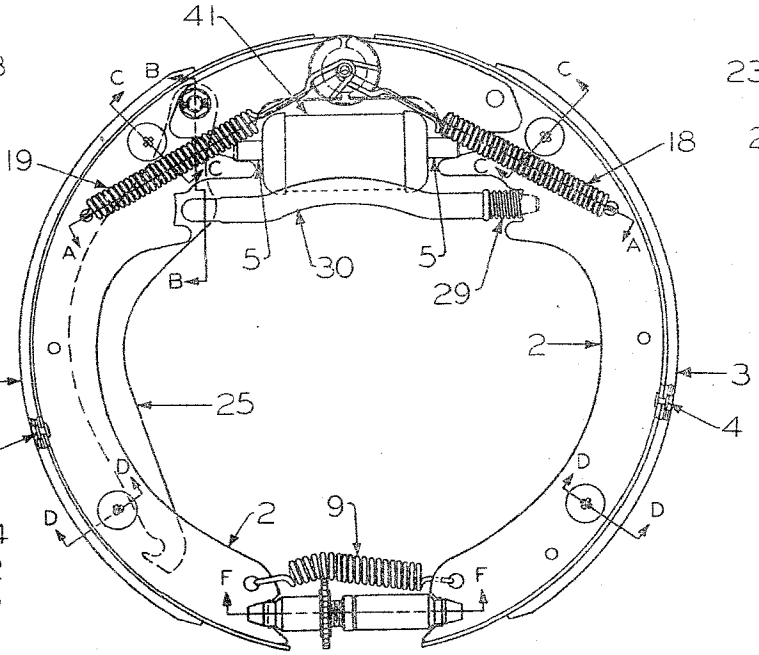
Figure 100. Hydraulic Brake Master Cylinder

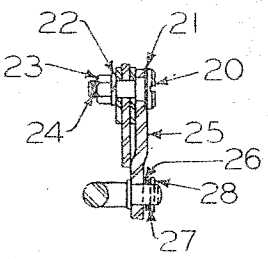


Section A-A

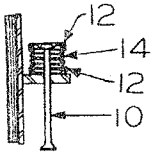


Section C-C

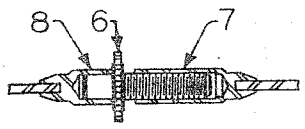




Section B-B

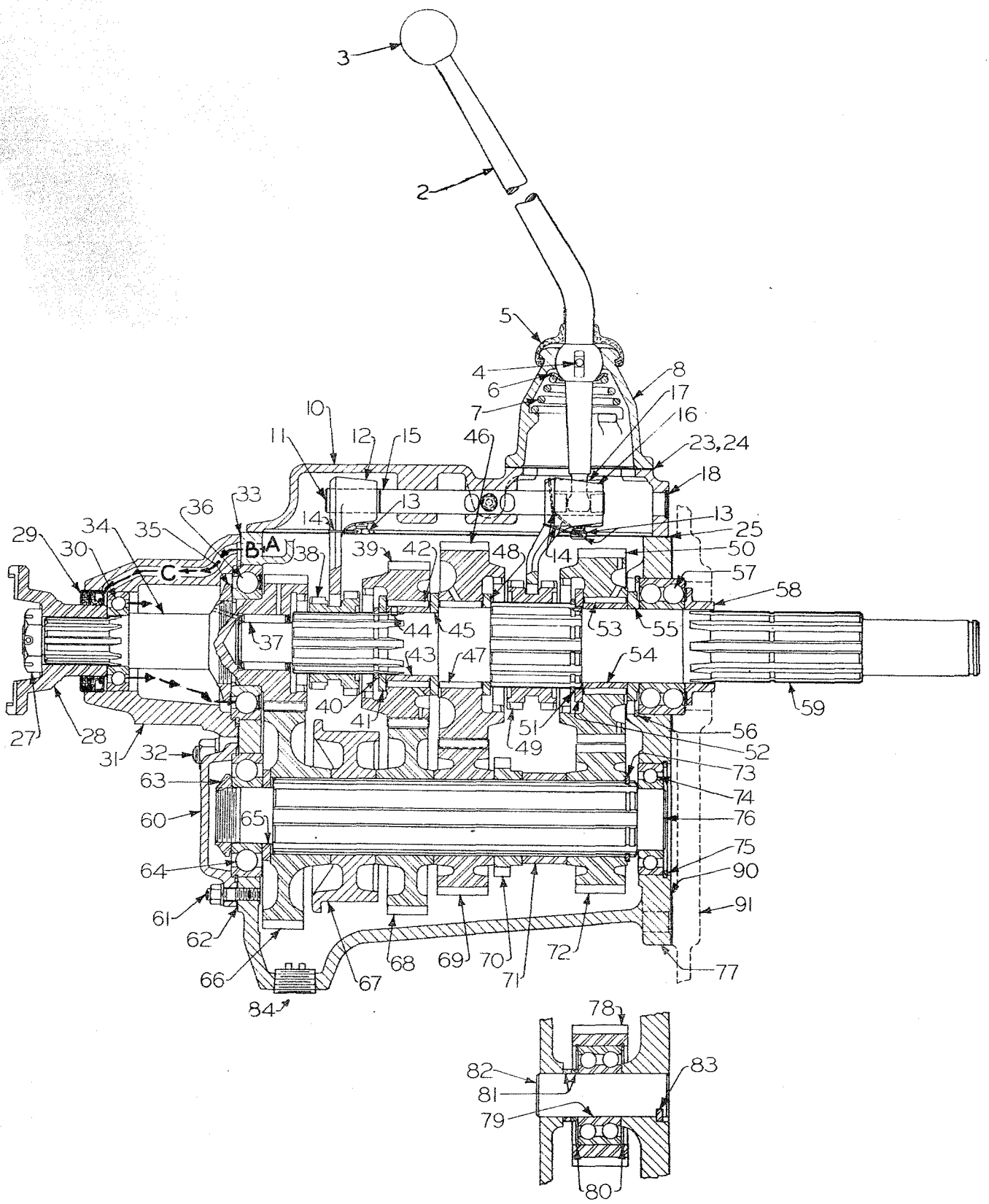


Section D-D



Section F-F

Figure 101. Hydraulic Brake



Sectional view showing reverse idler gear

Figure 102. Transmission

102. TRANSMISSION DISASSEMBLY.
(See Fig. 102)

In order to disassemble any part of the transmission, follow the instructions under "Transmission and Transfer Case Removal", paragraph 95, which will permit the transfer case and transmission being removed from the grader.

Now remove transfer case from transmission by following the instructions given under "Transfer Case Disassembly", paragraph 96. You should now disassemble the transmission as follows:

a. Remove cap screws holding large cover (10), with shift rods, and lift it off top of transmission.

b. Move both shifters (38) and (49) into mesh. Remove cotter and loosen nut (27).

c. Remove nuts from studs (32) and pull housing (31) with shaft (34) away from the transmission case. Remove nut (27) and yoke (28). Shaft (34) may now be tapped out of bearing (30). (Examine bearing (30), and if it requires replacing, be sure to do so. Also install a new seal (29).)

d. Examine bearing (36). It may be pressed off the shaft (34) after removing nut (35). The end thrust on shaft (34) is taken by bearing (36). Snap ring on its outside diameter is held between the face of transmission case (77) and face of housing (31). The bearing (30) floats on its outside diameter within the bore of housing (31). The inner diameters of both bearings (30) and (36) are held to the shaft shoulders by the nuts (35) and (27).

e. Oil pocket (A) delivers oil thru ducts at (B) and (C) to the forward side of bearing (30). In view of this, the gasket (33) and housing (31) must be reassembled with the oil ducts turned up as shown.

f. Oil flows thru bearing (30), after which it flows thru bearing (36) and back into the transmission case.

g. Slip the low and reverse shifter gear (49) to the left, and pry the snap ring (51) out of its groove. Slip both of these to left as far as they will go. Screw off the nut (58). Drive the main shaft (59) to the right until bearing (57) may be pulled off the shaft.

h. Lift up on clutch end of main shaft (59) and moving it toward the left, lift it out of case with gears mounted on it.

i. Washer (55) and reverse gear (50) may be slipped off the shaft, also forty-eight rollers (53), sleeve (54), thrust washer (52), snap ring (51), and low and reverse shifter gear (49).

j. Expand and slip the snap ring (40) off the shaft. Next slip the following parts off the shaft; Retainer (41), 2nd speed gear (39), forty-two rollers (42) and sleeve (43).

> CAUTION: There is a small pin (44) inside of this sleeve (43). Do not lose this pin as it must be used in reassembly.

k. Next remove the thrust washer (45) and low speed gear (46), together with forty-two rollers (47) and finally thrust washer (48).

NOTE: All end clearances of bearings are controlled by the location of the snap ring grooves cut in the main shaft (59). The three gears (39), (46) and (50) are mounted on roller bearings, and each must have not less than .006" total end lubrication clearance between the supporting thrust washers and the ends of the gear hubs.

l. Remove countershaft bearing cap (60), and nut (63), also snap ring (75). Countershaft (76) may now be pressed, or driven out toward the transfer case.

m. All countershaft gears may now be removed from the case for cleaning and inspection.

n. The reverse idler gear (78) and reverse gear parts may be removed, after removing shaft (83).

103. TRANSMISSION REASSEMBLY.

a. Clean and inspect all parts carefully. Always install new gaskets. Carefully check all snap rings for concentricity and tension before using them again.

b. Be sure to reassemble the countershaft gears as shown in Fig. 102.

c. Install a new nut (63) on the clutch end of the countershaft.

d. Reassembly is the reverse of the above procedure.

104. TIRE PUMP.

a. Lubrication.

Drive gears (47) and (34), Fig. 103, are splash lubricated by the lubricant held in the main transmission case.

The crank shaft bushing (4) and connecting rod bushings (29) and (30), Fig. 105, together with the piston and ring assembly, are splash lubricated by lubricant held in crank case at (4). Use SAE-140 extreme pressure lubricant for temperatures above 32° F., and SAE-90 extreme pressure lubricant for temperatures below 32° F.

To fill the crank case with oil, remove one cap screw (39), Fig. 104, and pour oil thru the bolt hole until excess oil flows out of the port in breather (36), Fig. 105.

b. Operation.

The compressor, with drive arrangement, is bolted to the left side of the transmission case.

The shift lever (57), Fig. 105, is shown in the driving position, with the sliding driven gear (47) engaged into the countershaft drive gear (51). (Lever (57) should never be shifted into this position unless the engine has first been stopped dead.)

The engine should be idled slowly while compressor is in use.

To stop the compressor, first stop the engine, then pull out the lock pin (54) and move lever (57) toward the engine.

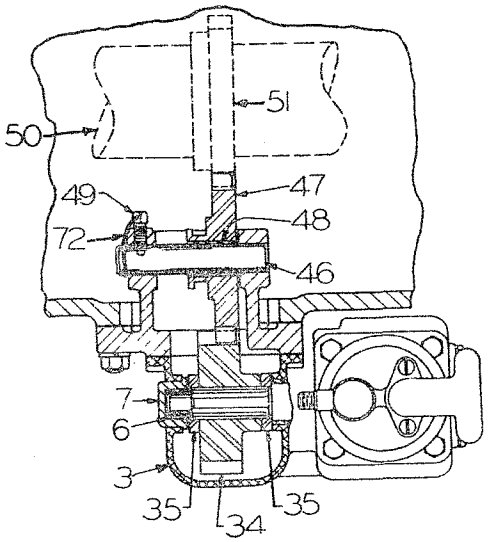


Figure 103. Compressor Drive

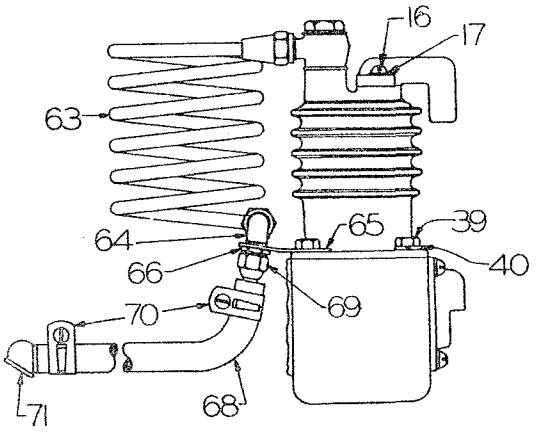


Figure 104. Compressor Hose

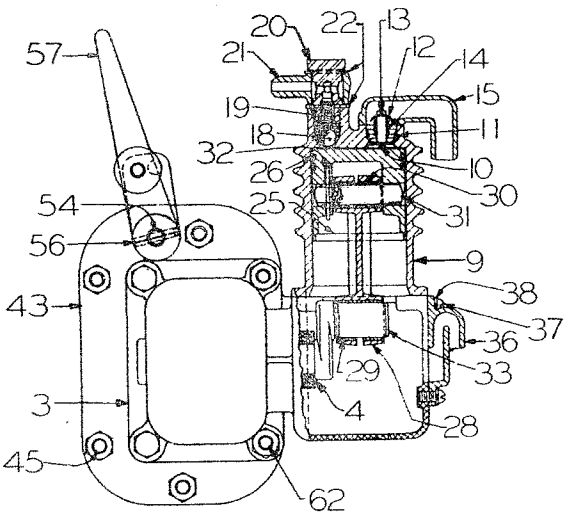


Figure 105. Compressor

105. *PROPELLER SHAFTS.*

a. Lubrication.

The needle bearings are packed with lubricant at time of assembly. Grease fittings at (A), Fig. 106 are provided in each bearing group.

The joints should be dismantled, cleaned and inspected every 3000 hours of operation. Worn parts should be replaced at that time. The needle bearings should be repacked with lubricant before assembly. See lubrication chart, page 10.

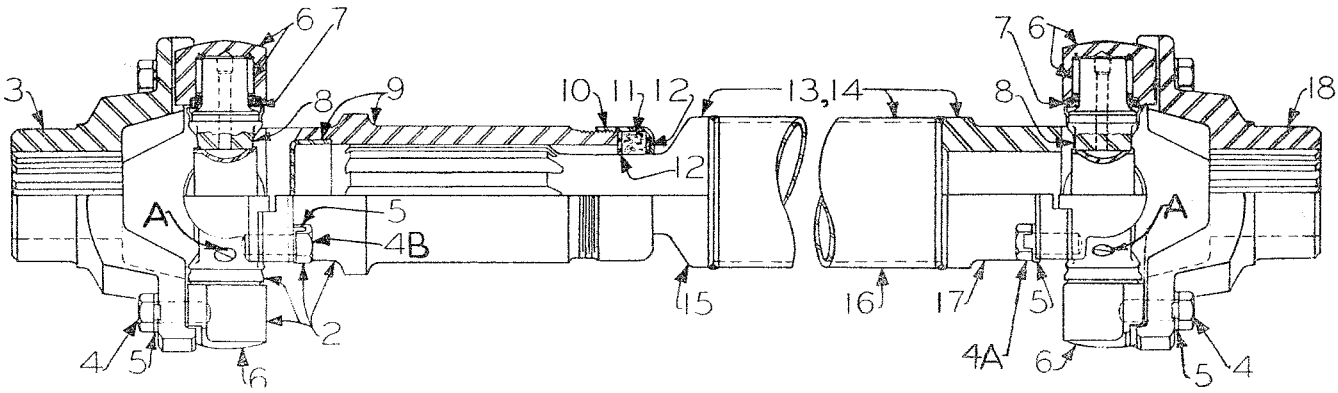


Figure 106. Rear Axle Propeller Shaft

106. *REAR AXLE PROPELLER SHAFT.*

The slip yoke group (9) must be installed nearest to transfer case.

When installing the slip yoke (9) on the male spline shaft (15) be sure the cap screw holes at (4A) and (4B) on both ends of the shaft, are in line with one another.

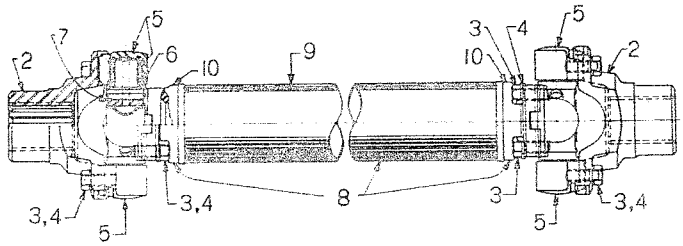
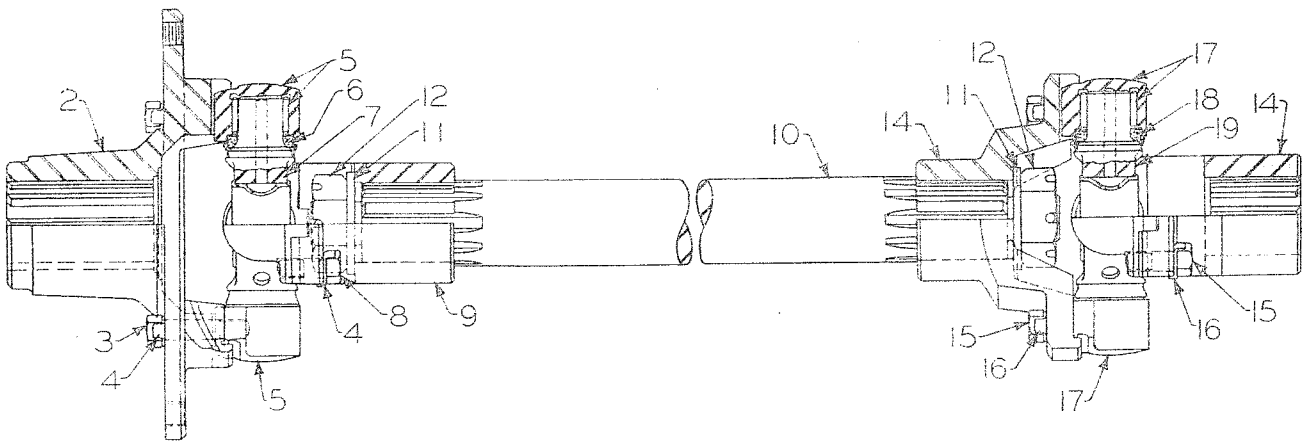


Figure 107. Clutch to Transmission Propeller Shaft

107. *CLUTCH TO TRANSMISSION PROPELLER SHAFT.*

When making repairs to the main clutch group, the tube (9) may be removed after first removing the eight cap screws (3).



Transfer case end

Figure 108. Rear Section of Front Propeller Shaft

108. REAR SECTION OF FRONT PROPELLER SHAFT. (See Fig. 108)

Cap screws (3), (8) and (15) must be tight and locked in place.

NOTE: Please notice that fitting yoke (9) is timed to the splined shaft (10) with the cap screws (8) to the side, which is quite satisfactory; however, the fitting yoke (14), located at the right end of shaft (10), is incorrectly shown and timed to the splined shaft (10). See Fig. 109 for proper timing of these yokes. Note that both yokes are turned up.

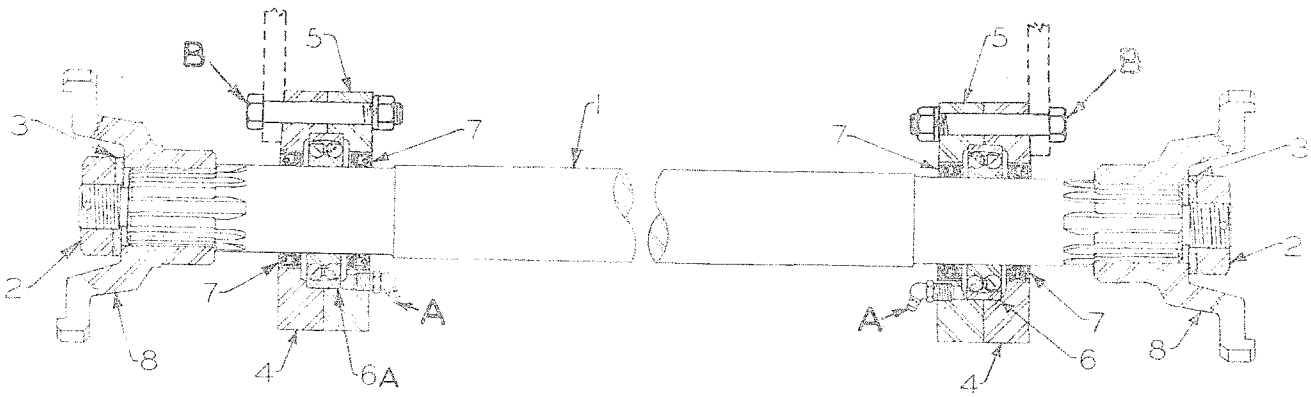


Figure 109. Center Section of Front Propeller Shaft

109. CENTER SECTION OF FRONT PROPELLER SHAFT.

The center section is mounted in, and rotates on, two anti-friction bearings (6) and (6A). Adjustments are not required.

Each bearing housing (5) is fitted with grease fitting (A). See lubrication chart, page 10.

The lips of the end seals (7) should be turned outward. Both nuts (2) should be tight and cottered.

NOTE: Please observe that both yokes (8) are correctly installed, or timed, on the splined shaft (1) with the flanges turned straight up and down.

