NOTICE
THIS BOOK SHOULD BE
KEPT WITH MACHINE

OPERATING AND SERVICE INSTRUCTIONS

No. 485

SUPER-300

SUPER 99

POWER GRADER
(With Attachments)

THIS OPERATOR'S MANUAL APPLIES
TO MACHINES NUMBERED SERIALLY
FROM No. 99SW-104 AND UP

PRICE $3.00 PER COPY

CONTACT YOUR NEAREST AUSTIN-WESTERN DISTRIBUTOR
THERE IS ONE NEAR BY

10-30-56

Printed in U.S.A.

- TO THE OPERATOR -

Your Super 99 Grader is the result of a combination of advanced engineering and research, skilled manufacturing, and the latest developments in metallurgical science. The entire design and construction is such that it can withstand usage with a minimum of maintenance, and will operate smoothly and easily with maximum safety to the operator.

A fine mechanism such as this grader will always respond best to considerate treatment and care. Therefore, before operating it, we suggest that even the experienced operator review the entire contents of this booklet. While the material in this booklet has been prepared in sufficient detail to be of maximum assistance to inexperienced operators, the "Old Timers" will find much information and many of the illustrations of considerable help.

If you should need information not given in this booklet, or require the services of a trained mechanic, we urge you to use the extensive facilities offered by the Austin-Western Distributor in your locality. Distributors are kept informed on the best methods of servicing and are equipped to provide prompt, high class service in the field, or in an up-to-date service station.

When in need of parts always give the Austin-Western Distributor your grader and engine serial numbers. We suggest that you write these serial numbers in the spaces provided below for ready reference when parts are required.

Grader Serial No. 99SW - _____

(STAMPED ON NAME PLATE, ALSO ON FRAME, ON LEFT HAND SIDE OF GRADER ABOVE FRONT AXLE)

Engine Serial No. _____

(GM ENGINES - STAMPED ON ENGINE BLOCK, BLOWER SIDE; ALSO ON ACCESSORY PLATE.

IHC ENGINE - STAMPED ON ENGINE BLOCK ABOVE LUBE OIL FILTERS)

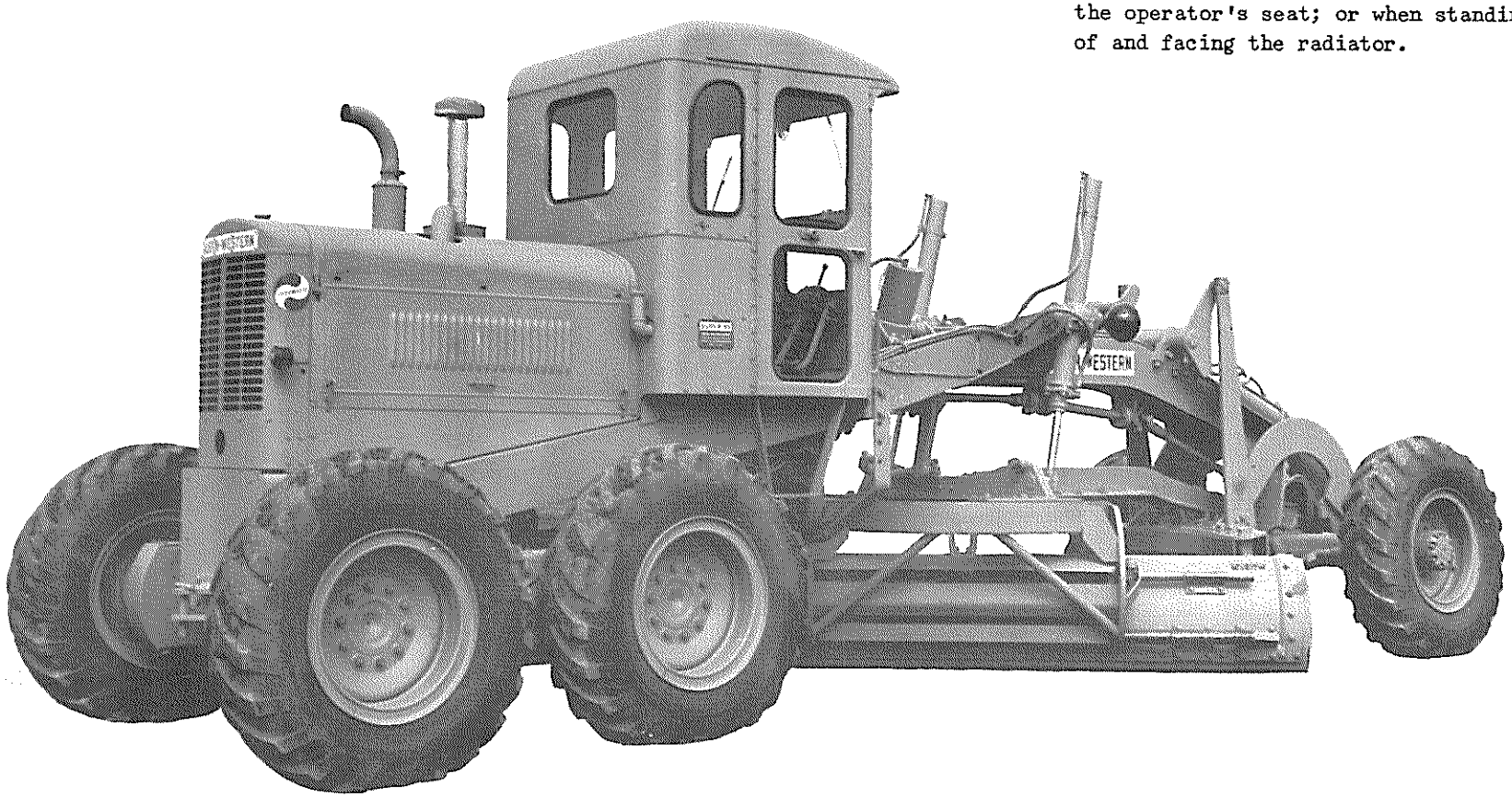
- WARRANTY -

Company warrants all Austin-Western products sold to Distributor for six (6) months after date of shipment, this warranty being limited to the replacement at the factory of such parts as it appears to Company upon inspection by Company to have been defective in material or workmanship. Company makes no warranty in respect to engines, tires, rims, electrical apparatus, or any other trade accessory not manufactured by Company, such being subject to the warranty of their respective manufacturers. No warranty is made or authorized to be made by Company other than herein set forth. Distributor agrees not to alter any products purchased hereunder nor to do anything that will in any way infringe, impeach or lessen the validity of the patents or trade-marks under which Company's products are made or sold.

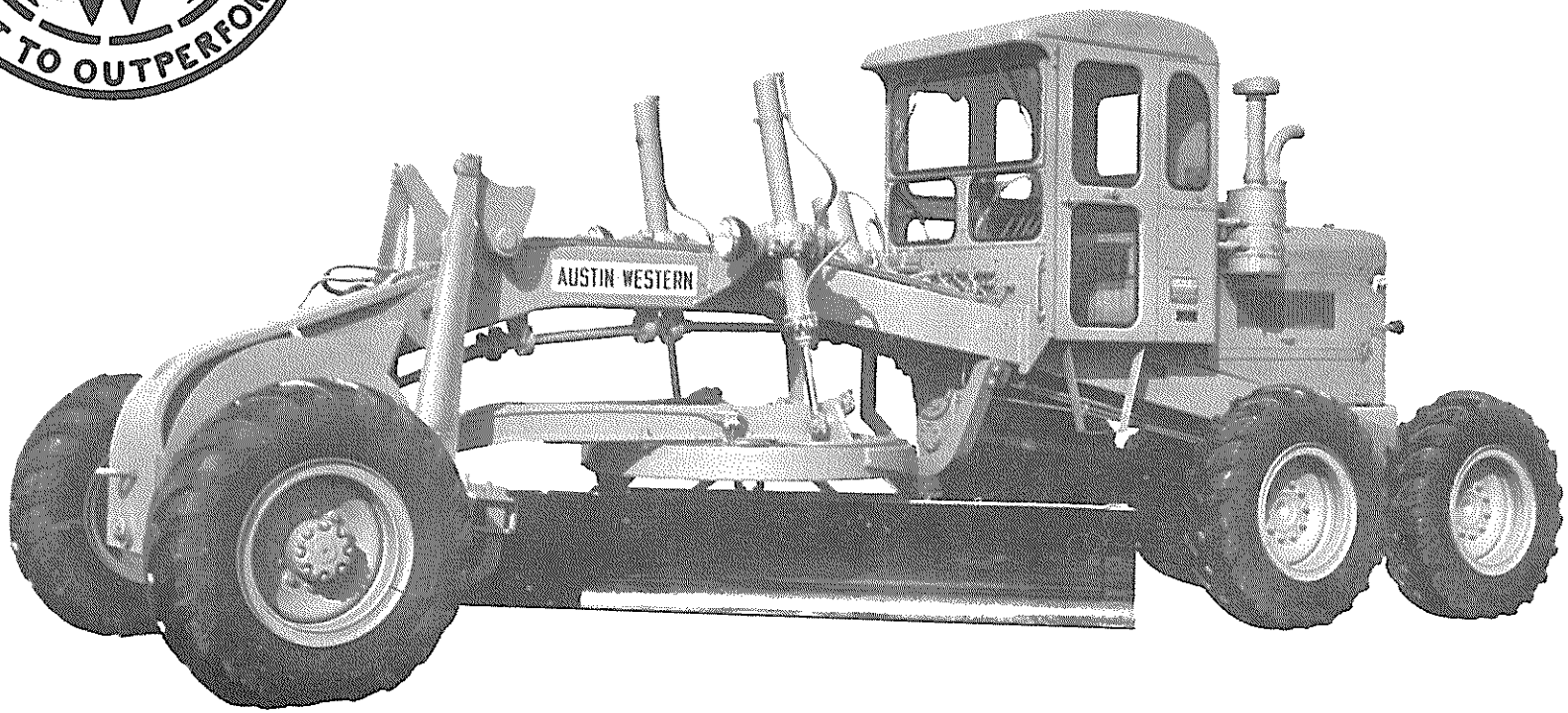
We reserve the right to make changes or add improvements at any time without incurring any obligation to make such changes on machines sold previously.

NOTE: Throughout this manual the use of the terms "LEFT" and "RIGHT" must be understood to avoid confusion when following instructions.

"LEFT" and "RIGHT" indicates left and right sides of the grader as viewed from the operator's seat; or when standing back of and facing the radiator.