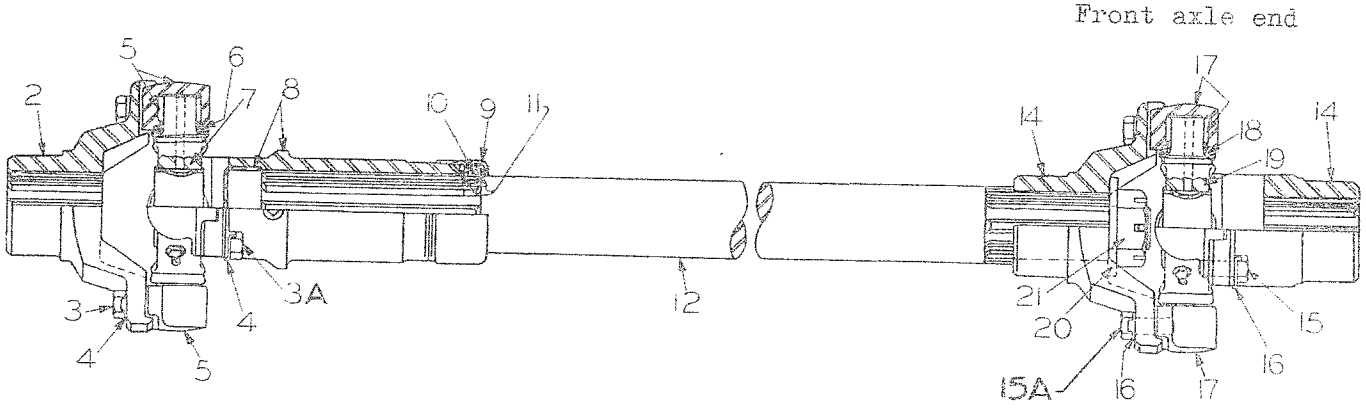


Figure 110. Front Section of Front Propeller Shaft

110. FRONT SECTION OF FRONT PROPELLER SHAFT.

The slip yoke (8) must be installed at the rear end (away from the front axle). When assembling slip yoke (8) to shaft (12) be sure to time the yoke exactly as shown in Fig. 109.

111. *FRONT AXLE.*

The front axle unit of the 99-H power grader is of the double reduction type. The drive from the propeller shaft to the front axles is made first thru a spiral pinion and bevel gear, and then thru a pinion and spur gear fully enclosed, running in oil. It is equipped with dust proof oil seals and mounted on anti-friction bearings thruout.

A differential is incorporated between the two axle shafts.

In making repairs to parts located at either end of main axle housing, including replacing the drive shafts, it is unnessary to remove the main axle housing from front end of the grader frame. However, should repairs be necessary to gear carrier or main axle housing itself, then axle assembly must be removed from frame. If possible, place the machine on a level place and block rear wheels securely.

If machine can be operated, it will be easier to wash out the main axle housing before disassembly is started. First remove the drain plug and allow all the oil to flow from gear case. Then refill the case with kerosene or diesel fuel.

> CAUTION: Do not use gasoline as it is dangerous because it may explode and cause a fire. Run machine slowly with the kerosene or fuel oil in gear case for several minutes both forward and reverse, and drain gear case. If you wish to get it absolutely clean, refill case a second time with clean kerosene or diesel fuel and repeat washing operation.

112. *WHEEL REMOVAL AND REASSEMBLY.*
(See Fig. 111)

All four wheels are attached in the same manner, so the following will apply to either right or left hand wheel.

(1) Remove the eight nuts (33) from the drive flange studs.

(2) Remove the drive flange (1). There are four tapered dowel bushings (3) placed over four of the studs holding the flange in place. These dowel bushings may stick to the studs or bind in tapered holes. They can usually be jarred loose by striking the drive flange sharply near each dowel. This should cause them to loosen and pop out slightly. You can then remove them with a pair of pliers.

(3) If the drive flange still sticks too tightly to be pulled off by hand, secure a couple of 1/2" hardened set screws to remove the flange. Lubricate the threads of hardened set screws well before inserting them in the threaded holes provided in the drive flange. Be sure to clean the threaded holes carefully and blow out all dirt present. The flange can then be forced off by screwing the set screws in thru the flange against the wheel face.

(4) Unlock the bent over edge of lock washer (7) and remove the hub bearing lock nut (6).

(5) Remove the lock washer (7), the drilled washer (8), and the adjusting nut (with pin) (9).

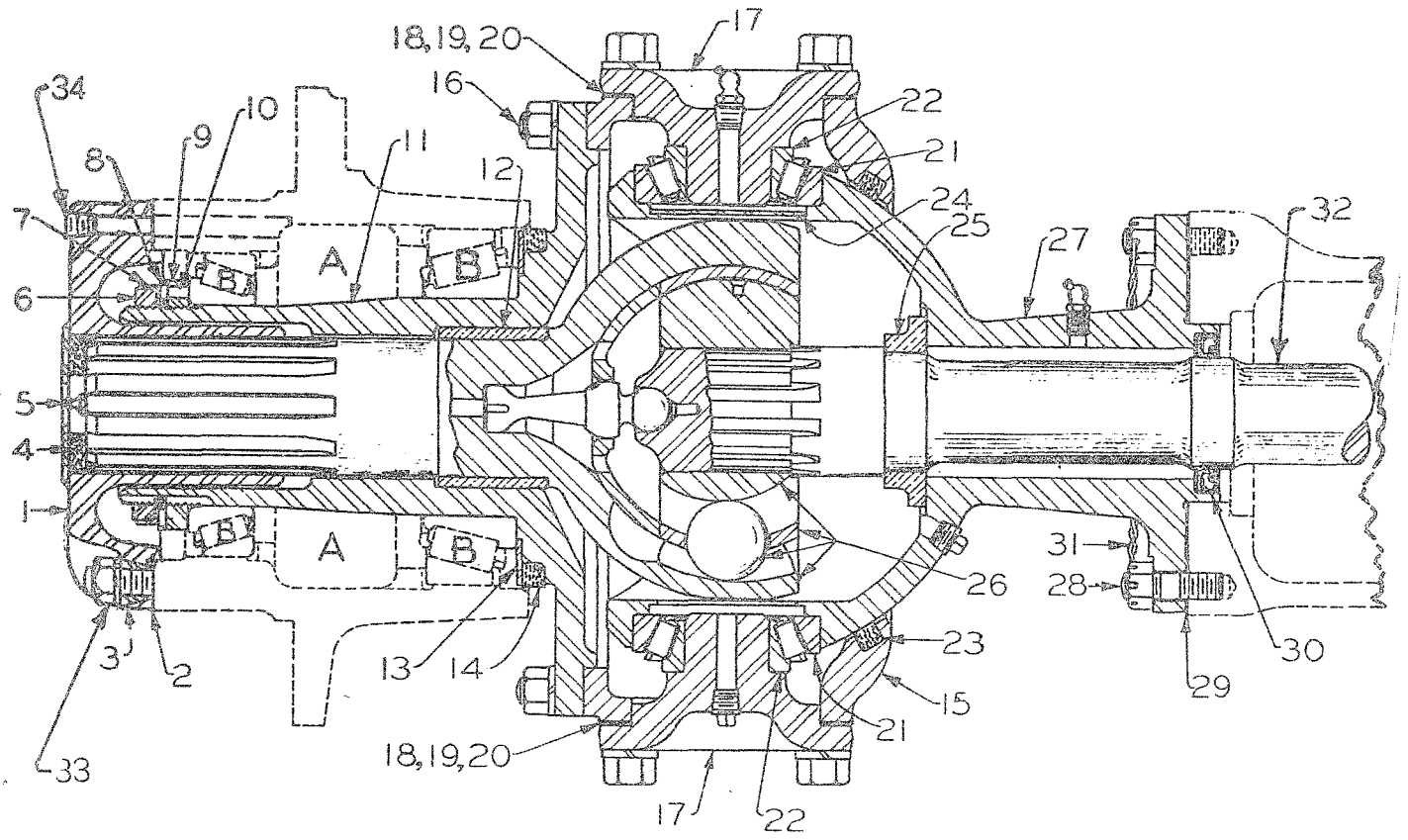
Jack up on axle housing inside of wheel until wheel clears ground, and place a well greased metal plate under the tire. Lower jack until weight of wheel only rests on plate.

(6) Slide the wheel off. Be sure to catch the bearing cone, forced off by wheel, so it does not fall on the ground and become dirty.

(7) If the hub bearing felt (14) is worn or damaged, replace it by prying off the inner bearing and removing the washer (13) and felt (14).

(8) Be sure to wash all the old grease from inside the wheel and from axle end and bearings. Repack the bearings with wheel bearing grease when reassembling. If bearings show any flat spots or chipping, replace both cone and cup.

(9) In reassembly, after replacing the wheel and outer bearing replace the adjusting nut (9) (with pin on outside). Tighten this nut up snugly. (Do not back it up for bearing clearance, as none is needed or desirable.) The slight preload thus put on the wheel bearings will



REF.	DESCRIPTION
1.	Driving hub or flange
2.	Gasket
3.	Dowel bushing
4.	Felt
5.	Grease fitting
6.	Lock nut
7.	Lock washer
8.	Washer
9.	Adjusting nut
10.	Adjusting nut pin
11.	Steering knuckle
12.	Steering knuckle bushing
13.	Washer
14.	Felt
15.	Knuckle flange
16.	Stud
17.	Pivot bearing cap

REF.	DESCRIPTION
18.	Shim
19.	Shim
20.	Shim
21.	Bearing cup
22.	Bearing cone and rollers
23.	Felt
24.	Grease retainer
25.	Axle retainer
26.	Drive joint group
27.	Trunnion socket
28.	Stud
29.	Gasket
30.	Oil seal
31.	Locking wire
32.	Axle shaft
33.	Stud nut
34.	Pipe plug

Figure 111. Wheel Hub, Steering Knuckle, and Universal Joint
(Used on all four drive wheels)

prevent any load misalignment due to working strains.

(10) Replace the drilled washer (8). Be sure one of the holes aligns with the pin protruding from the adjusting nut (9). If they fail to align, try taking the washer off and turning other side inward. If this fails to align the pin and a hole in washer, then the nut will have to be loosened slightly.

(11) Replace the lock washer (7). Replace and securely tighten the lock nut (6). Bend one edge of the lock washer (7) so as to firmly fix the lock nut (6).

(12) Replace the drive flange (1).

NOTE: Each drive flange (1) has a 1/8" pipe plug (34) recessed into the outside edge. When installing the flange, the plugged hole should mate a similar hole drilled sidewise into the wheel hub, and terminating into the compartment (A).

(13) The two Timken bearings (B) are packed or completely charged with lubricant at time of assembly at the factory, therefore it should not be necessary to pump still more lubricant into the plugged port (34) when the grader is being used at temperatures above 32° F.

(14) The purpose of the plug (34) in flange (1) is to make it possible (without removing the four wheels) to pump winterizing oil into compartment (A) when the temperature subsides to 32° F. and under. (1/4th pint of SAE-10W pumped into each wheel port (34) will winterize the wheel bearing grease at location (B).)

(15) If an excess amount of pressure gear grease is pumped thru opening (34) into compartment (A) during temperatures above 32° F., the excess lubricant will flow past the wheel felt (14). This excess lubricant should be kept off the tires.

(16) Replace the four tapered split dowel bushings (3) on proper studs. Replace lock washers and nuts on all studs. Tighten the four nuts on dowel bushing studs first. Retighten remainder of stud nuts.

(17) Check all nuts and retighten, if necessary, after operating grader about an hour, and again after a day's operation.

113. *UNIVERSAL JOINT WITH AXLE SHAFT REMOVAL. (See Fig. 111)*

a. Follow the instructions in paragraph 112 covering "Wheel Removal".

b. Remove the twelve nuts and lockwashers from studs (16).

c. Loosen the eight cap screws located in caps (17).

d. Remove the steering knuckle (11).

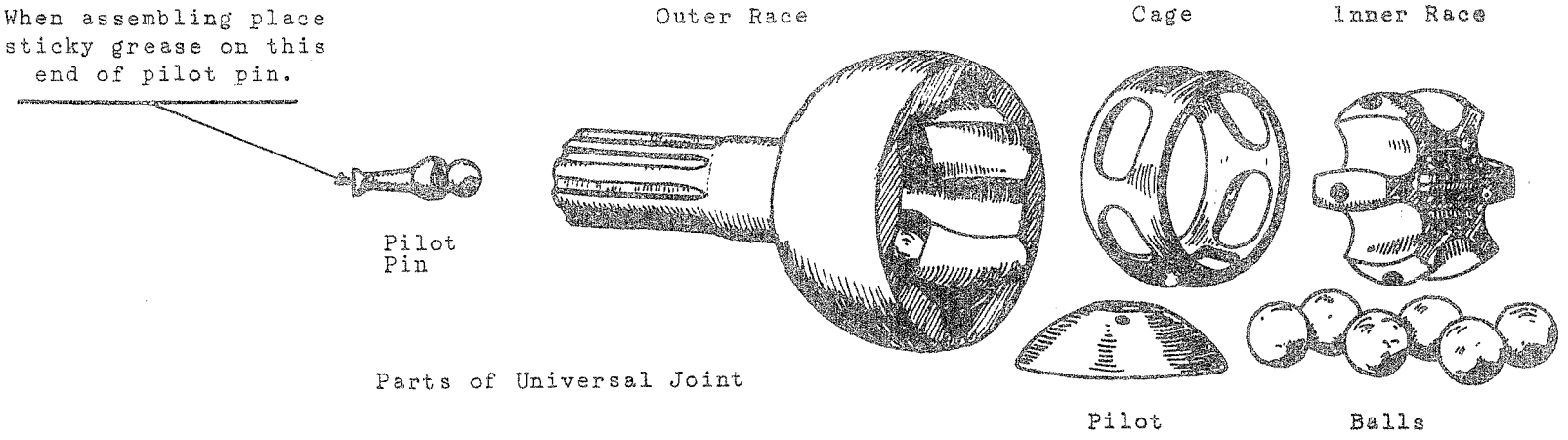
e. Grasp the splined end of universal joint now exposed and carefully pull the joint, with axle shaft attached, out of housing. Be especially careful not to damage the oil seal (30). There is another seal at inner end of axle shaft near the differential (46), Fig. 114. Use care not to damage these seals when reassembling.

f. Place the universal joint and axle assembly on a bench (or a box if bench is not available).

g. The universal joint group (26) can now be tapped off the end of axle shaft. (Use a bronze plug and hammer.) Be careful not to lose the pilot pin when the axle is out of joint. This part is loose and may fall out.

h. Wash all parts carefully with kerosene and check them carefully before reassembly.

i. If axle shaft is replaced, be sure the pilot pin is in place inside of the universal joint, as shown.



Parts of Universal Joint

Universal Joint Assembly

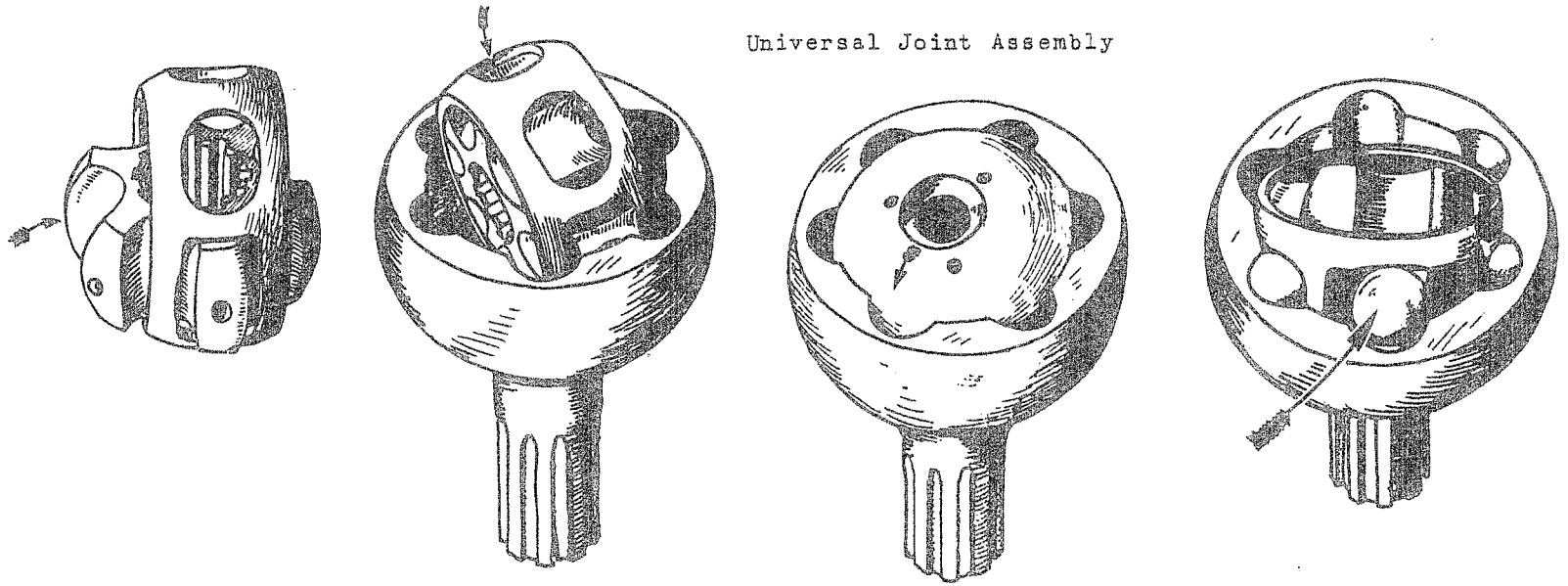


Illustration 1.

Removing or Inserting Inner Race Into Cage

Illustration 2.

Removing or Inserting Inner Race and Cage Into Outer Race

Illustration 3.

Removing or Inserting Pilot

Illustration 4.

Removing or Inserting Balls

Figure 112. Universal Joint

114. *AXLE UNIVERSAL JOINT DISASSEMBLY. (For Cleaning and Inspection Purposes Only)(See Fig. 112)*

a. Whenever the joint is removed from its housing for any purpose, it is a good idea to wash it and inspect it. If it is desired to disassemble it, study Fig. 112 and follow the procedure outlined below.

b. By pushing down on one side of the inner race, the opposite side will automatically come up (Illustration 4), and one ball can then be removed. By pressing down at another point, another ball can be removed, and so on until all balls are removed.

c. Straighten the cage and inner race and roll them upside down (Illustration 3).

d. Lift off the pilot (Illustration 3).

e. Continue rolling the cage and inner race until they are standing on edge (Illustration 2). If the rectangular slots are not aligned with outer race, revolve the cage slightly to align. Then lift inner race and cage out.

f. Roll the inner race right angles to the cage so that one lug projects thru one rectangular slot in case. Remove inner race from cage (Illustration 1).

g. Clean and inspect all parts. If worn, chipped or cracked, procure a new drive joint group from your nearest Austin-Western distributor. It is not practical to replace any parts in a used joint with new parts. Therefore the entire joint group must be replaced as a unit.

115. *WHEEL STEERING KNUCKLE DISASSEMBLY. (See Fig. 111)*

a. Follow the instructions in paragraph 113 covering "Universal Joint With Axle Shaft Removal".

b. Remove the lock wires and nuts from the nine studs (28) in outer end of axle main housing.

c. Remove the tie rod fork bolts at (1), Fig. 113.

d. Pull the entire trunnion and knuckle flange off the studs. It may stick and require force to remove it. At this point it is well to check the seal (30), in end of trunnion socket, and replace it, if necessary. Be sure to oil it well before reassembling.

e. Remove the four cap screws from top pivot bearing cap (17) and remove the cap and shims (18), (19) and (20). Keep the cap and shims together. (It will be well to tie them together if original parts are to be reassembled again.)

f. Now remove the lower pivot bearing cap (17), following the same procedure used to remove the upper pivot bearing cap (17).

g. Slip the knuckle flange (15) off flanged (inner) end of trunnion socket (27).

h. The felt (23) can now be removed and replaced with a new one, if necessary.

i. For reassembling, reverse the above procedure.

> CAUTION: Before reassembling be sure to wash and inspect all parts carefully. Cleanliness is most essential in preventing wear.

116. *WHEEL PIVOT BEARING ADJUSTMENT. ((21) and (22))(With the Wheel Removed but Steering Knuckle Still on the Power Grader)(See Fig. 111)*

a. Remove the four cap screws from top pivot bearing cap (17) and remove the cap and shims (18), (19) and (20). Keep the cap and shims together. (It will be well to tie them together so they can be easily assembled in the original position.) Mark the cap (17) so it can be put back in the original position.

b. Carefully wash out the bearing cup (21) and its compartment. Be sure to remove all grit and chips present. Wash bearing cone and rollers carefully. If bearings show signs of chipping or flat spots, replace both the cup and the cone with new ones.

c. Remove the lower pivot bearing cap (17) with shims (18), (19) and (20). Keep these together for reassembly in original positions.

d. Wash the bearing cone and rollers and cup carefully. If there are any signs of chipping or flat spots, replace both the cup and the cone with new ones.

e. Pack the bearings with grease and reassemble both caps with shims in original positions.

f. Tighten the cap screws evenly on both caps (17).

g. If there is any end play in the bearings, they will have to be adjusted by removing equal amounts of shim thickness from both top and bottom. If too tight, add new shims to both top and bottom of same thickness.

Continue this adjustment until the play is just out of bearings when screws are tight, then remove a thin shim (.007") from under both the top and the bottom bearing cap. This will bind the bearings slightly and is called "pre-loading". This is done to eliminate slight play from existing when these bearings are actually carrying the weight of machine while at work. The shims are of three different thicknesses; namely, .005", .007" and .020".