Right Side View



Left Side View

NOTE: HOW TO USE THIS INSTRUCTION MANUAL
(All information in this manual is subject to change without notice)

This manual, No. 485, is composed of five sections as follows:

SECTION 1

GENERAL INSTRUCTIONS TO OPERATOR (pages 3 to 11 inclusive). (Pages 6, 7, and 8 include lubrication of basic grader only.) (See page 67 for IHC diesel engine lubrication specifications, and page 74 for the correct diesel fuel. See page 40 for GM diesel engine lubrication specifications, and page 41 for the correct diesel fuel.)

SECTION 2

EARTH ROAD CONSTRUCTION (pages 12 to 38 inclusive).
NOTE: Power Grader Attachments. (See pages 31 to 38 inclusive for lubrication, use, and maintenance of all attachments.)

SECTION 3

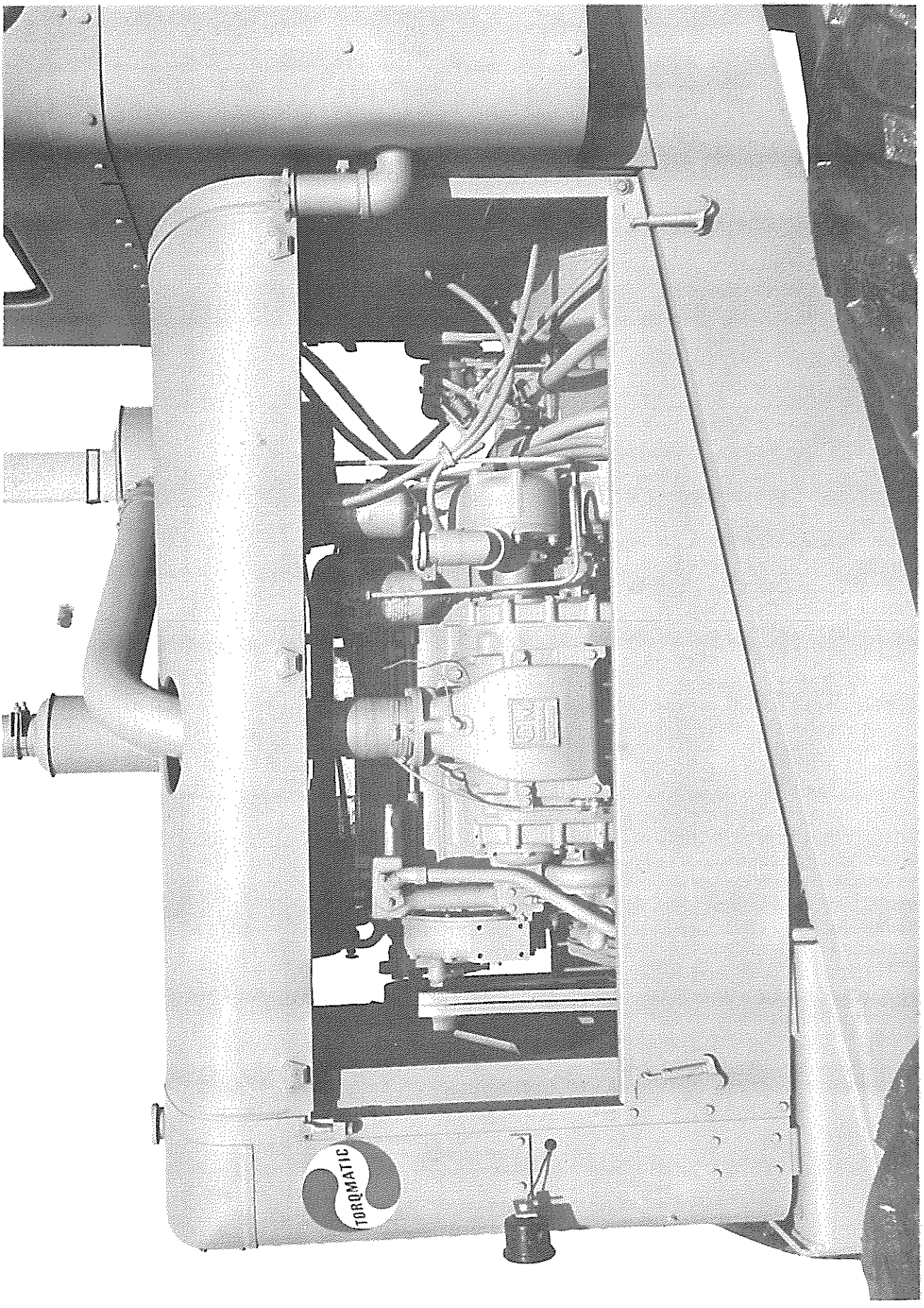
GM4-71 DIESEL ENGINE and CONVERTER OPERATION (pages 39 to 62 inclusive).