> CAUTION: The cap screws holding top and bottom pivot bearing caps (17) must be left loose until the axle and knuckle drive joint group have been put in place and knuckle (11) has been securely tightened in place by the twelve nuts on studs (16). Otherwise, knuckle flange (15) will distort and the pre-loading effect will be destroyed.

117. *FRONT WHEEL TOE-IN ADJUSTMENT. (See Fig. 113)*

a. The 99-H power grader is equipped with a tie rod adjusting nut (4) (which has both right and left hand threads). Turn the adjusting nut so that front toe-in is 0". Measurements to be made at the side wall of tires as close to center line of axle as possible.

b. No toe-out should be tolerated. Failure to comply with the above will cause excessive tire tread wear.

118. *REMOVAL OF FRONT AXLE ASSEMBLY FROM FRAME. (See Fig. 113)*

a. Place machine on level place.

b. Revolve blade until it is square across the lock circle latch.

c. Block both rear wheels securely to prevent possibility of machine rolling forward or backward.

d. Remove nuts (10) from pivot pins (7).

e. Disconnect steering ram hydraulic hoses at their union ends.

f. Unlock and remove the four cap screws from front propeller shaft universal joint fitting yoke.

g. Start the engine and raise blade as high as possible. Place blocking under each end of blade about a foot from the ends.

h. Force blade downward. This will lift the front end of frame upward. Lift it only enough so that axle pivot pins are free of excessive binding.

i. Remove the pivot pins (7).

j. Again push blade down to lift frame high enough to clear axle.

k. Roll axle out from under front end of frame.

l. Reverse above procedure for reinstalling. Adjust nut (6) 1/2 turn loose.

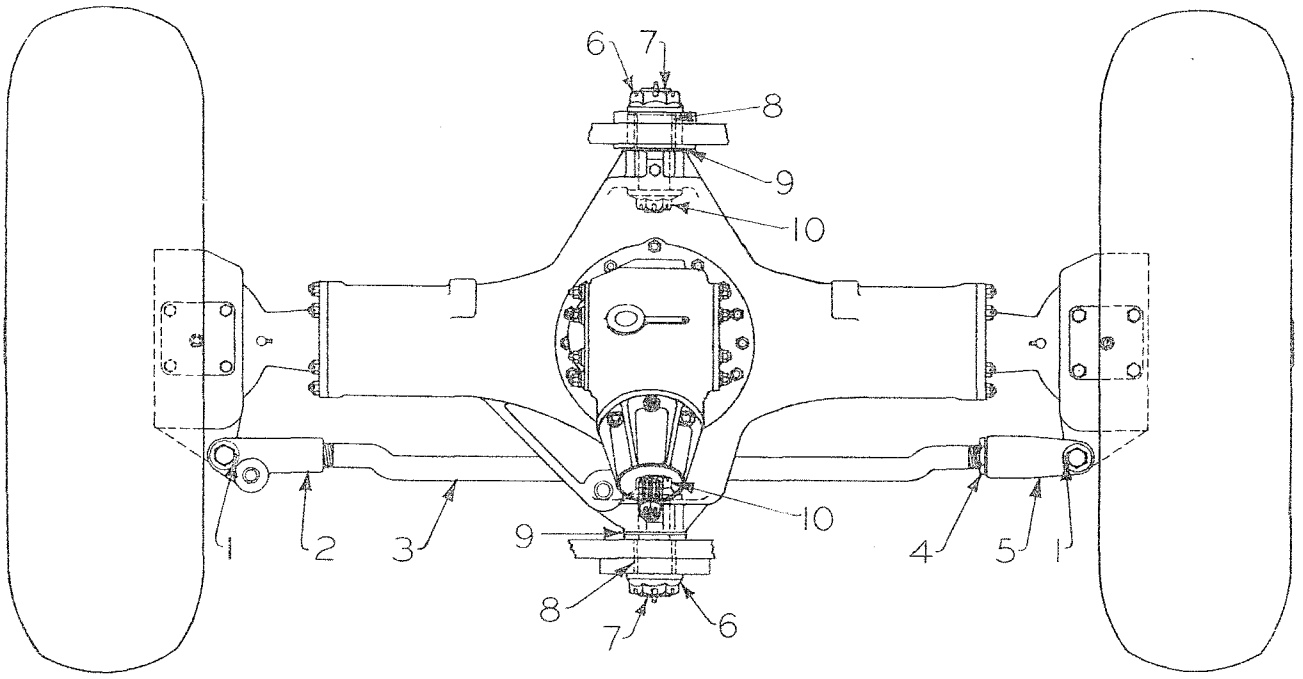


Figure 113. Front Axle

119. *FRONT AXLE GEAR CARRIER REMOVAL. (See Fig. 113)*

a. Remove axle from frame. See paragraph 118.

b. Remove bottom drain plug to drain oil from axle.

c. Block up under axle housing to hold it when wheels are removed.

d. Remove the lock wires and the nine nuts from studs (28), Fig. 111, on both sides.

e. Remove fork bolts at (1), Fig. 113.

f. Slide out, about 8", both the right and left wheel, with trunnion socket and axle still attached.

If the oil seals (30), Fig. 111, are damaged or worn, be sure to replace them before reassembling.

g. Remove the fourteen nuts from studs (50), Fig. 114.

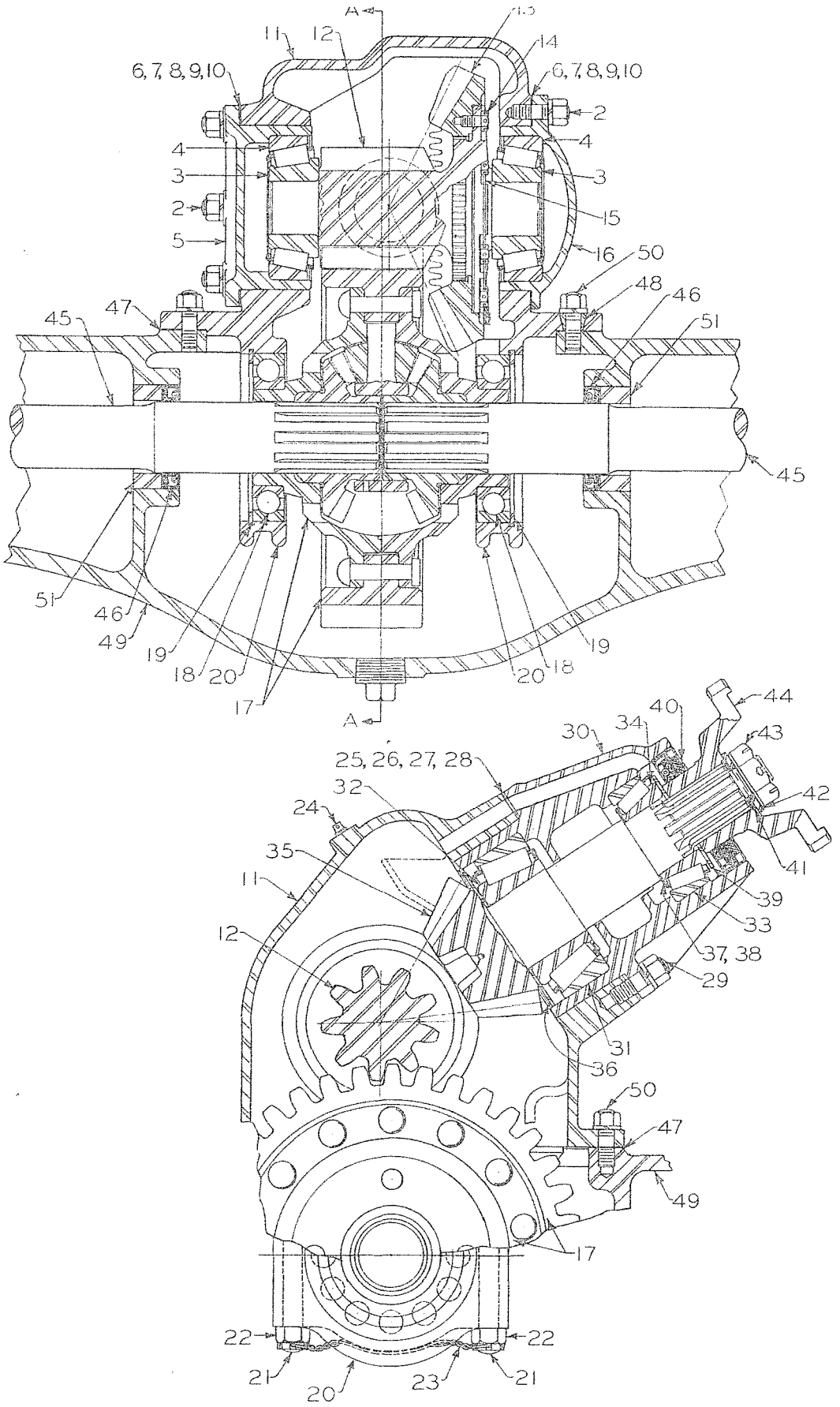
h. Remove the one tapered dowel bushing (48) from one of the studs.

i. Lift the gear and pinion carrier out of main axle housing.

120. *FRONT AXLE GEAR AND PINION CARRIER DISASSEMBLY. (After Removing the Assembly from Axle Housing) (See Fig. 114)*

a. Remove the lock wires and nuts on the four studs (21).

b. Remove the bearing caps (20). (If they are not already marked, mark them so they can be put back in exactly the same position in reassembly.)



Section A-A

Figure 114. Front Axle Gear and Pinion Carrier

c. Lift out the bull gear and differential group (17).

d. If ball bearings (18) on differential hub are worn, replace them with new ones.

e. Remove the six nuts and washers from pinion carrier studs (29).

f. Pull entire pinion carrier assembly out of large gear carrier housing. Tapped holes are provided for draw screws in case it sticks. Keep gasket (25) and shims (26), (27) and (28) in original positions for reassembly.

g. Check the pinion carrier assembly for loose bearings. Be sure the nut (43) is tight against the universal joint fitting yoke when checking, otherwise looseness may appear in bearings that are properly adjusted and not worn. If looseness or wear is actually present, disassemble it as follows:

(1) Remove the cotter and nut (43).

(2) Remove washer (42) and universal joint fitting yoke (44).

(3) Check oil seal (40) and replace it with new one if necessary.

(4) Place a bronze drift on threaded end of pinion shaft and drive it back thru bearing (34). Be careful to save all the shims (37) and washer (39).

(5) If inspection shows any flat spots or chipping on bearings (31), (32), (33) or (34), replace both the bearing cone and the cup of damaged bearing.

(6) To remove any bearing end play in pinion shaft assembly, remove shims (37) and (38) until play is eliminated; but be sure there is no binding after universal joint fitting yoke is tightened in place, and nut (43) is down tight. The shims are of two thicknesses; namely, .003" and .030", with a bearing washer (39).

h. if you desire to remove the bull pinion and bevel gear hub (12), this should be done before reinstalling the pinion shaft assembly, following these steps:

(1) Remove the twelve nuts and washers from studs (2).

(2) Remove the bearing cap (5). Save the gasket (6) and all shims (7), (8), (9) and (10). Wire these to the cap so they will be replaced in original position. Threaded draw screw holes are provided to remove this cap if it sticks.

(3) Remove bearing cap (16), saving the gasket (6) and shims (7), (8), (9) and (10). Wire them to the cap to prevent mix-up. Threaded draw screw holes are provided for easy removal of this cap.

(4) Slip the pinion sidewise out thru side of case and remove the six cap screws (14) holding the bevel gear (13).

(5) Remove the bearing cone and roller assembly (3) and (4) from bull pinion end of shaft (12). Sometimes, due to steel casting variation, it is necessary to remove the bearing cone and roller assembly from the other end also. If bearing cone (3) cannot readily be driven from shaft, pour hot oil over bearing only, to expand it for easier removal.

NOTE: Keep the shaft (12) cold.

(6) Slip the bevel gear off its splined hub so that it can be cocked and pinion shaft, with loose bevel gear still over it, can be removed from carrier. Be sure to wire bevel gear screw heads in reassembling.

(7) If inspection shows chipping or flat spots on either bearing, replace both the cone and cup of that bearing.

(8) Clean and check all parts carefully before reassembling.

121. *FRONT AXLE GEAR AND PINION CARRIER REASSEMBLY. (See Fig. 114)*

a. When installing a new bevel gear (13), or a new bull pinion shaft (12), be sure to assemble the two together before putting them into the gear carrier. By doing this you will be sure they fit together properly at splines. The bevel gear is held firmly in place by six cap screws (14), thru the backing flange. The splines in the bore of the bevel gear will permit the cap screw holes to align in two positions only. It is therefore best to mark (with paint) the bevel gear and hub flange to make alignment easy. The bevel gear should be a snug fit on the hub splines.

b. Position the bevel gear (13) loosely and slightly cocked, over the middle of bull pinion shaft (12).

c. Insert both bevel gear and shaft (with bearings off) into the gear carrier housing.

d. Align the bevel gear holes with flange holes and drive the gear into place tightly against the flange. Be careful not to damage the gear teeth.

e. Insert and tighten the six cap screws (14). Install lock wire (15).

f. Heat the bearing cones (3) in hot oil (not over 300° F.) and tap them into place against the hub shoulders. (Always replace worn bearings.)

g. Replace the bearing cap (16), together with the gasket (6) and the shims (7), (8), (9) and (10) but first make sure the bearing cup (4) is in good condition. If otherwise, replace it and bearing cone. Check the position of gasket (6) and shims (7), (8), (9) and (10) and the bearing cap (5). Oil ports in case and cap must align and the shims must be properly placed, or the flow of oil will be cut off and the lubrication of the bearing will then be insufficient.

h. Replace bearing cap (5) with gasket (6) and shims (7), (8), (9) and (10).

i. If end play exists in the bull pinion and bevel gear shaft (12) (after the caps (5) and (16) are tightened), it can be eliminated by removing shims (7), (8), (9) or (10), as required. See pages 109 and 110 for diagrams on proper tooth contact. Be sure the bull pinion shaft (12) has only a slight drag when both caps are tight.

j. Install the bevel pinion carrier assembly. The gasket and shims (25) and (26) have holes that must be aligned with oil ports in the housing, or the pinion bearings will not be lubricated sufficiently.

k. If pinion (35) needs to be adjusted for proper mesh with bevel gear, add or remove shims (26), (27) or (28), as required. See pages 109 and 110 for diagrams on proper tooth contact.

l. Place the large spur gear and differential group (17) in position after installing the two hub bearings (18). The spur gear is offset to clear the bevel gear, so be sure you do not try to install it with the wrong side toward the bevel gears.

m. Replace the bearing caps (20) and tighten the nuts on studs (21) and wire them to prevent their loosening.

n. Install a new gasket (47).

o. Lower the now completely assembled gear carrier down into front axle housing (49).

p. Put the tapered dowel bushing (48) in proper place and tighten this stud nut first; then tighten the rest of the nuts on studs (50).

q. Carefully push the axles and wheels back into axle housing and replace and tighten the slotted nuts (28), Fig. 111. (Install wires thru stud ends to keep nuts from loosening.)

r. Check the toe-in adjustment. See page 104, paragraph 117.

s. Fill axle housing with recommended oil. Pour about a pint of this oil into small hole in pinion carrier (30). This hole has a 1/8" pipe plug in it. This oil prevents the bearings (34) and (32), Fig. 114, from insufficient lubrication when first starting newly assembled axle.

122. BEVEL GEAR AND PINION ADJUSTMENT.

a. General.

No other phase of axle maintenance is more important, yet less understood, than the adjustment of bevel drive gears and pinions in order to secure proper tooth contact.

It must be kept in mind that checking for tooth contact area and location is done with no load on the gear set.

When the area of tooth contact is toward either the heel or toe, the teeth will be overloaded at that end and chipping may occur.

When the area of contact is too high, then the load application is farther from the base of the teeth, thus increasing the bending load and possibly resulting in breaking teeth out at the base.

When the area of contact is less than specified, a higher localized load results in squeezing out the film of lubricant. A metal to metal contact such as this causes scoring, scuffing or galling, which contributes to noisy operation and rapid wear.

Two other points to keep in mind are:

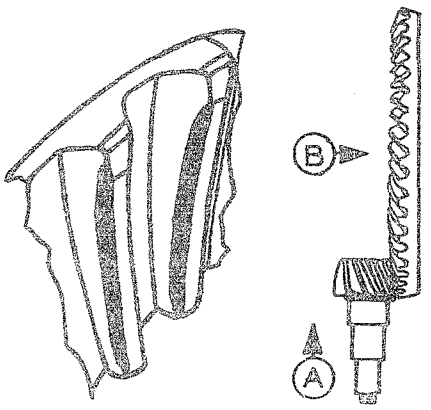
First: The factory adjustment of bevel drive gear and pinion sets is as correct as special equipment and years of experience in building thousands of axles can make it, and should not be disturbed except when absolutely necessary. For example, should it be necessary to dismantle and reassemble the gear carrier group to replace some part other than the gear and pinion, do not disturb the shim adjustment. Always replace worn bearings.

In addition to this, backlash should be checked and noted before disassembling the unit, in order that the gear may be adjusted to the original backlash when making final adjustments.

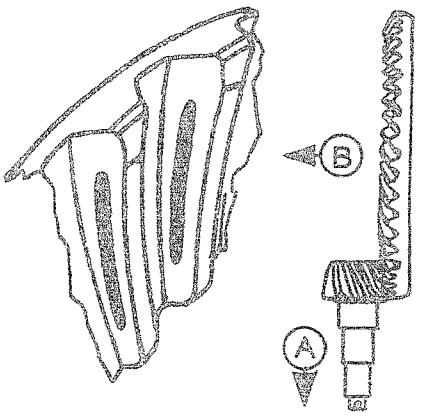
Second: Always bear in mind that gears and pinions are matched at the factory, and as far as possible should remain matched in service. Well matched sets operate quietly.

b. Checking Tooth Contact.

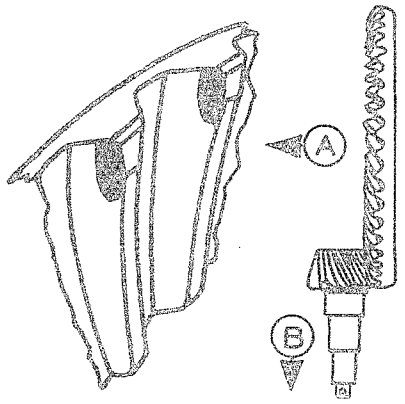
This is accomplished by means of oiled red lead applied lightly, or sparingly, to the drive side of the bevel gear teeth. When the pinion is rotated the red lead is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape and location of the contacts. Sharper contact impressions can be obtained by applying a small amount of resistance to the gear when rotating the pinion. (Hold a block of wood against the gear and use a wrench to rotate the pinion.) When making adjustments always check the drive side of the bevel gear teeth. Coast side contact will be automatically correct when the drive side contact is correct. As a rule, coating about 12 gear teeth with red lead is sufficient for checking purposes.



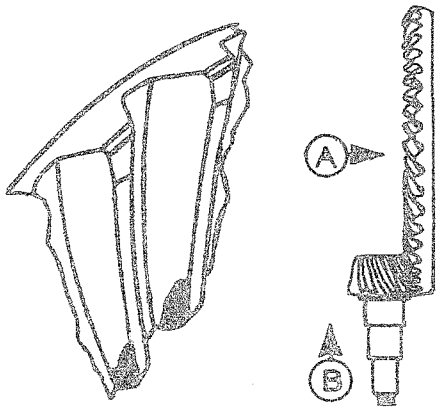
(1) The above diagram shows a HIGH NARROW CONTACT, which is undesirable and will result in noisy operation, galling, and overloading of the teeth. To obtain correct contact, remove shims to move the pinion (A) in toward the toe of the gear teeth (toward the center of the axle) to lower contact area to the proper location. This adjustment will decrease the backlash between the pinion and gear teeth, which can be corrected by moving the gear (B) away from the pinion. A backlash of .005" to .010" is correct. Several adjustments of both pinion and gear may be necessary before correct contact and backlash are secured.



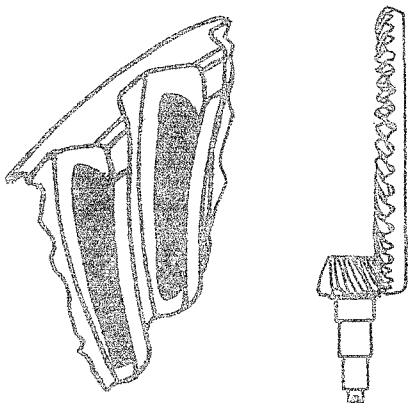
(2) The above diagram shows a LOW NARROW CONTACT, which will result in galling, groving of teeth and noise. To secure correct contact, add shims to move pinion (A) out from gear (away from center of axle) a sufficient amount to move the contact area to the proper location. To obtain correct backlash (.005" to .010") move the gear (B) in toward the pinion.



(4) The above diagram shows a SHORT HEEL CONTACT, which produces approximately the same results as a short toe contact: noise, excessive gear tooth wear and chipping of tooth edges. To correct this condition, the gear (A) must be moved in toward the pinion to increase the lengthwise contact and to move the contact toward the toe of the teeth. Correct backlash (.005" to .010") is obtained by moving the pinion (B) out toward the heel of the gear teeth (away from the center of the axle).



(3) The above diagram shows a SHORT TOE CONTACT, which, because the contact area overlaps the toe of the bevel gear teeth, will result in chipping of tooth edges and excessive wear at this point if not corrected. To secure correct contact, move the gear (A) away from the pinion. This will increase the lengthwise contact and move the contact area toward the heel of the gear teeth. Correct backlash (.005" to .010") is obtained by moving the pinion (B) in toward the gear (toward the center of the axle).



(5) The above diagram shows when ADJUSTMENTS HAVE BEEN PROPERLY MADE. This is the correct tooth contact that will be secured. Note that the area of contact starts near the toe of the gear teeth and extends about 80% of the tooth length toward the heel. This adjustment results in a quiet running gear and pinion set, which, because the load is distributed over the teeth within the proper area, will deliver all the long service built into it.

123. *REAR AXLE.*

The rear axle unit of the 99-H power grader is of the double reduction type. The drive from the propeller shaft to the rear axles is made first thru a spiral pinion and bevel gear, and then thru a pinion and spur gear, fully enclosed, running in oil. It is equipped with dust-proof oil seals and mounted on anti-friction bearings thruout.

The oil level is the 3/8" pipe threaded hole with square head pipe plug. It is located on the center line of axle on right hand side of grader, a few inches below the large (1-1/4" pipe plug) filler opening.

Keep this filled with oil as recommended in the lubrication instructions, page 10.

In making repairs to parts located at either end of the main axle housing (49), Fig. 120, including replacing of the drive shafts, it is unnecessary to remove the main axle housing from the rear end of power grader frame. In fact, it is possible to remove the gear carrier (2) from axle housing without rolling the rear end from under the frame. (See instructions for "Gear Carrier Removal", page 113.)

If the machine is in operating condition it is best to drain the gear oil from the rear axle and refill it with kerosene or diesel fuel, and run the machine slowly, backward and forward several minutes. It is best to drain this first wash-out and refill with clean kerosene or diesel fuel, and repeat. In this way, a second washing will usually get everything clean and free of oil.

> CAUTION: Do not use gasoline as there is danger of explosion and fire.

124. *REAR WHEEL REMOVAL. (See Fig. 111)*

Both wheels are attached in the same manner, so the following will apply to either right or left hand wheel.

Follow the procedure shown on page 99, paragraph 112, "Wheel Removal and Reassembly".

125. *UNIVERSAL JOINT WITH AXLE SHAFT REMOVAL. (See Fig. 111)*

Follow the instructions as shown on page 99, paragraph 112, covering "Wheel Removal and Reassembly".

Follow the instructions shown on page 101, paragraph 113.

126. *AXLE UNIVERSAL JOINT DISASSEMBLY. (For Cleaning and Inspection Purposes Only) (See Fig. 112)*

Follow the instructions as shown on page 103, paragraph 114.

127. *REAR WHEEL STEERING KNUCKLE DISASSEMBLY. (See Fig. 111)*

Follow the instructions as shown in paragraphs 112 and 113.

Follow the instructions as shown on page 103, paragraph 115.

128. *REAR WHEEL PIVOT BEARING ADJUSTMENT. ((21) and (22))(With the Wheel Removed but Steering Knuckle still on the Power Grader)(See Fig. 111)*

Follow the instructions as shown on page 99, paragraph 112.

Follow the instructions as shown on page 103, paragraph 116.

129. *REAR WHEEL TOE-IN ADJUSTMENT.*

The 99-H power grader is equipped with tie rod adjusting nut (4), Fig. 113 (which has both right and left hand threads). Loosen the clamping bolts and adjust so there is no toe-in or toe-out. Check this monthly, and after overhauling axle. Measurements to be made at side wall of tires as close to the height of center line as possible.

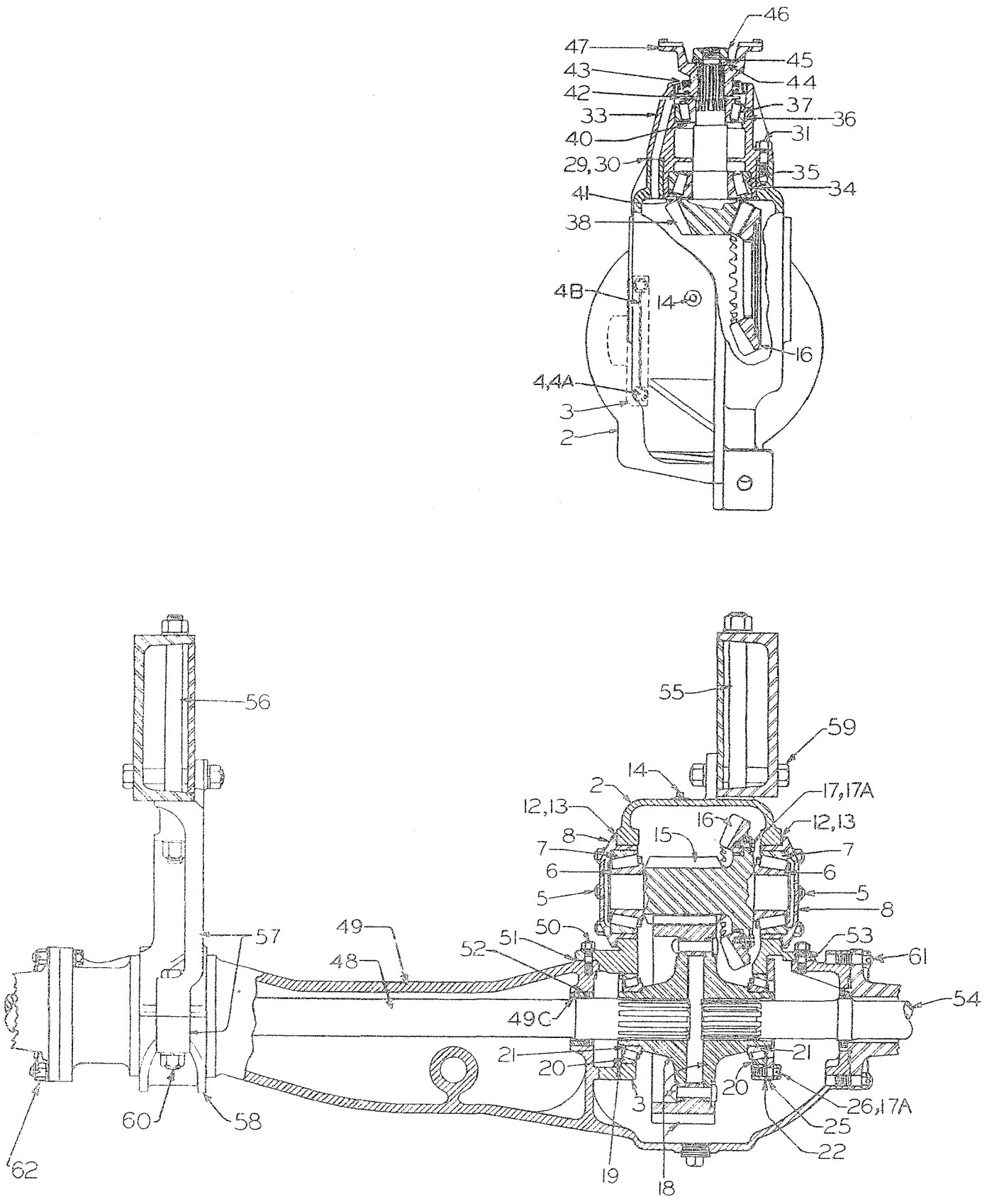


Figure 120. Rear Axle Gear and Pinion Carrier
(Machines H-100 to H-4668 inclusive)

130. *REMOVAL OF REAR AXLE ASSEMBLY FROM FRAME. (See Fig. 120)*

It is not essential to roll the rear axle from under grader to remove the gear carrier.

(1) Place machine on level place.

(2) Revolve blade until it is square across and lock circle latch.

(3) Block both front wheels securely to prevent possibility of machine rolling forward or backward.

(4) Remove the lower nuts from the two long axle studs (55).

(5) Remove the short bolt running crosswise through the frame (59).

(6) Disconnect the steering ram rod cap and tie the ram up out of the way.

(7) Remove the two bolts (60) holding the cap (58). Be sure to mark the cap and axle bracket to facilitate reassembly.

(8) Unlock and remove the four cap screws from rear propeller shaft universal joint fitting yoke.

(9) Start the engine and raise blade as high as possible. Place blocking under each end of blade about a foot from the ends.

(10) Force blade downward, lifting the front end. It will still be necessary to jack up under the rear bumper to lift the frame off the rear axle, but by lifting the front end first, it makes the lifting easier and keeps the power grader from tipping.

(11) Roll rear axle back toward the rear bumper and block under the axle bracket (57) on left side and under the frame on opposite side.

(12) Remove the jack from under bumper.

(13) Roll the rear axle out from under the power grader.

131. *REAR AXLE GEAR CARRIER REMOVAL. (Without Rolling the Rear Axle Out From Under the Grader) (See Fig. 120)*

a. Place machine on level place.

b. Start the engine and revolve the blade until it is square across.

c. Raise the blade as high as possible and place firm blocking under each end about a foot from the ends.

d. Force the blade downward. This will lift the front wheels off the ground and make the rear end lighter.

e. Place a jack under the center of rear bumper and jack up until both rear tires clear the ground at least an inch. Place a well greased plate under the right hand tire.

f. Lower the jack so the wheel weight rests only on the tire.

g. Remove the tie rod fork bolts.

h. Remove the lock wire and nine nuts from studs (61) on right side.

i. Slide the wheel to right (on greased plate) until the short axle shaft (54) is out of housing (49). Rolling the rear wheel and axle is a two-man job.

j. Remove the bolts (60) and cap (58).

k. Disconnect the drive yoke at front of pinion carrier (4 cap screws).

l. Block up directly under the gear carrier.

m. Remove the two long axle studs (55) and the one bolt (59).

n. Jack up the rear bumper about two inches more.

o. Lower the main axle housing (49) on right hand end to the floor.

p. Remove the nine nuts (62).

q. Slip the main axle housing (49) to the right about five inches so you can lift out the gear carrier, but be careful not to slide it too far or the axle shaft

(48) will slip out of guide near oil seal (52).

r. Remove the 12 nuts and washers from studs (50). It is necessary to slightly raise the gear carrier in order to entirely remove some of these nuts. Fix the location of these in your mind so you remember to start these nuts on first in putting it back together.

s. Remove one split tapered dowel bushing (53). (Reinstall it later in the same hole.)

t. Lift out the gear carrier assembly.

u. In reassembly, reverse the above procedure and use a new gasket (51). After starting all the nuts on studs (50) tighten first the one with the tapered dowel bushing on it. If oil seal (52) is worn or damaged, replace it. The same applies to seals (30), Fig. 111 (one at each trunnion).

132. *REAR GEAR CARRIER DISASSEMBLY. (After Removing It from Main Housing of Rear Axle) (See Fig. 120)*

a. Remove the two nuts on studs (4), cap (3), washer (19), and bearing cup (20).

b. Remove the four cap screws (26), bearing retainer (25), with shims (22). In reassembly, when all play is removed, remove shims to thickness of .010" to .013" more to pre-load these bearings.

NOTE: The written test as shown in the following list of paragraphs may be followed in further dismantling, cleaning, checking and reassembling the rear gear carrier, including proper bevel gear and pinion tooth contact:

(1) Paragraph 122, page 109.

(2) Paragraph 121, page 108, except sub-paragraphs (l) and (m).

(3) Paragraph 120, pages 105 and 107, except sub-paragraphs (a), (b), (c) and (d).

Always replace worn bearings with new ones. Always keep worn but usable Timken cups and cones mated or wired together during disassembly.

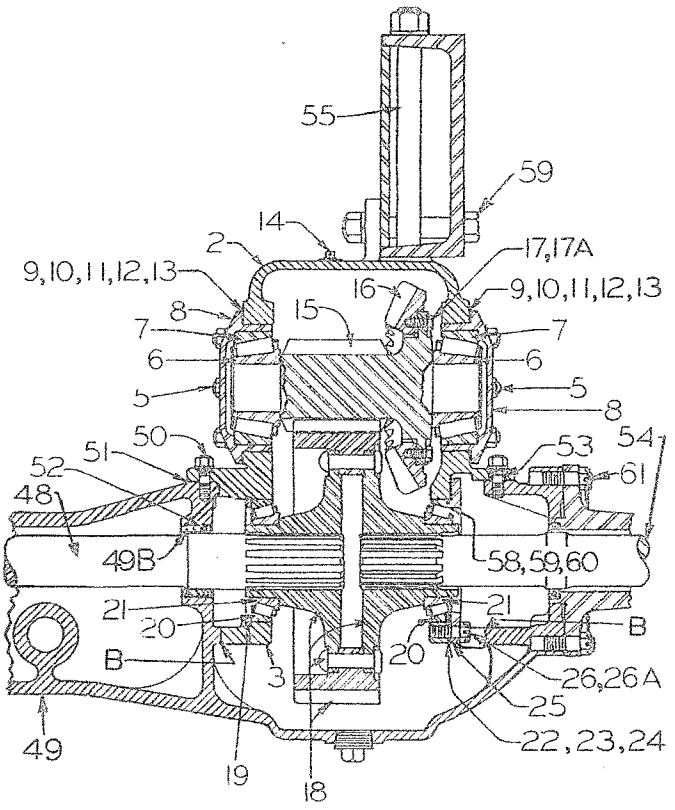


Figure 120A. Rear Axle Gear and Pinion Carrier (Machines H-4670 and up)

132A. *REAR GEAR CARRIER ASSEMBLY. (Machines H-4670 and up) (See Fig. 120A)*

a. Lock plates (17A) should not be reinstalled, instead, order and install six new cap screws having the heads drilled to receive conventional lock wire.

b. Shims (22), (23), and (24) are to be added, or removed, as required, to establish zero clearance at (B) (see above illustration, Fig. 120A). After shims (22), (23), and (24) are properly installed, the necessary shims (58), (59), and (60) are next installed as per following paragraph.

c. Shims (58), (59), and (60) are to be added, or removed, as required, to establish proper Timken bearing adjustments at (20) and (21), and as shown in paragraph 132, sub-paragraph (b) of this page.

NOTE: The written text as shown under paragraph 132A above, applies to Fig. 120A *ONLY*, and *NOT* to Fig. 120 as illustrated on page 112.

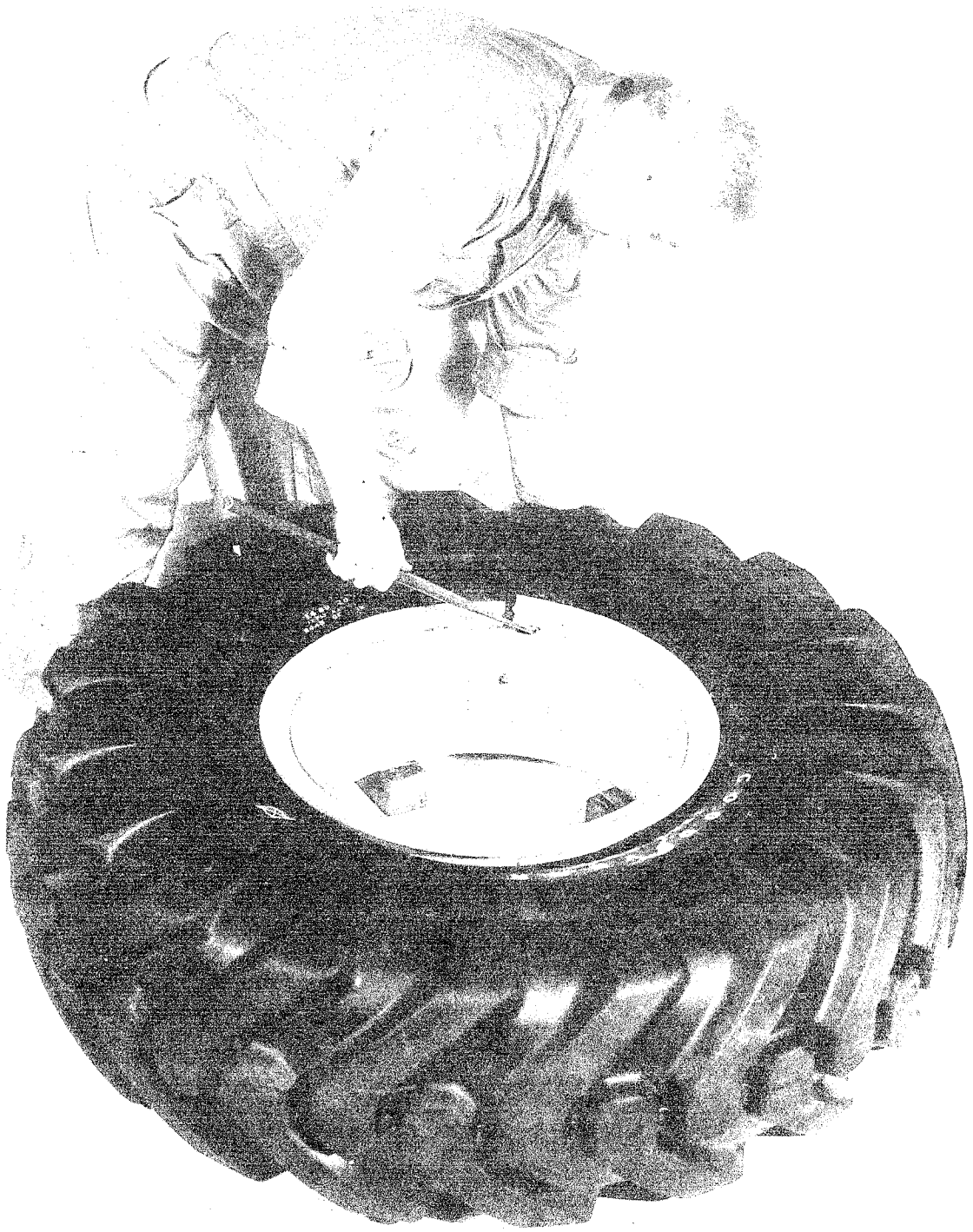
133. *TIRE MOUNTING AND DEMOUNTING PROCEDURE.*

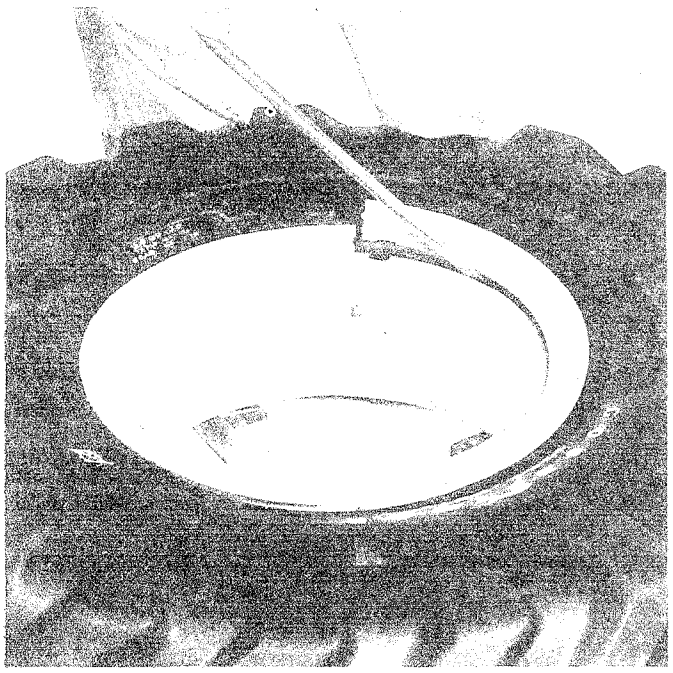
a. General.

If the tire and rim are to be demounted as a unit, it is a course only necessary to remove the rim nuts. In replacing a demounted rim, the rim nuts should always be tightened evenly so the tire will run straight and true. The nuts should be rechecked after one or two hours of operation.

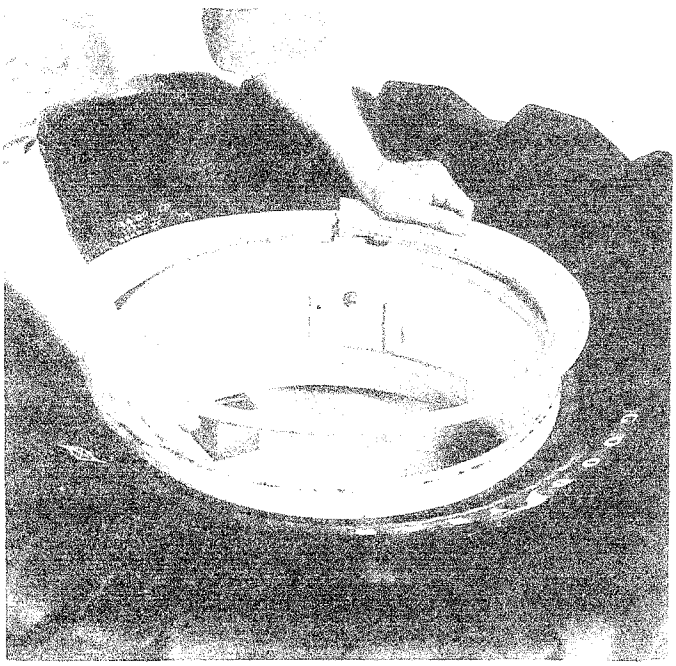
b. Demounting.