SECTION 4

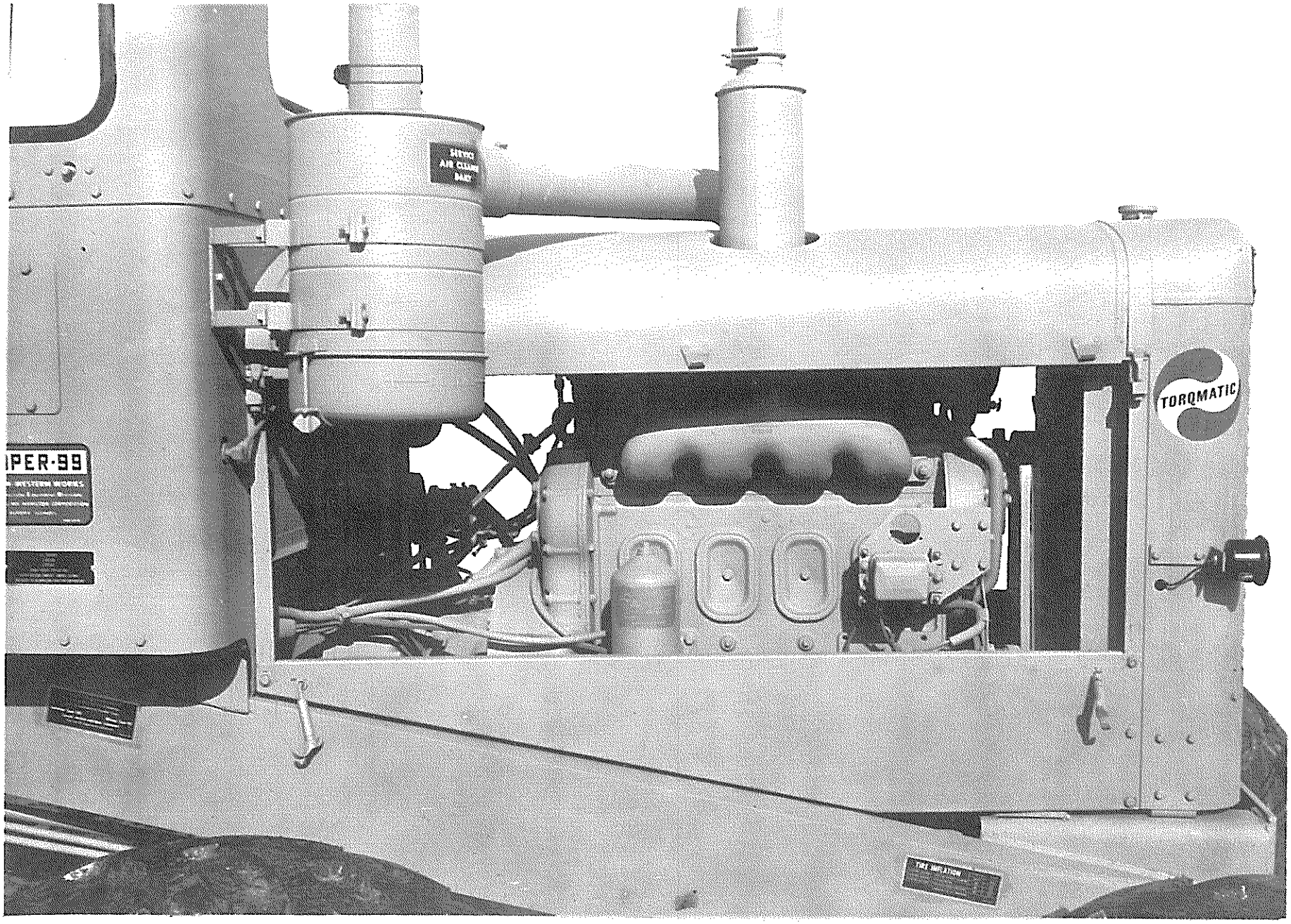
IHC UD-14A DIESEL ENGINE OPERATION (pages 63 to 101 inclusive).