In removing the casing from the rim it should be remembered that the rim is of the drop center type, with one removable rim flange.

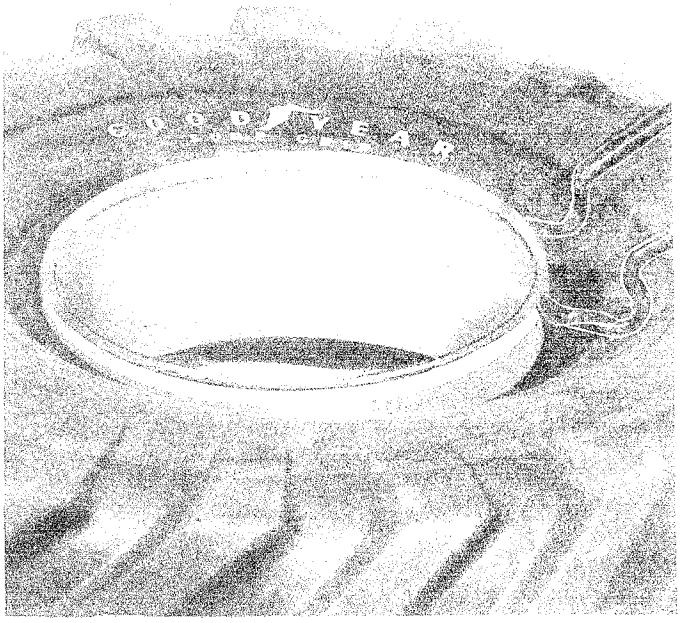




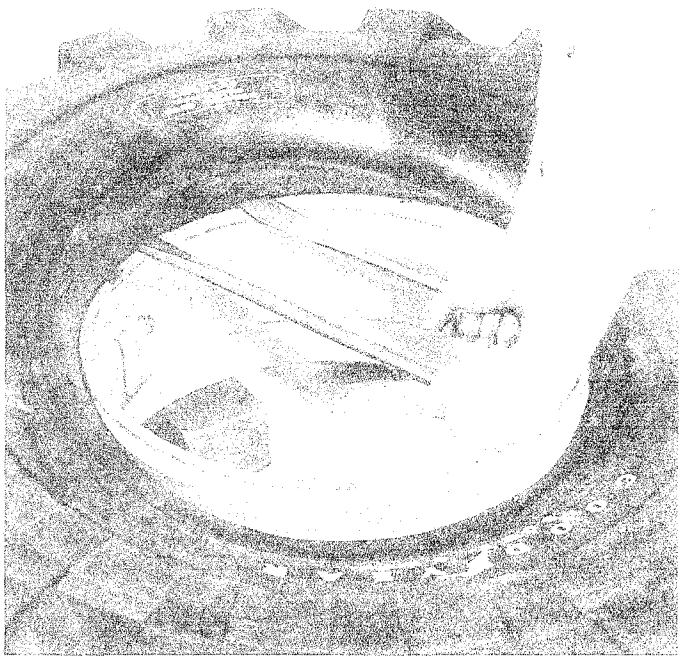
(1) The above photo and photo on page 115 show the tire and rim assembly placed on blocks of a sufficient height to permit clearance between the casing and the floor. The valve core is then removed to allow complete deflation of the tube. Next a tire iron is inserted in the notch as shown, and the rim flange is pried out of the rim gutter.



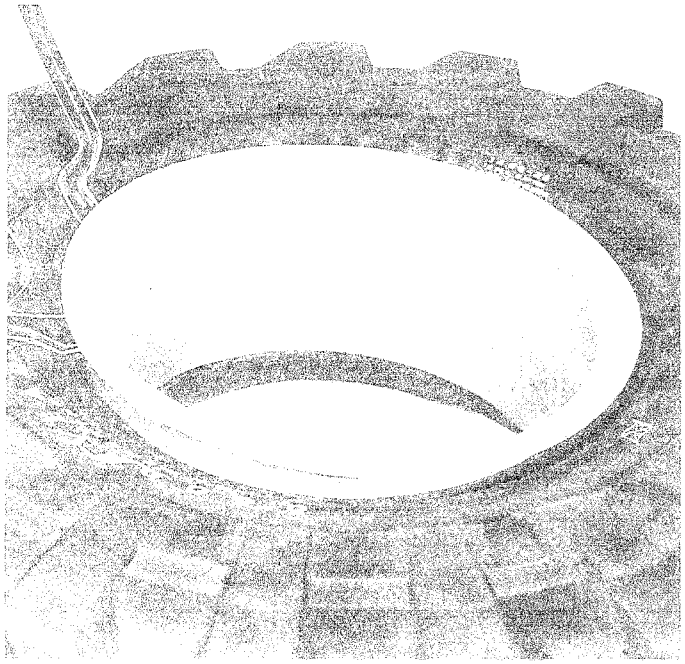
(2) The loose flange is removed as shown in the above photo.



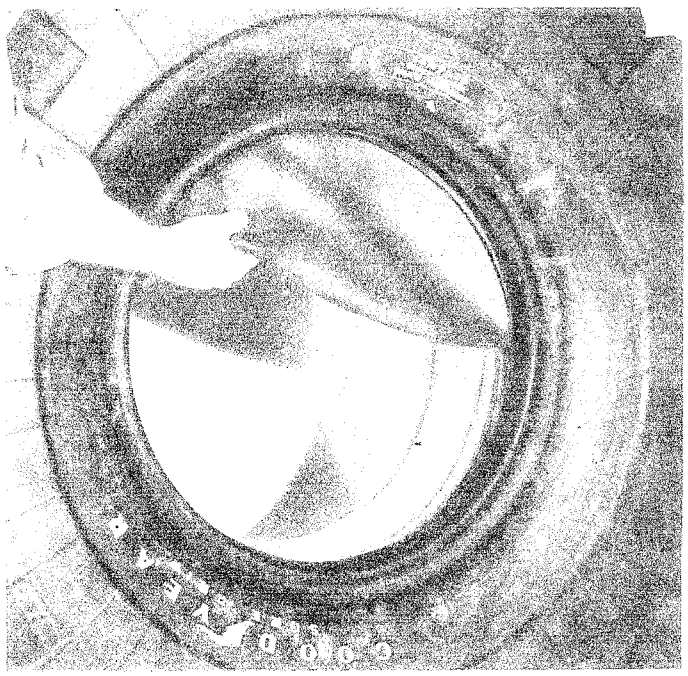
(3) The above photo shows the upper tire bead opposite the valve being forced downward into the rim well. This operation may be facilitated by the use of special tools, such as the Goodyear tire remover, No. 399 shown.



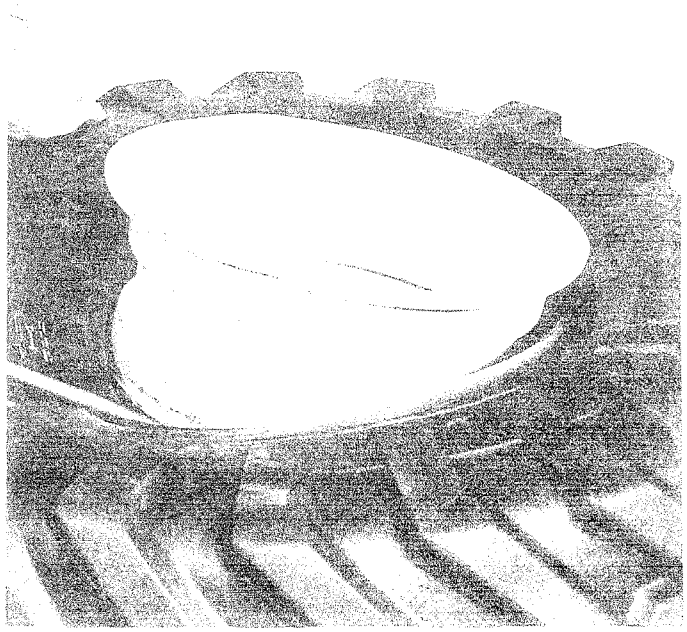
(4) With a portion of the bead in the rim well, the diametrically opposite side of the bead is worked over the rim gutter section, and then the entire bead is worked over the gutter as shown in the above photo.



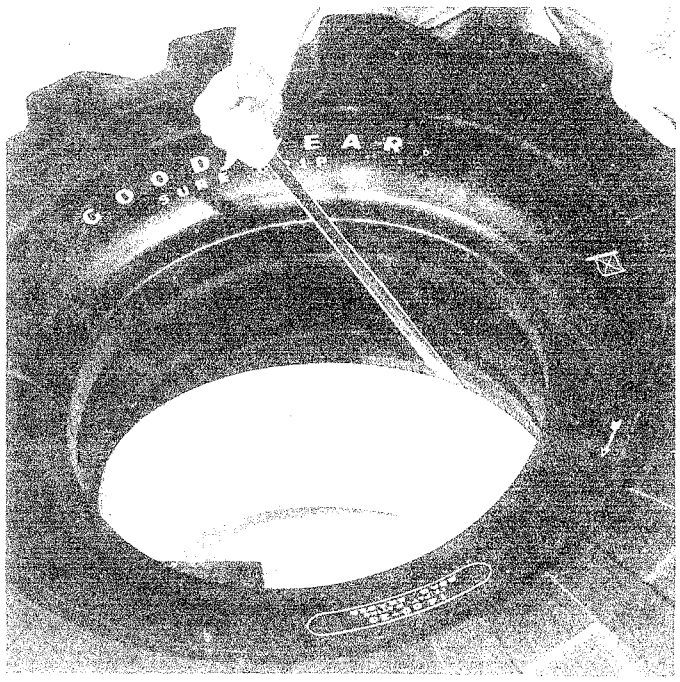
(5) The tire and rim assembly is turned over and the other bead is broken loose from the tapered rim base as shown above. The valve rim nut is then removed and with the valve cap in place to protect the threads, the valve stem is forced out thru the hole in the rim.



(6) The above photo shows the tire placed in the vertical position with the rim partially removed and the tube being removed from the casing.



(7) The bead is forced into the well on one side and a tool inserted diametrically opposite, prying the rim out of the tire as shown in the photo above.



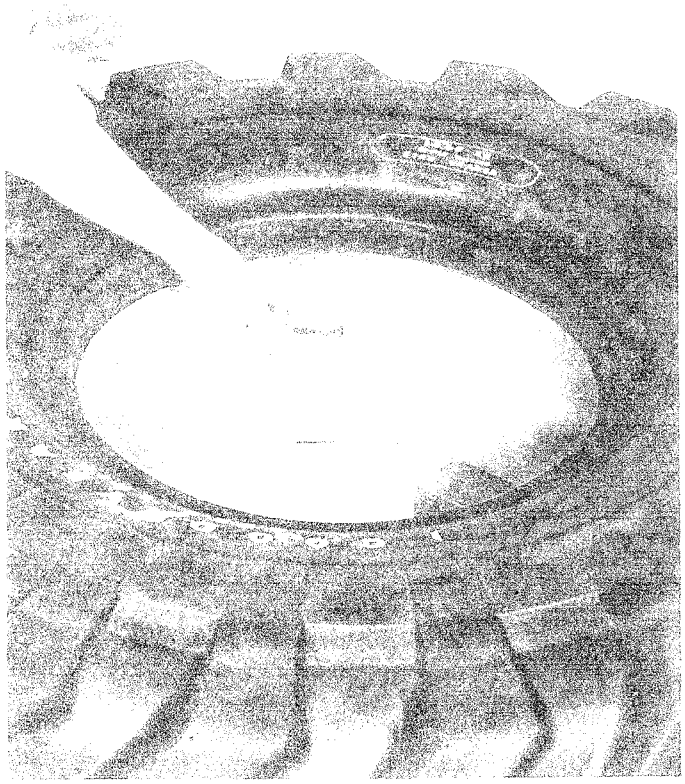
c. Mounting.

The tire and tube should be carefully inspected to remove all foreign material. The tube is then inserted in the tire and inflated until it is just rounded out.

CAUTION: Too much air will make mounting difficult.

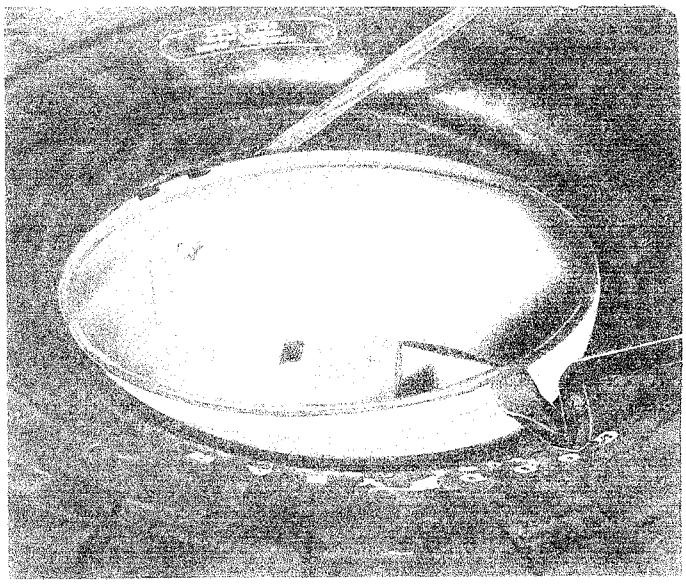
The base of the tube and the inside of the tire beads may be lubricated lightly with a mixture of soap and water to facilitate mounting.

(1) The preceding photo on page 117 (lower right corner) shows the rim placed on blocks, the same as when starting tire removal. The valve locating chain is screwed on the valve stem. The tire is placed over the rim with the valve in line with the valve hole, and the end of the chain is then led thru the hole. One side of the lower bead is then forced into the rim well, and the opposite side is worked over the rim gutter section, as shown.

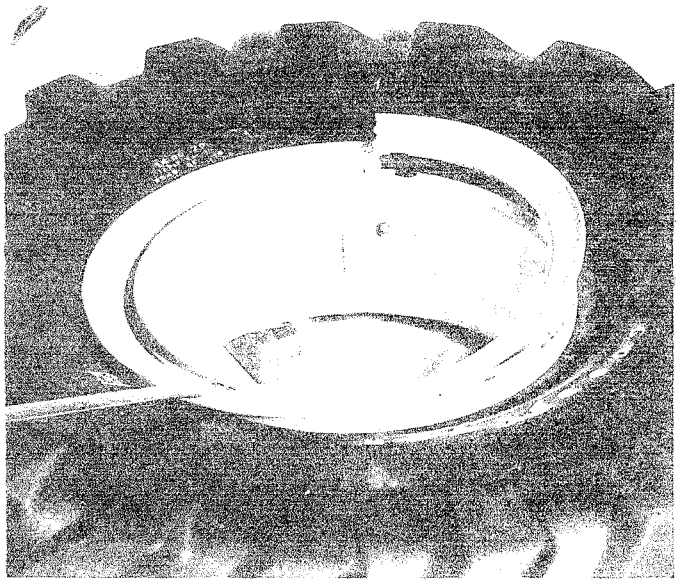


(2) As shown in the photo above the valve stem is pulled thru the hole in the rim and the rim nut is then screwed on to hold the valve in place.

CAUTION: When mounting a new tire, be sure that all four tires have the same number of plys as fitted to the other wheels. Otherwise, undue tire tread wear may occur.



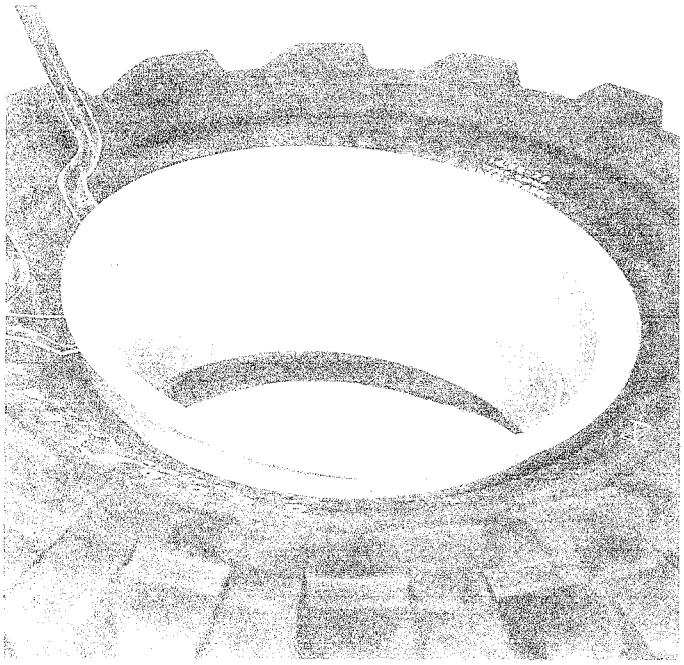
(3) One side of upper bead is pried into the rim well, and the opposite side is worked over the gutter section as shown in the photo above.



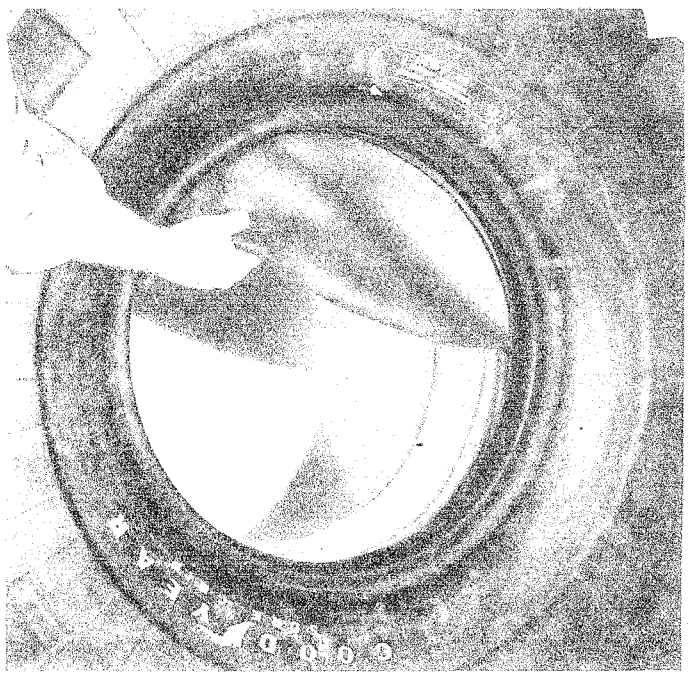
(4) One end of the locking ring is engaged and the ring is worked into the rim gutter in a counter-clockwise direction with the aid of a tire iron, as shown in the above photo.

CAUTION: The locking ring should be carefully checked to see that it is fully seated and the assembly turned over with the loose flange down before starting to inflate.

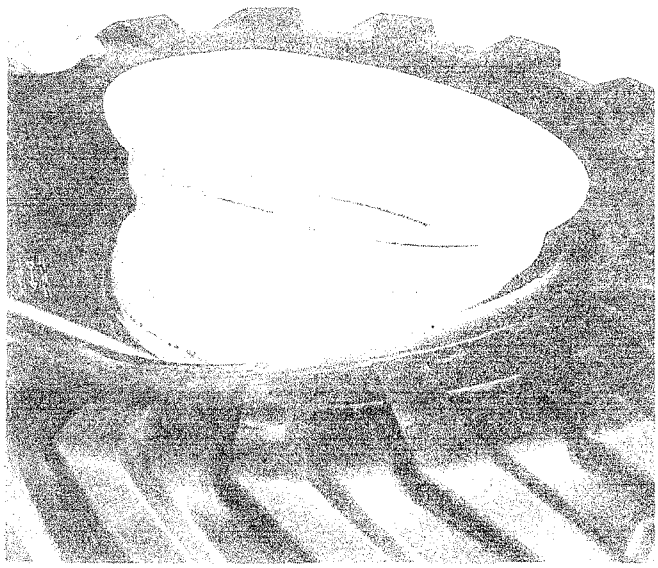
If the tire is inflated in a vertical position, the operator should always stand on the fixed flange side.



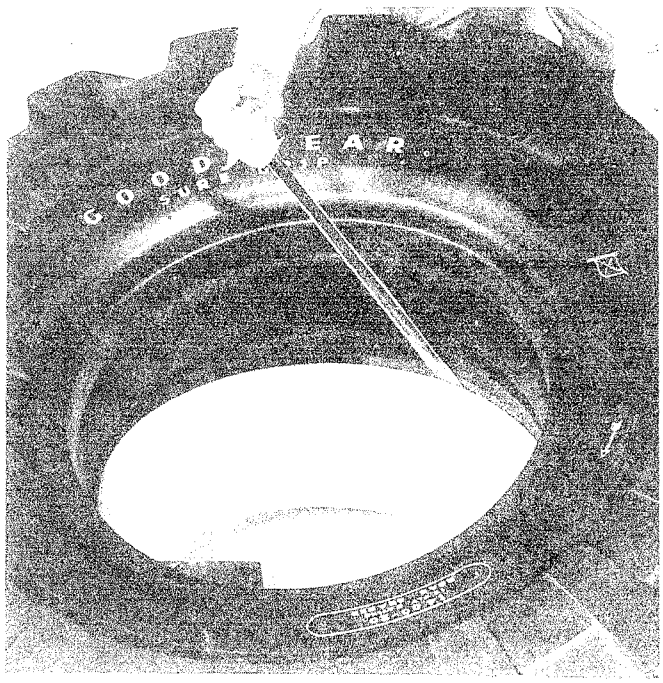
(5) The tire and rim assembly is turned over and the other bead is broken loose from the tapered rim base as shown above. The valve rim nut is then removed and with the valve cap in place to protect the threads, the valve stem is forced out thru the hole in the rim.



(6) The above photo shows the tire placed in the vertical position with the rim partially removed and the tube being removed from the casing.



(7) The bead is forced into th well on one side and a tool inserte diametrically opposite, prying the rim ou of the tire as shown in the photo above.



c. Mounting.

The tire and tube should be carefull inspected to remove all foreign material The tube is then inserted in the tire an inflated until it is just rounded out

CAUTION: Too much air will make mounting difficult.

133A. *TIRE INFLATION.*

TIRE SIZE	14.00 x 20; 14 PLY		16.00 x 20; 14 PLY	
	*Front Tire Inflation	*Rear Tire Inflation	*Front Tire Inflation	*Rear Tire Inflation
With or without Scarifier.....	30	45	30	30
With Bulldozer.....	40	45	30	30
With Conveyor Loader.....	25	55	30	50
With Snow Plow and Wing.....	40	40	55	55
With Rear Roller.....	25	50	30	45

NOTE: * Variation of 2 lbs. permissible. Always replace leaky valves and caps with genuine "Schrader" parts.

CAUTION: When mounting a new tire, be sure that all four tires have the same number of plys as fitted to the other wheels. Otherwise, undue tire tread wear may occur.

134. *WATER WEIGHTS FOR FRONT AND REAR TIRES.*

a. *General.*

Where it is found desirable, water for weight may be used inside the tires of the 99-H power grader. During freezing weather calcium chloride solution instead of water should be used, for damage occurs due to the chunks of ice, which form on the inside, cutting the inner tube. To add water weight, proceed as follows:

(1) Jack up one wheel and rotate so tire valve stem is at the top.

(2) Put conical valve cap, or equivalent, on valve to prevent valve stem from slipping inside rim. Remove valve inside and allow all air pressure to escape.

(3) Attach special hose connection (Schrader #8687, or equivalent) to valve and to water or calcium chloride supply line.

(4) Insert water or calcium chloride solution. When using Schrader #8687 connection, any back pressure built up inside the tire can be relieved by pressing on the release valve button.

(5) Check water level by pressing on release valve and rotating tire until water or solution runs out. Tire should not be filled more than 3/4ths full.

(6) When using a connection without a release valve, it is necessary to remove same in order to release back pressure inside the tire or check the water level. When doing this be sure to leave the conical valve cap in place. Allow water to run out, or add more, as needed to get the desired level. Remove coupling and replace valve inside, still leaving the conical valve cap in place.

(7) Inflate tire to about 50 pounds to seat beads and then reduce to pressure three or four pounds above the recommended figure. Remove conical cap. After a few days operation, recheck the pressure in the tires and reduce to the recommended figure if this has not already occurred.

(8) Never pour the water over the calcium chloride crystals. Always place the water in the container and then add the proper amount of calcium chloride crystals.

(9) By the use of a "T" or "Y" hose coupling, it will be possible to make a double connection to permit two tires to be filled at the same time.

135. *TIRE CHAINS.*

Tire chains may be used in snow removal on all four wheels.

Tire chains must have cross chains every other side link. Never use tire chains having cross chains every two or three side links.

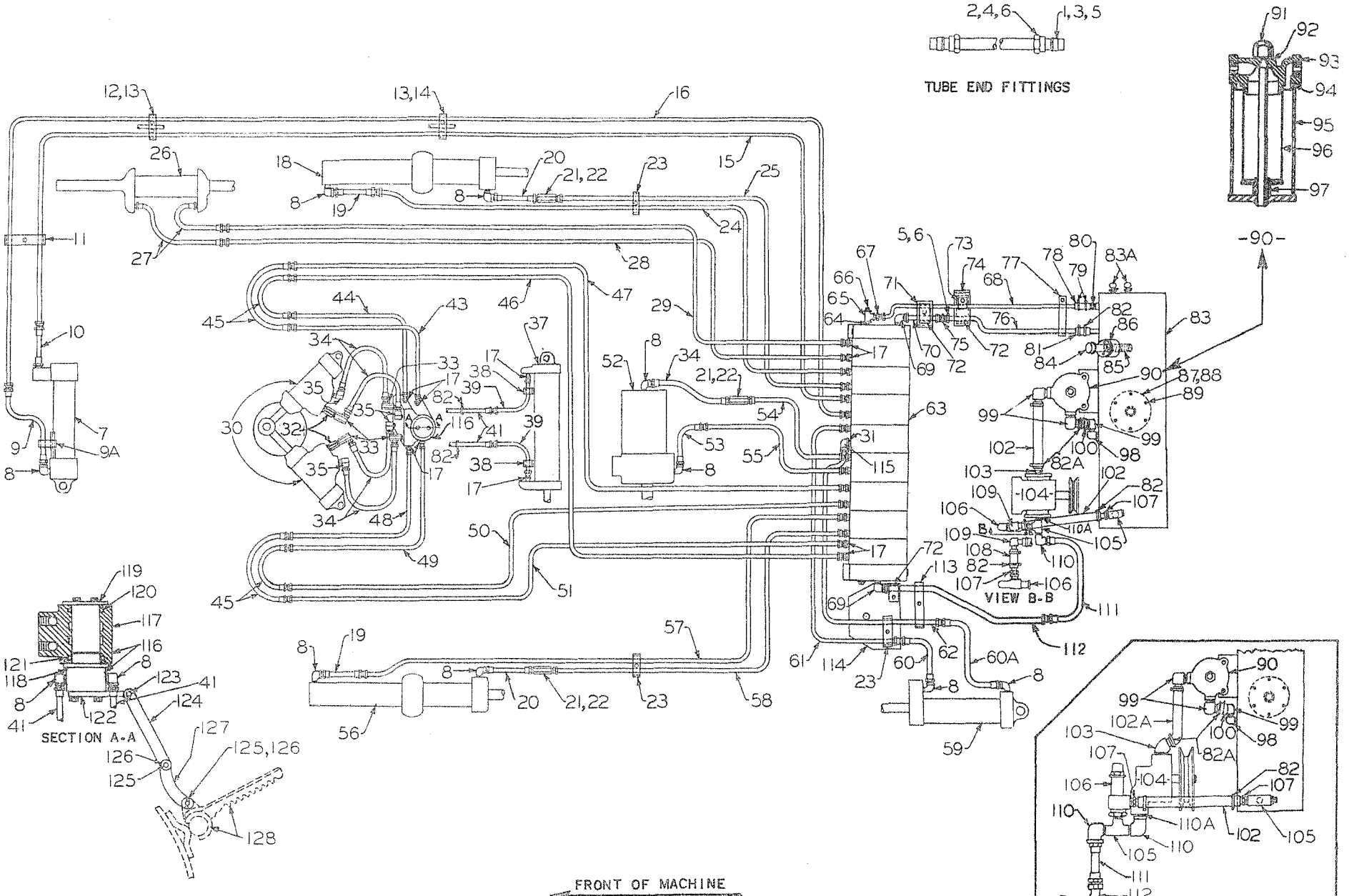


Figure 133. Hydraulic Piping Diagram
(UD-14A, UD-16 and D-471 Engines)

136. *HYDRAULIC SYSTEM.*
(See Fig. 133)

a. General.

The hydraulic system on the 99-H power grader is sealed in its entirety, except for the breather filler cap.

It consists of an anti-foam reservoir, filters, pump, control valves, rams and necessary piping.

It requires periodic attention, and this can be summed up as shown in the following paragraphs.

b. Hydraulic Oil.

(1) The oil in the hydraulic system can be contaminated by dust of a gritty nature that is finer than the openings in the screen of the hydraulic oil strainer. By maintaining the quality of the oil in the hydraulic system, you increase the life of the pump, valves and rams, and you also keep your machine at a high degree of efficiency. Change the hydraulic oil at least twice a year, flushing out the supply tank thoroly, using clean hydraulic oil only. Keep oil supply free from dust. Use clean cans when changing oil.

(2) The kind of oil to use in the hydraulic system is SAE-10W for temperatures above 32° F. For temperatures below 32° F. use ice machine oil having a pour point of minus 40 and a viscosity of 100 seconds at 100° F. Using a heavier oil than the above will cause air bubbles and foaming. Either a parafin or asphalt base oil will be acceptable.

c. Reservoir.
(See Fig. 133)

(1) Reservoir (83) is fitted with a drain plug and hand hole (87) at the bottom. When changing oil this hand hole may be removed and the entire inside of the reservoir may be cleaned and swabbed out.

(2) Draining and cleaning the pump strainer (90) may be necessary after the first week of operation, due to the accumulation of pipe scale, threading cement or abrasives. In any event, drain and clean it at least twice a year.

(3) High and low oil level test cocks (83A) are provided. Oil level should be between these two test cocks.

(4) Screen group (85) is provided for the purpose of keeping out debris from the inside of the reservoir and system, should someone inadvertently use unclean cans and pour unclean oil into the reservoir.

d. Pump Strainer.

(1) The strainer (90) is located in the suction supply line between the back side of the reservoir and the hydraulic pump (104).

(2) To clean the strainer, unscrew the hex nut (91) on top of the tank casting or head (93), and let the tank down. Remove screen (96), wash out thoroly with air and kerosene, and reinsert.

(3) A coil spring (97) is used to hold the screen tightly up against the head. Be sure this spring is not lost in cleaning operation, otherwise screen will drop to bottom of tank and become useless.

(4) Be careful not to lose or destroy small gasket (94), (between tank and head) and copper washer (92) under nut (91). This strainer will probably need more attention than any other item and should be your first thought in case of sluggish operation or failure of the oil to properly move the rams.

e. Hydraulic Relief Valve.

(1) The relief valve (106) has been properly set at the factory and should not be tampered with. Should loss of power occur (slow action in rams or a howling noise in the pump), your trouble is most likely due to a clogged screen in the hydraulic oil strainer (90), or to the quality of oil. The proper setting of the relief valve is 1000 lbs.

(2) Never attempt to set relief valve without using a pressure gauge, as too high relief valve setting will materially shorten the life of hydraulic working parts.

137. *HYDRAULIC PIPE FITTINGS, HOSE AND PIPING.*

a. *Hydraulic Pipe Fittings.*
(See Fig. 134)

CAUTION: In reassembly, pull nut up finger tight and then give one-fourth turn only with a wrench. This is important and must be observed when disconnecting and reconnecting established lines.

To install a new pipe or fittings proceed as follows:

Step 1. Cut Tubing Square.

Use a tube cutter with a rotating cutting wheel, or cut with a saw. Then file or grind end reasonably square. Remove burrs.

Step 2. Assemble Nut and Ring to Tube.

Make sure head of sleeve (A) is toward nut.

Step 3. Insert Tube into Fitting.

Make sure tube rests squarely on shoulder point (B).

Step 4. Tighten Finger Tight.

Bring nut down on sleeve and make finger tight, as shown in illustration Step 4.

Step 5. Tighten with Wrench.

Give nut one and one-half turns only with wrench to bring up as tight as shown in illustration Step 5.

CAUTION: Never tighten over two turns as this will distort the sleeve and tubing, thereby preventing a leak-proof seal.

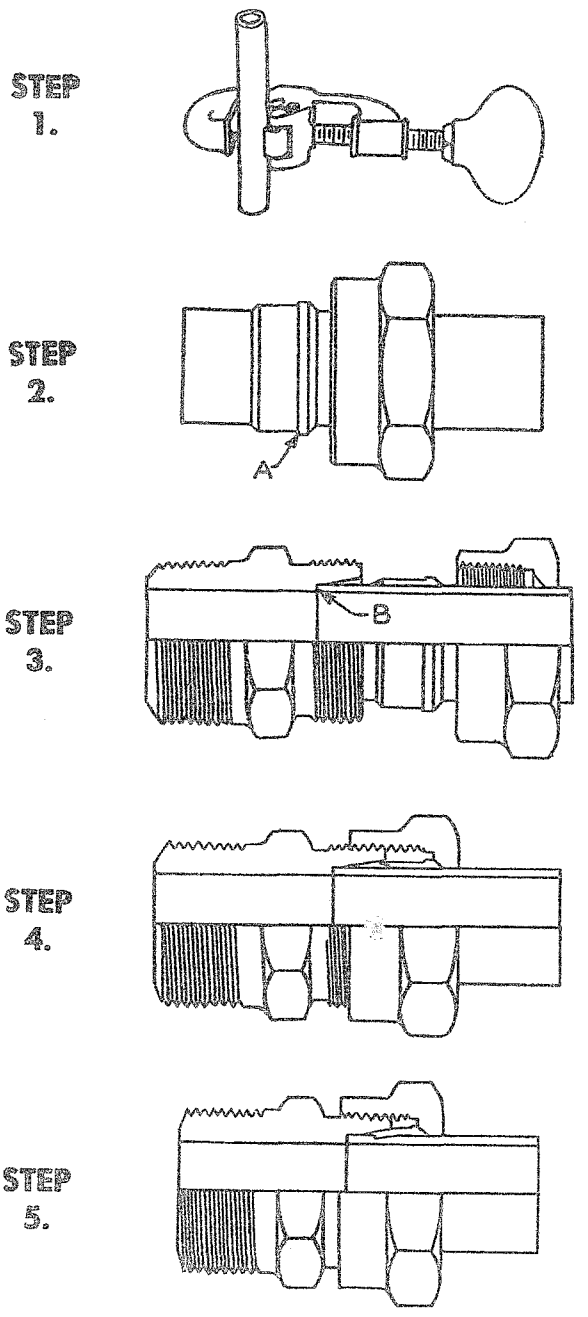


Figure 134. Hydraulic Pipe Fittings

b. *Hydraulic Hose.*

The connecting hose is amply strong to stand the pressures encountered. Constant vibration may tend to loosen some of the fittings and they should be inspected occasionally and tightened with special wrenches provided.

c. *Hydraulic Piping.*

Always procure replacement piping from the nearest Austin-Western distributor.

138. HYDRAULIC PUMP WITH DRIVE PULLEY. (See Fig. 135)

a. General.

The hydraulic pump is a small, important unit and should be handled with care. Loss of volume will more than likely be due to loose connections or to a clogged screen in the hydraulic oil strainer. We strongly recommend leaving the pump alone. Should anything occur that would lead you to believe the pump might be in need of repair, procure another pump, or repairs, from your nearest Austin-Western distributor.

When installing a pump be sure to pack the exposed bearing with a fibrous grease similar to Texaco Marfak #2 before mounting pump on bracket.

To adjust pump drive belt (22), remove pump pulley cap screws and transfer shim, or shims (21) from between pulley flanges to a position under cap screw heads.

b. Hydraulic Pump Dismantling and Reassembly.

To remove the inner parts of the pump, proceed as follows:

(1) Remove the head screws (2) and the head (3). The head-end valve plate bushing (6) can then be pulled out, leaving exposed the rotor (8), vanes (17), and cam ring (7).

(2) These parts can all be removed for inspection, and the shaft-end valve plate bushing (9) will then be exposed. It too can be removed by a hook-shaped tool. Parts that may show damage or excess wear should be replaced.

(3) Reassemble in reverse order with parts replaced in original position. (See instructions at top of Fig. 135.) Renew head ring packing (4) if it has become compressed or damaged, otherwise air will be drawn in when pump is started. Assemble the pump head so that ring pin hole registers with protruding part of ring pin (5).

Extreme caution must be taken when reassembling parts to insure no grit or lint gets into vane slots or between assembled parts. Not only may this cause a vane to stick, but it may also cause damage to valve plate bushings. A small amount of foreign matter also will give a false indication of head screw adjustment, thereby impairing pump efficiency. Wash parts in kerosene and use every reasonable precaution against dirt.

(4) When reassembling a pump the head take-up screws (2), if tightened excessively, can cause binding between the rotor (8) and the two valve plate bushings (6) and (9). It is very important these take-up screws be drawn up moderately and evenly. Rotate the pump shaft by hand while gradually tightening first one and then another of the head screws, until all have been pulled up evenly without causing the shaft to bind. Insert a wire thru screw heads so that adjustment will be maintained.

c. Inspection.

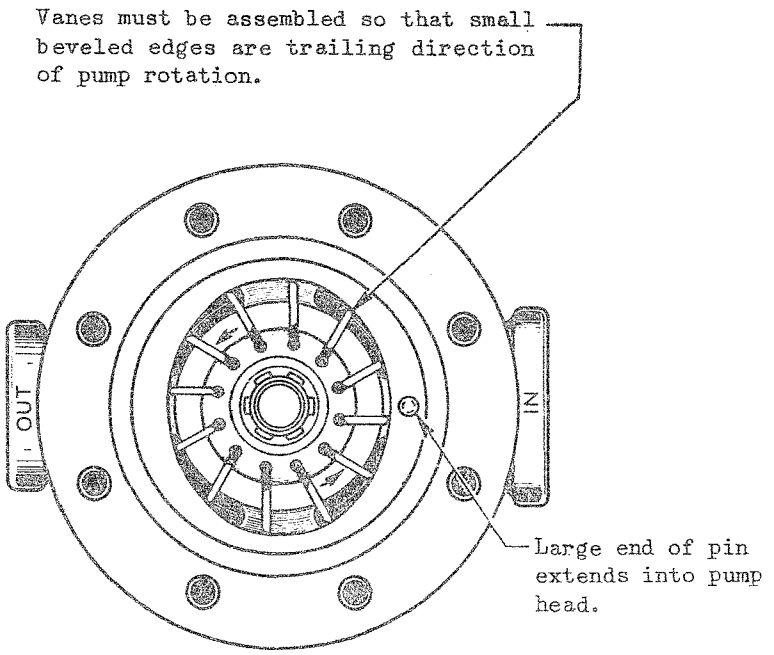
Inspection of shaft, shaft bearing, and shaft packing, can be made as follows:

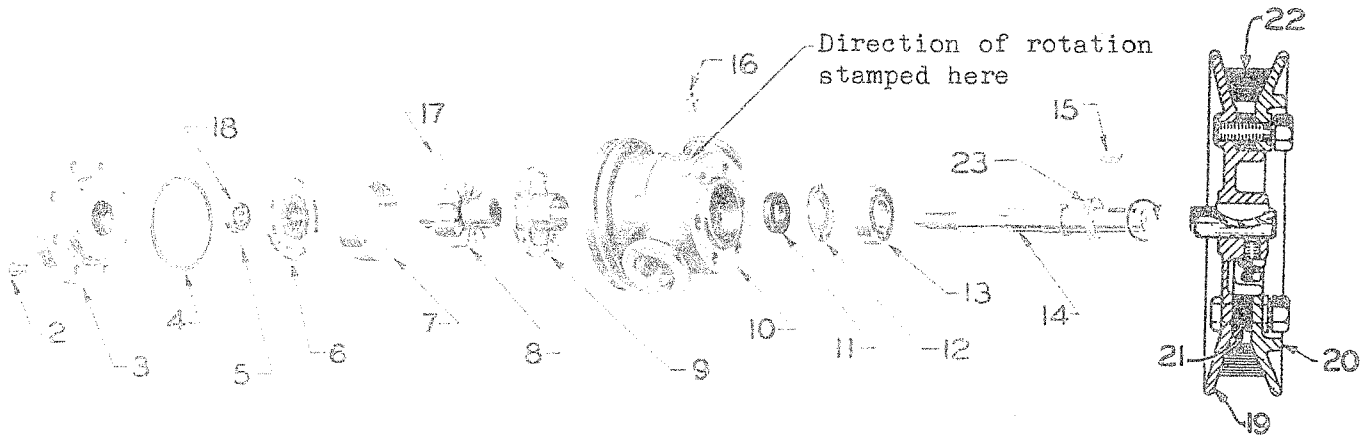
The opposite end of the pump must be opened to gain access to the shaft parts. Remove the shaft (14) and bearing (13). The stamped steel packing gland (12) and the special cork packing (11) can then be inspected. The cork packing should be renewed to prevent air leaking into the pump (or oil leaking out when the pump is not running). When replacing the gland make certain its outside diameter bears on the outer ball bearing race, and its inside diameter against the cork shaft packing. All of this work may be accomplished without disturbing the head-end of the pump.

d. Hydraulic Pump Rotation.

The pump drive pulley on this grader rotates right hand or clockwise, therefore the internal parts, such as vanes, etc., must be assembled as shown in Fig. 135 under "Right Hand Rotation". If the pump is assembled for left hand rotation, it will not operate. (That is, develop 1000 lbs. pressure and deliver eight gallons of oil per minute.)

Head End View of Pump
(Right Hand Rotation)
With Pump Head and Head End Bushing Removed





REF.	DESCRIPTION	REF.	DESCRIPTION	REF.	DESCRIPTION
2.	Screw	10.	Body	17.	Vane
3.	Head	11.	Packing	18.	Bearing
4.	Packing	12.	Gland	19.	Pulley-inner half
5.	Ring pin	13.	Bearing	20.	Pulley-outer half
6.	Bushing	14.	Shaft	21.	Shim
7.	Ring	15.	Shaft key	22.	"V" belt
8.	Rotor	16.	Lube fitting	23.	Felt
9.	Bushing				

Figure 135. Hydraulic Pump (1st type - PGF-9373)
(Machines H-100 to H-2538 inclusive)

138A. HYDRAULIC PUMP WITH DRIVE PULLEY. (See Fig. 135A)

a. General.