SECTION 5

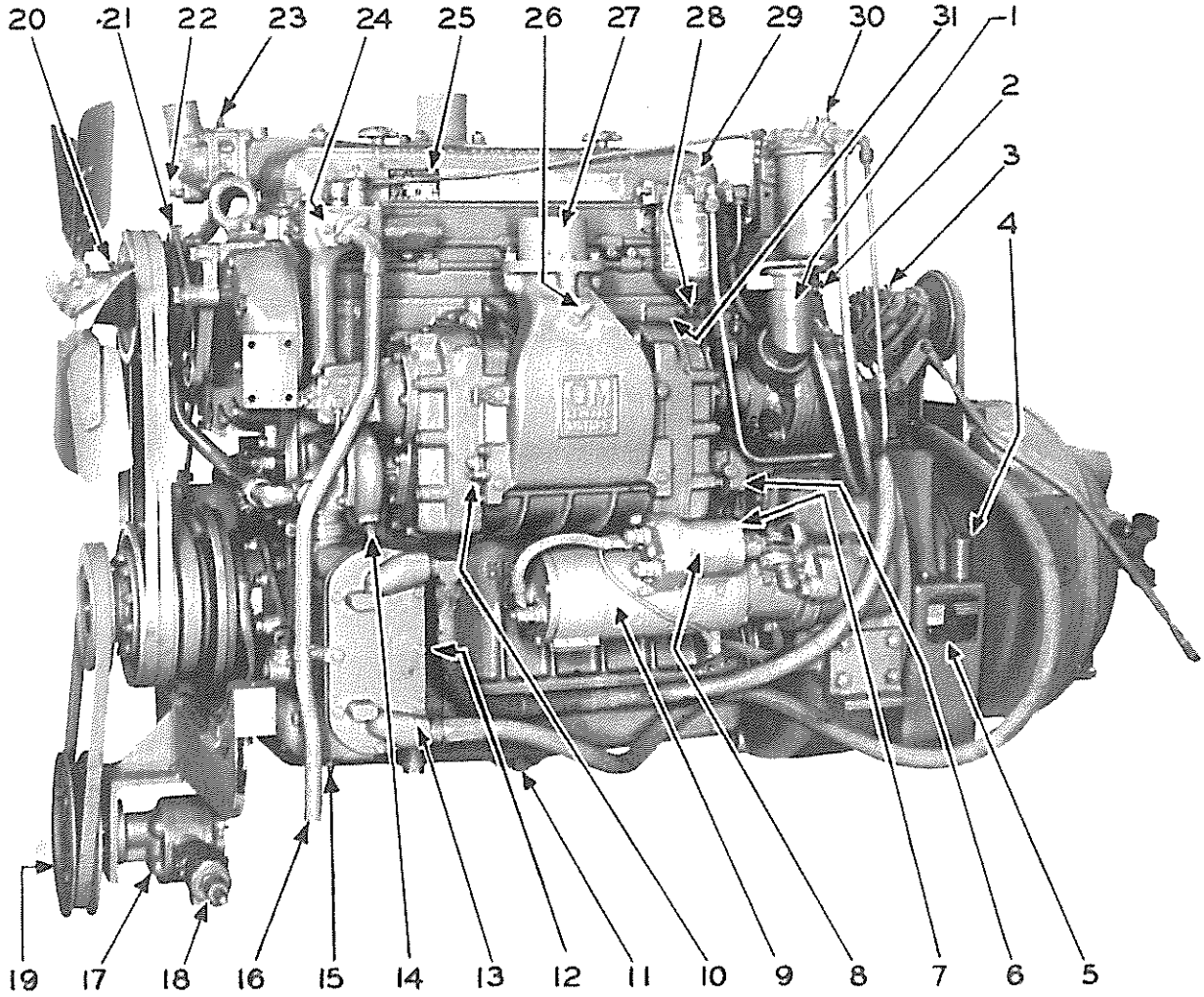
POWER GRADER OVERHAULING (pages 105 to 157 inclusive). (Includes maintenance, dismantling, and assembly of all basic grader parts.)



Right Side View of GM4-71 Engine with Torque Converter

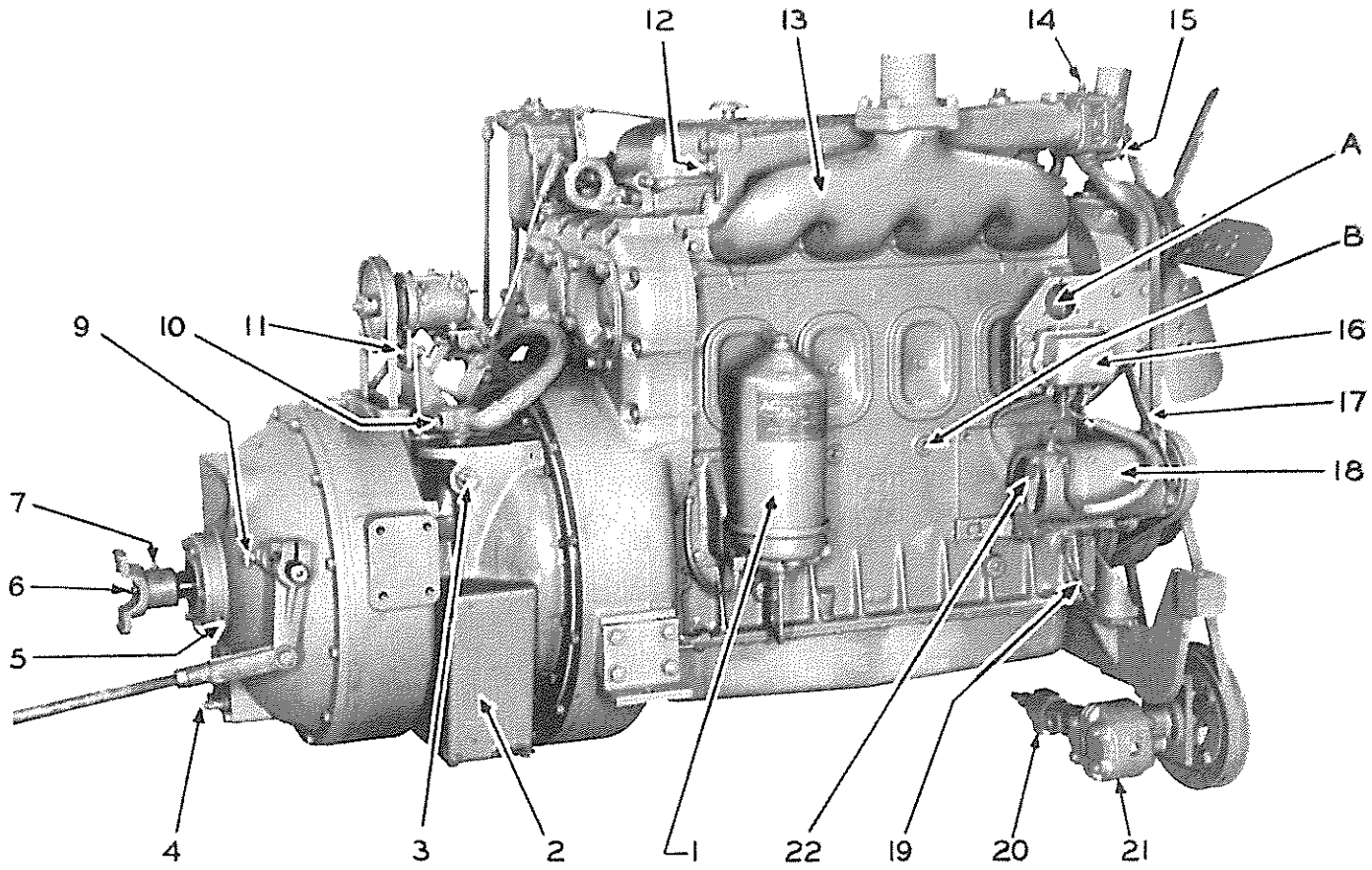


Left Side View of GM4-71 Engine with Torque Converter
(Read Instructions on Pages 3, 4 and 4A Before Starting Grader)



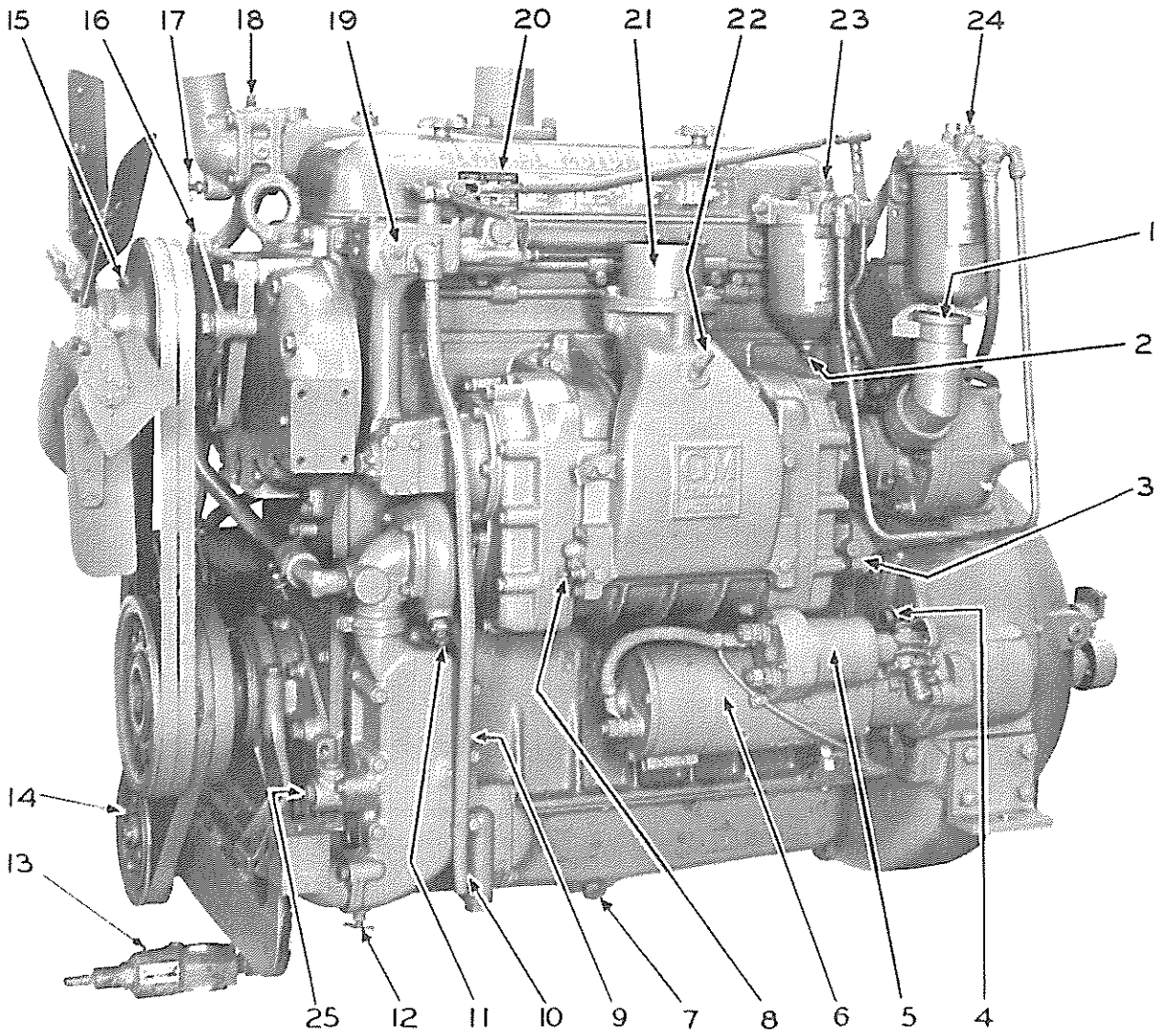
GM-4080 ENGINE (BLOWER SIDE)