The hydraulic pump is a small, important unit and should be handled with care. Loss of volume will more than likely be due to loose connections or to a clogged screen in the hydraulic oil strainer. We strongly recommend leaving the pump alone. Should anything occur that would lead you to believe the pump might be in need of repair, procure another pump, or repairs, from your nearest Austin-Western distributor.

When installing a pump be sure to pack the exposed bearing with a fibrous grease similar to "Texaco Marfak #2" before mounting pump on bracket.

To adjust pump drive belt (22), remove pump pulley cap screws and transfer shim, or shims (21) from between pulley flanges to a position under cap screw heads.

b. Hydraulic Pump Dismantling and Reassembly.

To remove the inner parts of the pump, proceed as follows:

(1) Remove the head screws (2) and the cover (3) with spring (4). The pressure plate (5) can then be pulled out, leaving exposed the rotor (8), vanes (9), and cam ring (7).

(2) These parts can all be removed for inspection, including the sealing rings (6). Parts that may show damage or excess wear should be replaced.

(3) Reassemble in reverse order with parts replaced in original position. (See instructions at top of Fig. 135A.) Always renew both sealing rings (6), otherwise air will be drawn in when pump is started. Assemble the cover (3) and ring (7) so that pin holes register with pin holes of body (11).

Extreme caution must be taken when reassembling parts to insure no grit or lint gets into vane slots or between assembled parts. Not only may this cause a vane to stick, but it may also cause damage to pressure plate (5). A small amount of foreign matter also will give a false indication of head screw adjustment, thereby impairing pump efficiency. Wash parts in kerosene and use every reasonable precaution against dirt.

(4) When reassembling a pump the head take-up screws (2), if tightened excessively, can cause binding between the rotor (8) the cover (3) and the body (11). It is very important these take-up screws be drawn up moderately and evenly. Rotate the pump shaft by hand while gradually tightening first one and then another of the head screws, until all have been pulled up evenly without causing the shaft to bind.

c. Inspection.

Inspection of shaft, shaft bearings, and shaft packing, can be made as follows:

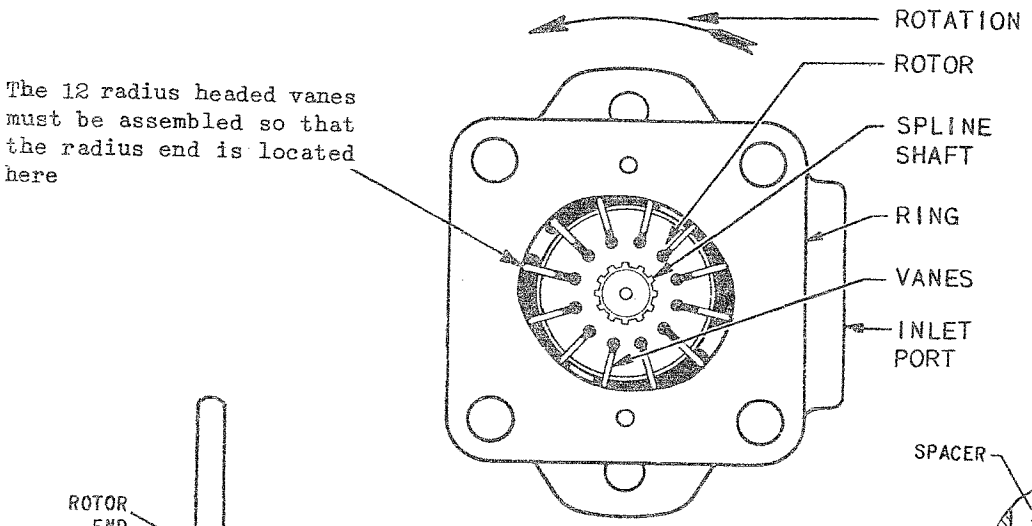
The opposite end of the pump must be opened to gain access to the shaft parts. Remove the snap ring (17) and the shaft (14) with bearing (16) may be pulled out of the body (11). The stamped steel oil seal (13) can then be inspected. The seal (13) should be renewed to prevent air leaking into the pump (or oil leaking out when the pump is not running). When replacing the seal (13) make certain the lip is turned towards the body (11). Inspect (and replace if necessary) the bearing (12) before installing the seal (13). All of this work may be accomplished before assembling the rotor end of the pump. (Install the rotor end of the pump last.) Pack the bearings and bearing compartment with "Texaco Marfak #2" ball bearing grease, or equivalent, before installing the shaft.

d. Hydraulic Pump Rotation.

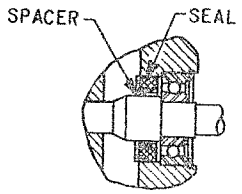
The pump drive pulley on this grader rotates right hand or clockwise, therefore the internal parts, such as vanes, etc., must be assembled as shown in Fig. 135A under "Right Hand Rotation". If the pump is assembled for left hand rotation, it will not operate. (That is, develop 1000 lbs. pressure and deliver eight gallons of oil per minute.)

Cover End View of Pump
(Right Hand Rotation)

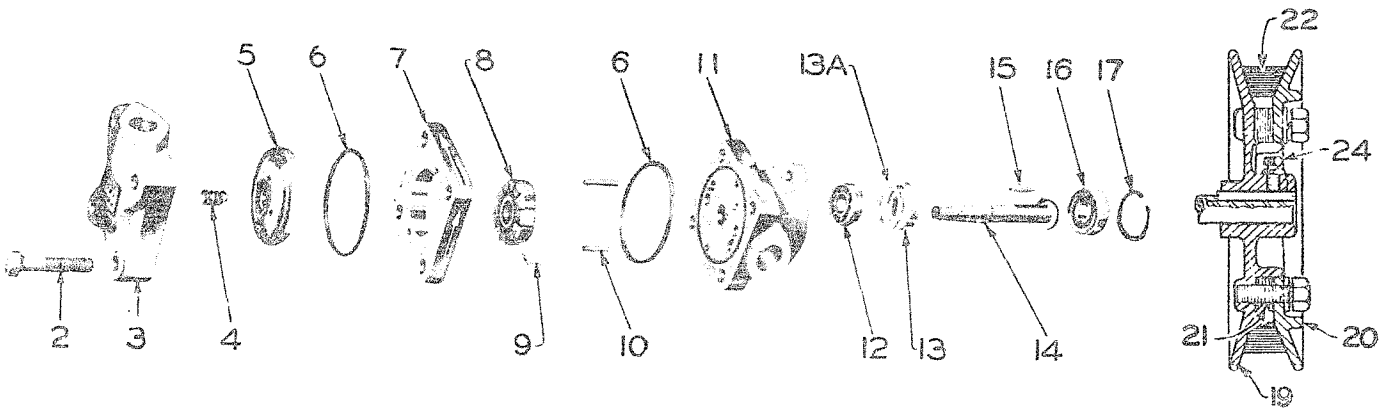
With Pump Cover (3) and Pressure Plate (5)
with Spring (4) Removed



Enlarged End View
Of Radius Headed Vane



Spacer
and Seal Assy.



REF.	DESCRIPTION
2.	Cap screw
3.	Cover
4.	Spring
5.	Pressure plate
6.	Seal ring
7.	Ring
8.	Rotor
9.	Vane (radius headed)
10.	Pin
11.	Body
12.	Bearing
13.	Oil seal
13A.	Oil seal spacer
14.	Shaft
15.	Shaft key
16.	Bearing
17.	Snap ring
19.	Pulley - inner half
20.	Pulley - outer half
21.	Shim
22.	"V" belt
24.	Set screw

Figure 135A. Hydraulic Pump (2nd type - PGF-11898)
(Machines H-2540 and up)

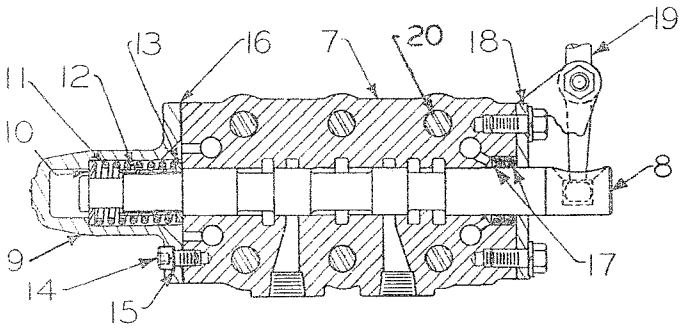


Figure 136. Hydraulic Control Valve

139. *HYDRAULIC CONTROL VALVES.*
(See Fig. 136)

A separate trouble-free valve is used to control each operating ram, and all the valve bodies are bolted together to form a single unit. Each movable valve is held in a neutral position by the use of one spring (11). The spring (11) and parts within cap (9), do not require adjustment or cleaning whatsoever, from one season to another, and this likewise applies to the chevrons (17).

Do not turn or alter the position of the nuts at each end of rods (20). Should you believe the control valve group requires attention, contact your nearest Austin-Western distributor for service assistance.

140. *HYDRAULIC RAM CYLINDERS.*
(See Fig. 137)

a. General.

The ram cylinders should require little or no attention thru many years of trouble-free service. The honed cylinder walls are of special annealed quality steel, and pistons are of special construction to eliminate scoring by the use of special molded cups and spacer shoes. The piston rods are chrome plated. Shims are provided at the ball sockets to permit easy adjustment after long hard wear. The piston rod glands contain a special packing ring assembly, and care should be taken not to turn the cap (18) too tightly, as this destroys the feather-edged action of the "V" shaped chevrons (13).

In making cylinder cup replacements do not replace with leather or other questionable material, as the special moulded duck cups (3) supplied as original equipment, are the only type recommended. Each cylinder has a special wiper ring (17) and felt (16) in the gland to prevent the entry of dirt in the packing chamber.

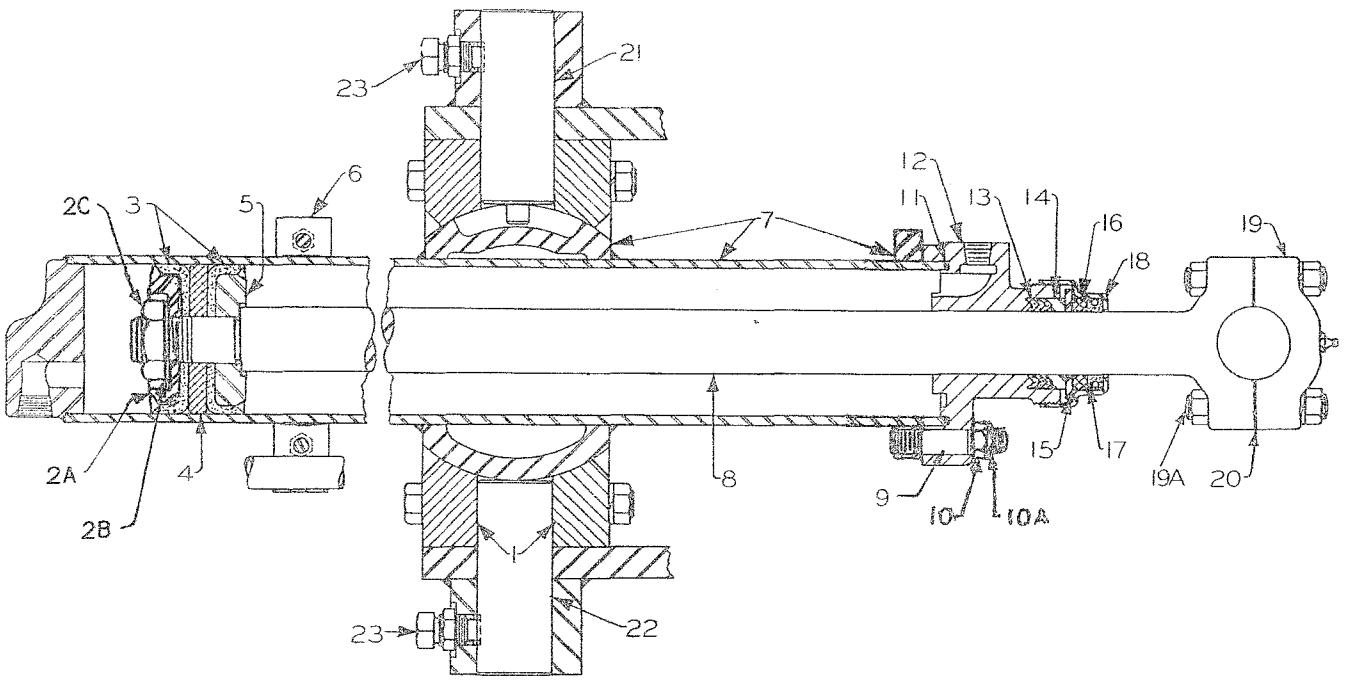


Figure 137. Blade Lift Ram

141. BLADE LIFT RAM.
(See Fig. 137)

To dismantle and reassemble proceed as follows:

(1) Lower the moldboard to the ground and with engine shut off, disconnect the two hose connections at the top and bottom of the ram.

(2) Remove nuts off the studs (19A) and swing the rod (8) out sideways.

(3) Remove nuts (10). The head (12) with rod (8), may now be pulled out of the cylinder (7) exposing the cups (3).

(4) To remove the cups (3) together with the piston (4) and outer spreader (2A) and inner spreader (5) from the rod (8), clamp the socket end of rod in a vise. By means of a suitable long wrench remove nut (2C). After removing the nut (2C) the cups and parts may be slipped off the rod (8). Loosen cap (18) and remove the head (12) with seal parts.

(5) Assembly is reversal of the above procedure.

(6) Coat the inner bore of cups (3) with quick setting compound, such as Perma-Tex #3, before placing them on the rod.

(7) When retightening the nut (2C) use a socket wrench with 3 foot handle. Then drive against the end face of nut, using a bronze plug and hammer. Then retighten the nut still further. This is necessary in order to securely clamp the cups (3) to the rod (8).

(8) Before inserting the cups and rod (8) into the lower end of cylinder (7) be sure to install a new gasket (11) into the recess of the head (12). Piston ring squeezer or fine wire tightened over the end of the cup will have to be used in order to compress the cup for easy entry into the exposed bore of cylinder (7). Retighten the cap (18) with your hands.

(9) To remove the complete blade lift ram group from the machine, lower the moldboard to the ground and detach the two hydraulic hoses. Detach the ball socket (19). Remove the two set screws (23) and pull out the two pins (21) and (22).

142. BLADE SIDE SHIFT RAM.
(See Fig. 138)

a. To remove the complete ram group, disconnect the ball socket (16), the two hydraulic hoses, the nut (18) and parts (19) and (20).

b. To dismantle and expose the ram cups (5), proceed as shown in paragraph 141, (3) to (8) inclusive. When assembling the cups, drive against spreader (4) in order to seat the cups (5).

c. When assembling, always install two new gaskets (2) and ring (12). Nut (18) should only be tightened slightly, ther cottered.

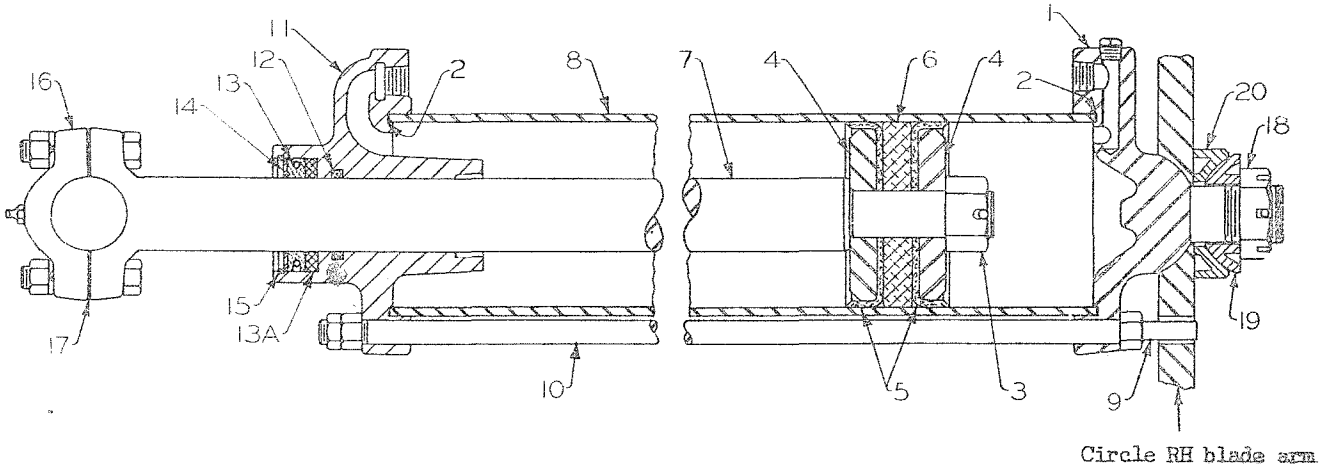


Figure 138. Blade Side Shift Ram

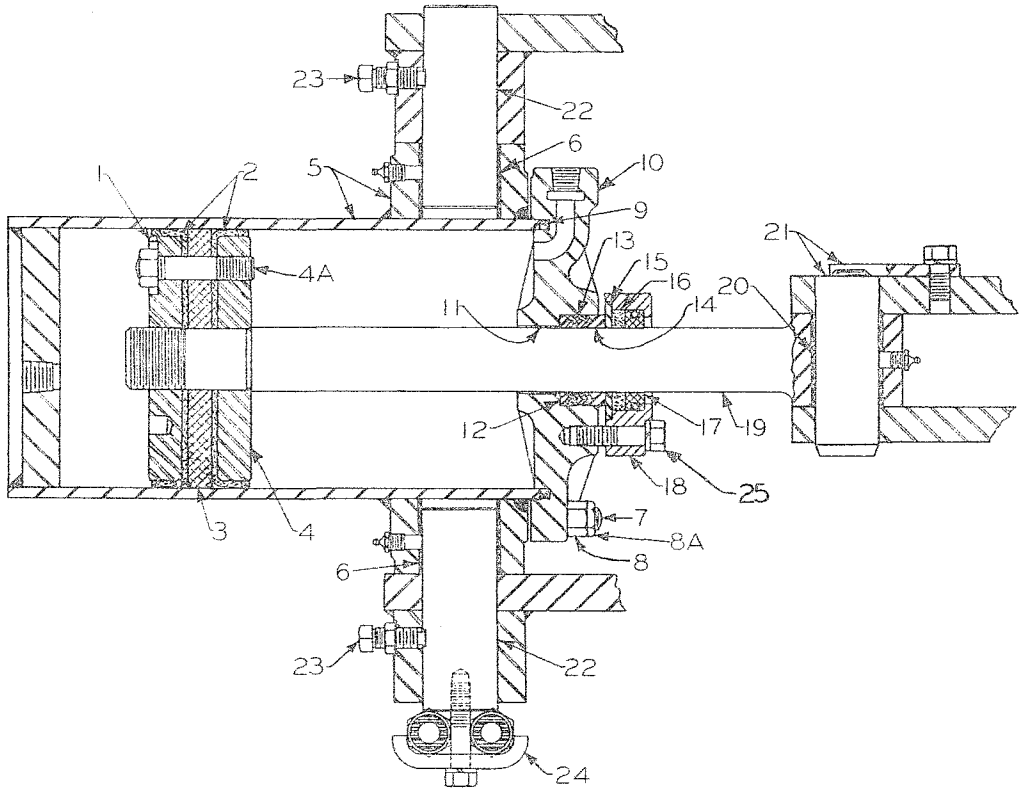


Figure 139. High Lift Ram

143. *HIGH LIFT RAM.*
(See Fig. 139)

To remove the complete ram group, lower the moldboard to the ground and disconnect the two hydraulic hoses.

Remove pin (21). Then remove the two set screws (23) in order to remove the two shafts (22).

To dismantle and expose the ram cups (2) proceed as shown in paragraph 141, (3) to (8) inclusive.

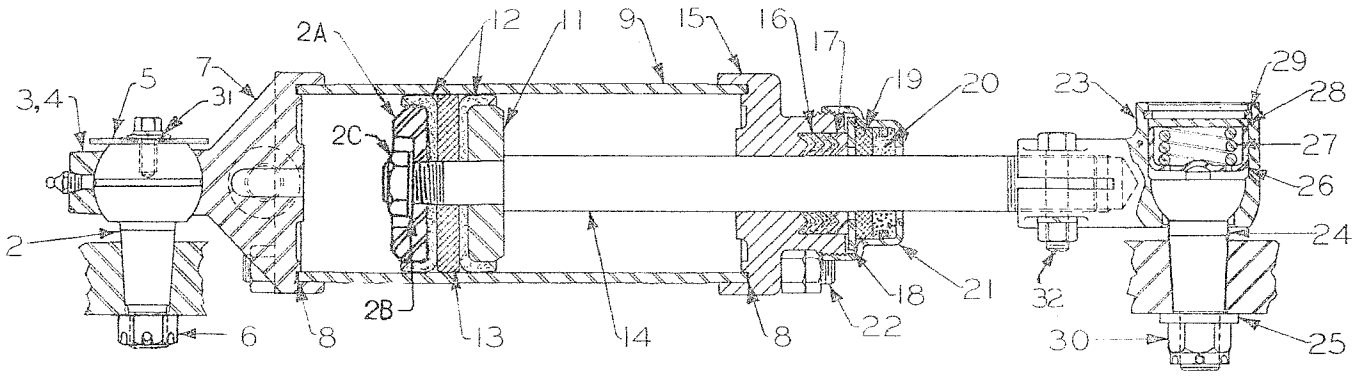


Figure 140. Front Steer Ram

144. *FRONT STEER RAM.*
(See Fig. 140)

Remove cap (4), also disconnect the two hydraulic hoses. Remove nut (30) and drive ball stud (24) upward to remove the complete ram.