REF.	DESCRIPTION
1.	Engine oil filler neck
2.	Fuel strainer drain cock
3.	Tail-shaft governor oil cup
4.	Torque converter filler hole and oil level dip stick
5.	Torque converter name and serial number plate
6.	Fuel pump
7.	Engine oil level dip stick (behind starter)
8.	Starter solenoid switch
9.	Starter
10.	Emergency shut-off lever
11.	Engine oil drain plug
12.	Engine oil cooler by-pass valve (on side of oil cooler body)
13.	Torque converter oil cooler
14.	Water pump drain plug
15.	Oil cooler water drain cock
16.	Crankcase breather tube
17.	Hydraulic pump
18.	Hydraulic relief valve
19.	Hydraulic pump drive split pulley adjustment screws
20.	Fan shaft lubrication plug
21.	Fan belt adjustment bracket
22.	Thermostat elbow drain cock
23.	Air vent plug (Ref. 22 and 23 must be opened when refilling drained engine)
24.	Engine governor
25.	Option and accessory plate
26.	Ether starting fluid nozzle
27.	Engine air intake pipe
28.	Fuel filter drain cock
29.	Fuel filter vent plug
30.	Fuel strainer vent plug
31.	Engine serial number



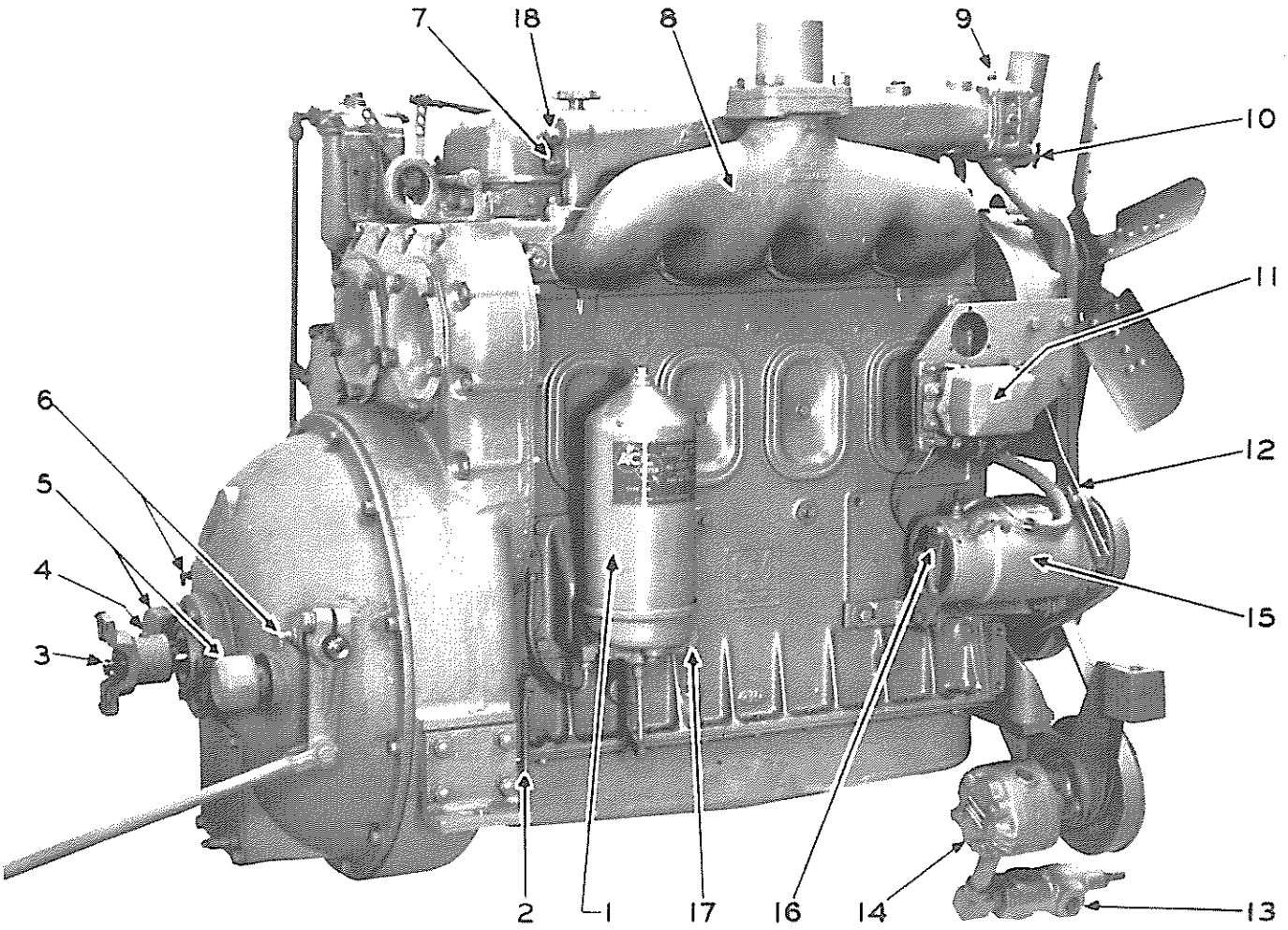
GM-4080 ENGINE (GENERATOR SIDE)

REF.	DESCRIPTION
1.	Engine oil filter
2.	Torque converter
3.	Torque converter oil pressure sender
4.	Clutch throwout bearing lubrication fitting
5.	Clutch shaft bearing lubrication fitting
6.	Clutch pilot bearing lubrication fitting
7.	Slip yoke lubrication fitting
9.	Clutch throwout cross shaft lubrication fitting (one each side)
10.	Torque converter temperature sender
11.	Tail-shaft governor adjustment bracket
12.	Water temperature sender
13.	Exhaust manifold
14.	Air vent plug (Ref. 14 and 15 must be opened when refilling drained engine)
15.	Thermostat elbow drain cock
16.	Voltage regulator
17.	Generator adjustment bracket
18.	Generator
19.	Air box drain tube
20.	Hydraulic relief valve
21.	Hydraulic pump
22.	Generator oil cup