To dismantle and expose the ram cups (12) proceed as shown in paragraph 141, (3) to (8) inclusive.

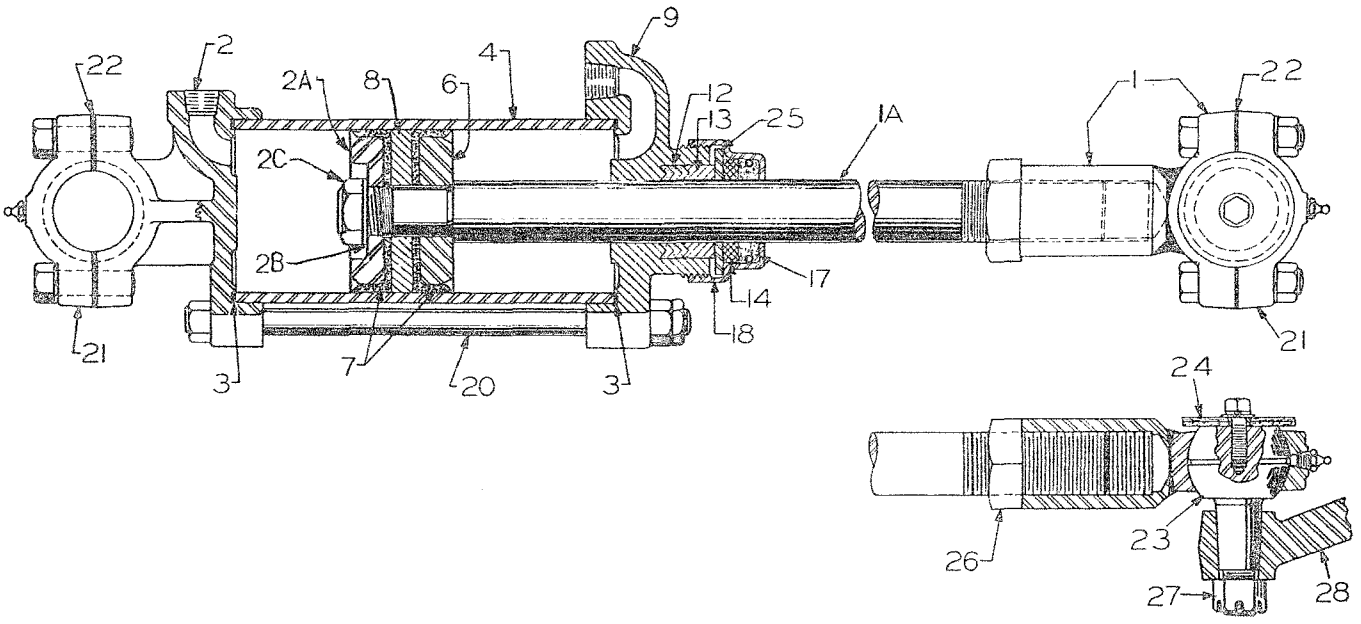


Figure 141. Rear Steer Ram

145. *REAR STEER RAM.*
(See Fig. 141)

To remove the complete ram, remove the two caps (21) and disconnect the two hydraulic hoses.

To dismantle and expose the ram cups (7) proceed as shown in paragraph 141, (3) to (8) inclusive.

When assembling the cups, drive against the spreader (5) in order to seat the cups (7).

Always install new gaskets (3).

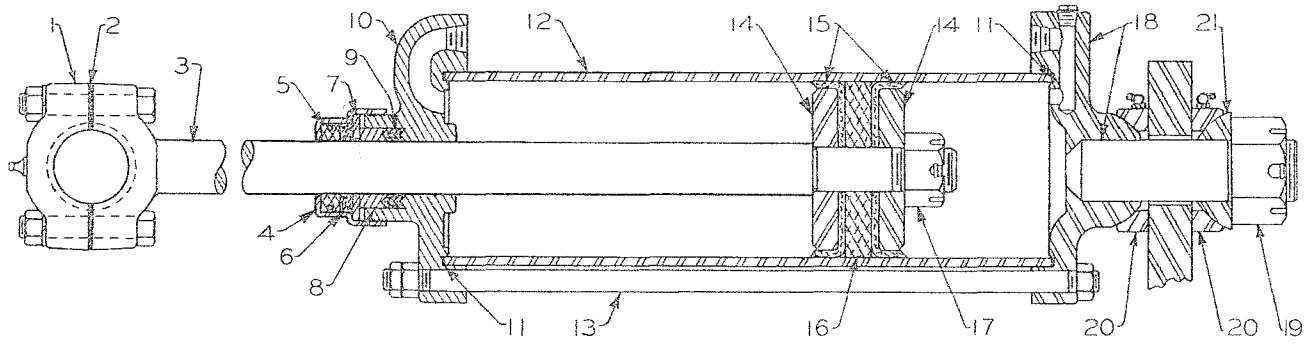


Figure 142. Scarifier Ram
(Also used with Bulldozer and front Snow Plows)

146. *SCARIFIER RAM.*
(See Fig. 142)

To remove the complete ram, lower the scarifier to the ground. Remove nut (19), also cap (1) and two hydraulic hoses.

To dismantle and expose the ram cups (15) proceed as shown in paragraph 141, (3) to (8) inclusive.

147. *CIRCLE AND DRAW BAR.*
(See Fig. 143)

a. General.

The strong all welded circle (2) supports the moldboard and tilting arrangement, (19) to (22) inclusive, and hydraulically operated side shift cylinder (D).

When blade is out of the ground, the combined circle and moldboard may be revolved 360° without discomfort to the operator. Without leaving his seat, the operator may side shift (either right or left) the full stroke of the ram, while the blade is in the ground and while the grader is moving.

The hydraulic "finger controls" at the operator's station, when manipulated, control the flow of oil. The operator controls the amount of oil flow; namely, from the smallest perceptable amount, to full flow of eight gallons of oil per minute.

Do not lubricate the top side of the circle. The circle should be rotated at least half way every day, in order that high pressure grease may be evenly spread by hand, over the inside bore and the bottom flange of the circle.

b. Draw Bar.

The strong all welded draw bar (3) has a ball and socket pulling arrangement (4) at the forward end.

Wear adjusting shims are provided, and after many years of hard, trouble-free service, the original clearance at the ball sockets may be reestablished.

Four adjusting screws (23) are provided for horizontal wear take-up. Shims may be removed to compensate for vertical wear.

c. Tilting Links.

To change the leaning position of the moldboard, proceed as follows:

(1) Start engine and place moldboard bit straight across and on the ground.

(2) Loosen the two nuts (21) (one on each side).

(3) Loosen the two vertical bolts which pass thru the slots of link (20) (two on each side).

(4) Move hydraulic blade lift control levers at operator's station in direction required, then retighten all bolts referred to above.

d. Moldboard.

The hydraulic controls at the operator's station should always be used when reversing the moldboard. The moldboard should be raised out of the ground when this operation is performed.

Both moldboard ends are forged with an offset which strengthens it and which makes it possible to bolt in renewable flush type end boots.

A good operator uses caution when operating the grader. He does not abuse it. He stops the grader and backs away from objects that should first be removed (dynamited), such as stumps and rocks. Be careful when operating the grader around street manholes or bridge abutments.

When the machine is being operated under muddy conditions during freezing weather, always apply a coating of anti-rust or water resistant grease to upper shaft (25) and lower shaft (26) for easy side shifting of blade.

The moldboard should be side shifted full stroke to the right and left sides, at termination of each days work. This is necessary in order to clean off the debris from both upper and lower shafts (25) and (26). Water resistant grease should then be applied by hand over the entire exposed length of both shafts.

When the machine is not being used, coat the shafts and moldboard with anti-rust or water resistant grease to keep them from rusting.

When operating under dry or dusty conditions, dc not grease upper and lower side shift shafts.

e. Blade Extensions.

Blade extensions are provided to enlarge the usefulness of your machine for light work only.

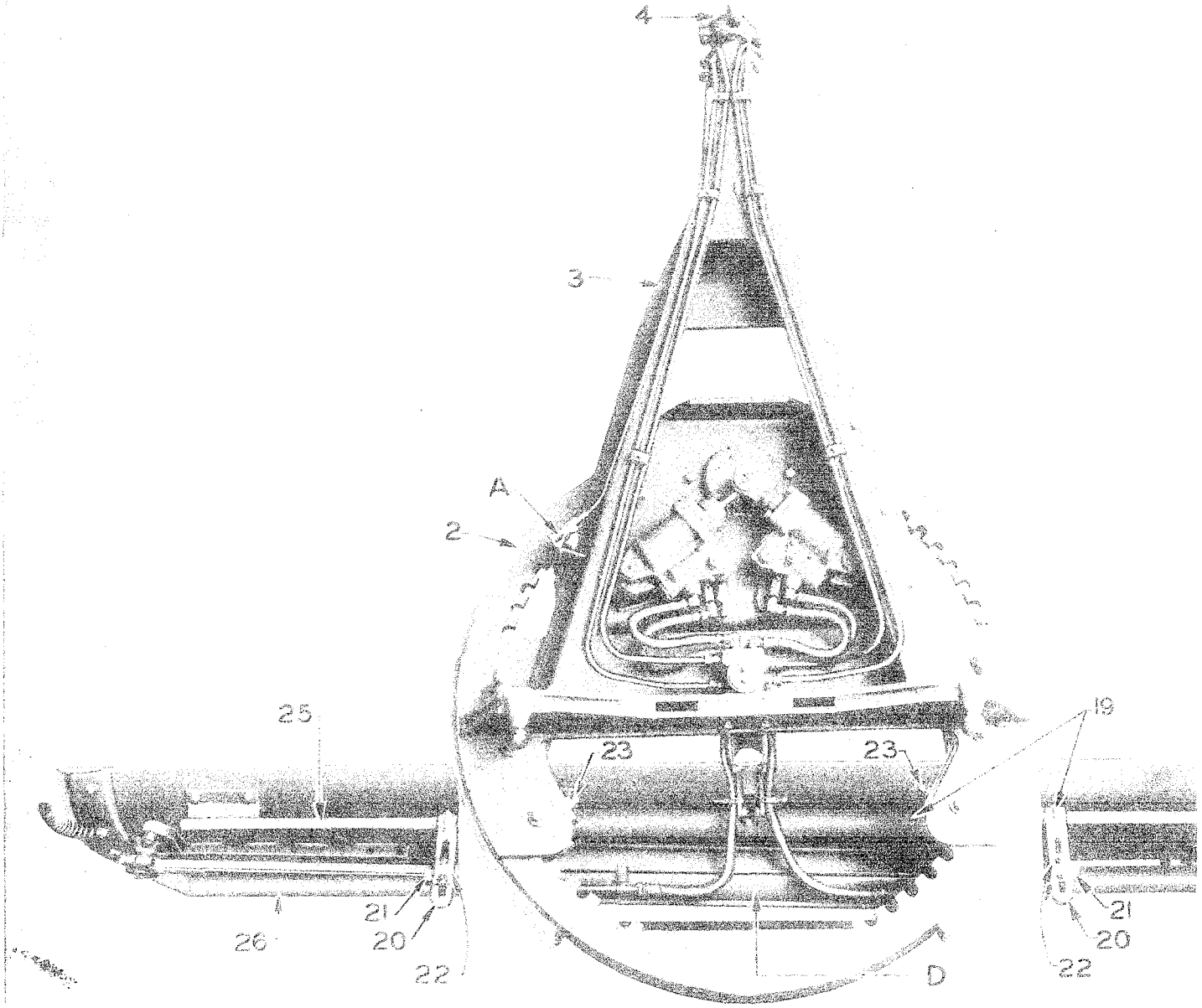


Figure 143. Circle and Draw Bar

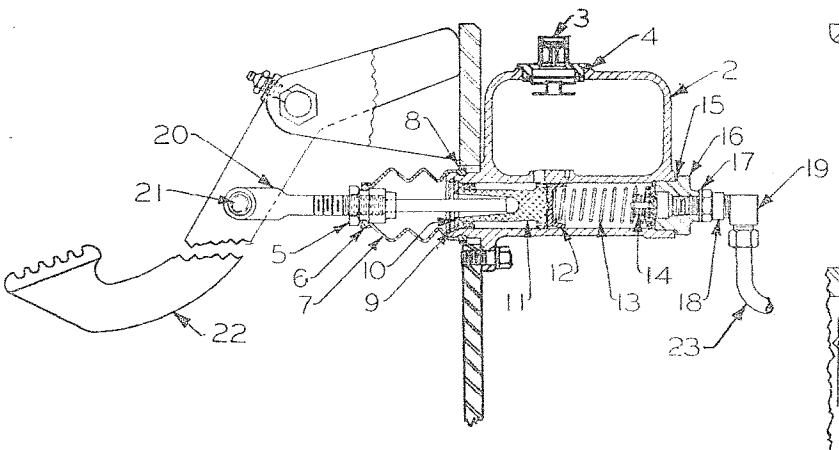


Figure 144. Circle Latch Master Cylinder

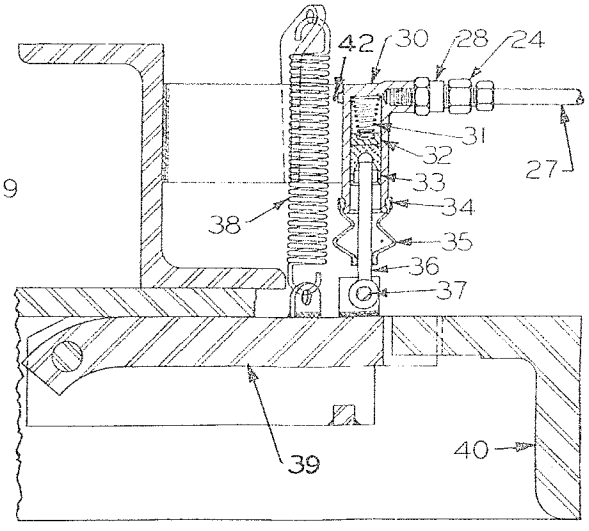


Figure 145. Circle Latch and Cylinder

f. Blade Circle Latch.
(See Figs. 144 and 145)

The moldboard with circle is securely locked to the circle draw bar at all times when the latch (39) is in raised position.

To unlock the circle it is necessary to stop the grader, then depress the foot pedal (22) which is conveniently located at the operator's station. The hydraulic piston (11) is thereby moved inward, forcing oil thru lines to the cylinder (30). The piston (33) being interconnected with the latch (39), forces the latch downward, thus unlocking it. The latch cannot be unlocked and the circle rotated while the moldboard is moving material. The circle reverse control lever at the operator's station may be manipulated slightly in order to free the latch for effortless disengagement.

No periodic mechanical adjustments are required to this simple mechanism.

To bleed the interconnecting lines of air, loosen screw (42) located at side of cylinder (30) and depress lever (22) several times. Then hold it downward and relock screw (42).

Keep filler cap (3) clean on master cylinder to prevent air vent from being plugged with dirt.

Use only genuine "Lockheed" or "Delco" brake fluids. Substitutes may do considerable damage to the hydraulic system.

Be sure to keep the reservoir half full of fluid when bleeding the system of air. Should the reservoir be drained during the bleeding operation, air will again enter the system, and rebleeding will be necessary.

When cleaning cylinder parts such as (2), (11), (33) and others, use alcohol.

NOTE: When reversing the circle proceed as follows:

(1) Use the hydraulic controls, levers (3) and (8), page 13, and lift the moldboard and bit out of the ground.

(2) Release the blade circle latch (Use foot pedal (11), page 13.)

(3) Always rotate the circle as required by using hydraulic power; lever (2), page 13. Never reverse the circle by placing one end of the moldboard in the ground and moving the grader either forward or backward.

148. CIRCLE REVERSE HYDRAULIC MOTOR.
(See Fig. 146)

The hydraulic oil motor has been adjusted and timed properly at the factory and should not be tampered with unless it becomes necessary to disassemble for the purpose of making repairs or replacements. To time valves properly, proceed as follows:

(1) Rotate circle with power (as slowly as possible) to centering pin hole which has been provided on outer rim of crank pin flange located at (X). A 3/8 diameter cold rolled pin should be used. Final centering of pin hole must be done by manual movement of circle to avoid shearing of pin.

(2) Disconnect the two hydraulic hoses at (A) and (B) from the cylinder and valve body which is to be timed.

(3) Remove one pipe plug (C) located on top of the body and nearest to openings (A) and (B).

(4) Attach air hose to unplugged pipe plug hole (C).

(5) Remove valve end hex plug (D) at cam lever end.

(6) Loosen jam nut (E) on cam adjusting screw (EE).

(7) Adjust air pressure as low as possible.

(8) Proceed to adjust slotted screw (EE) in the end of the cam lever until the amount of air blown out of two open ports (A) and (B) is equal. This means that the piston valve (F) is in neutral position, while the main 4" cylinder piston (G) is on dead center.

(9) Tighten lock nut (E) and cam adjusting screw, making sure that position of screw (EE) does not change when tightening lock nut.

(10) Recheck air test after locking.

(11) Remove centering pin at (X). Screw in valve end hex plug (D) and air timing pipe plug (C). Connect hoses.

(12) Rotate circle to opposite dead center hole location at (XX).

(13) Proceed to time other valve after removing the two hoses at (AA) and (BB), and the one pipe plug (CC) located under the body.

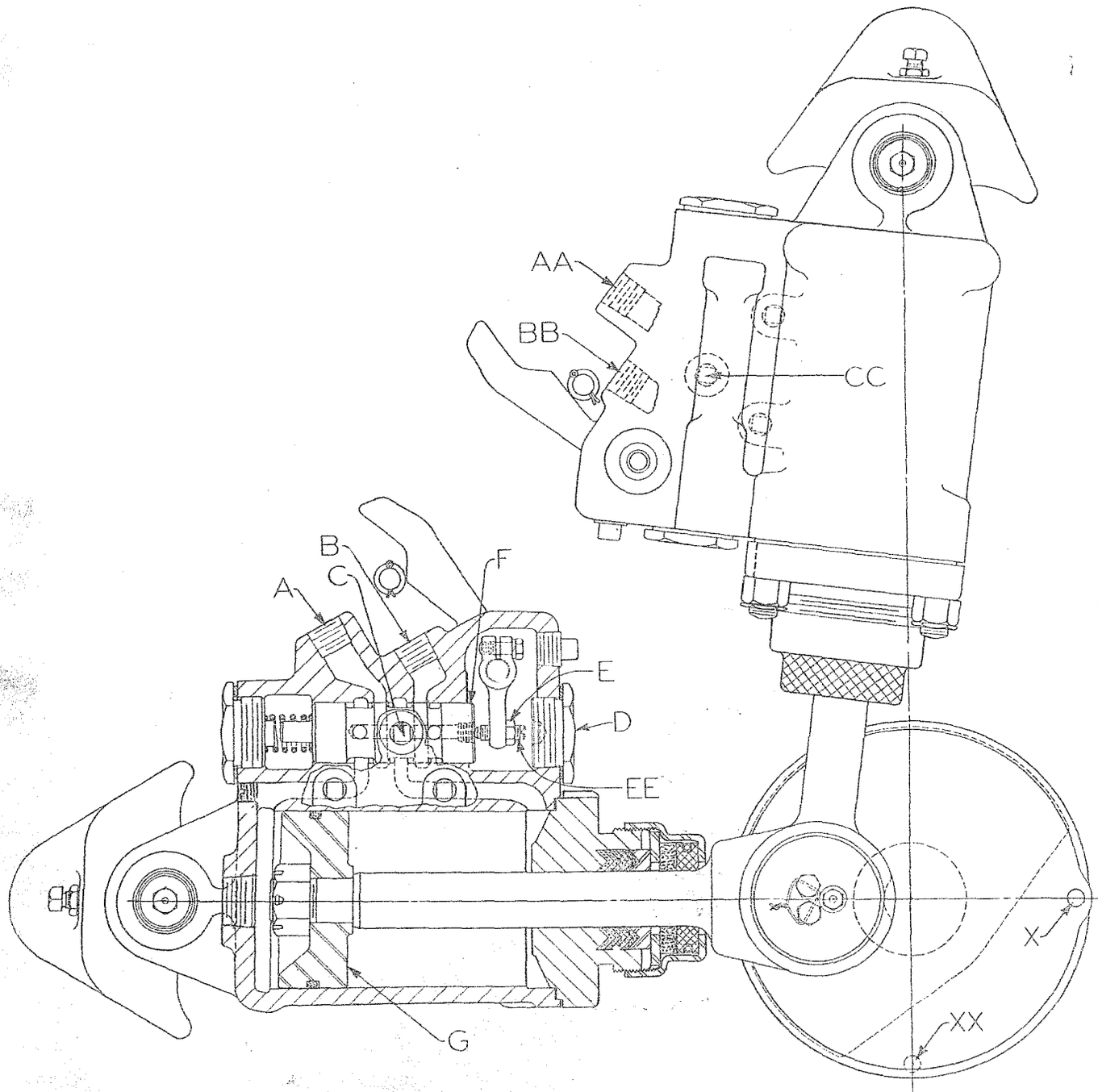


Figure 146. Timing Hydraulic Oil Motor