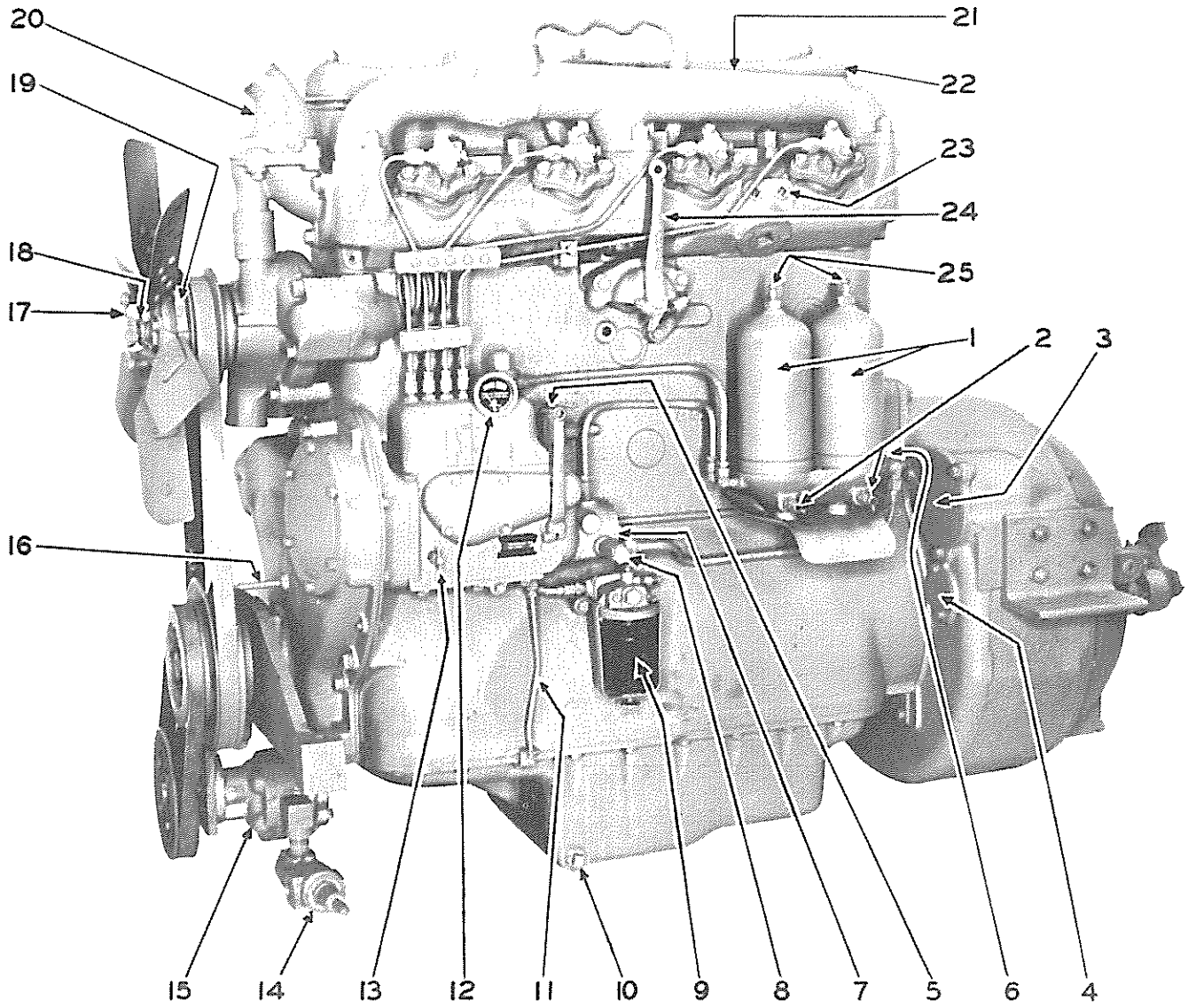
GM-4055C ENGINE (BLOWER SIDE)

REF.	DESCRIPTION
1.	Engine oil filler neck
2.	Fuel filter drain cock
3.	Fuel pump
4.	Engine oil level dip stick
5.	Starter solenoid
6.	Starter
7.	Engine oil drain plug
8.	Emergency shut-off lever
9.	Engine oil cooler by-pass valve (on side of oil cooler body)
10.	Engine breather tube
11.	Water pump drain cock
12.	Oil cooler water drain cock
13.	Hydraulic relief valve
14.	Hydraulic pump drive split pulley adjustment screws
15.	Fan shaft lubrication plug
16.	Fan belt adjustment bracket
17.	Thermostat elbow drain cock
18.	Air vent plug (Ref. 17 and 18 must be opened when refilling drained engine)
19.	Engine governor
20.	Options and accessory plate
21.	Engine air intake pipe
22.	Ether starting fluid nozzle
23.	Fuel filter vent plug
24.	Fuel strainer vent plug
25.	Cab heater hose inlet



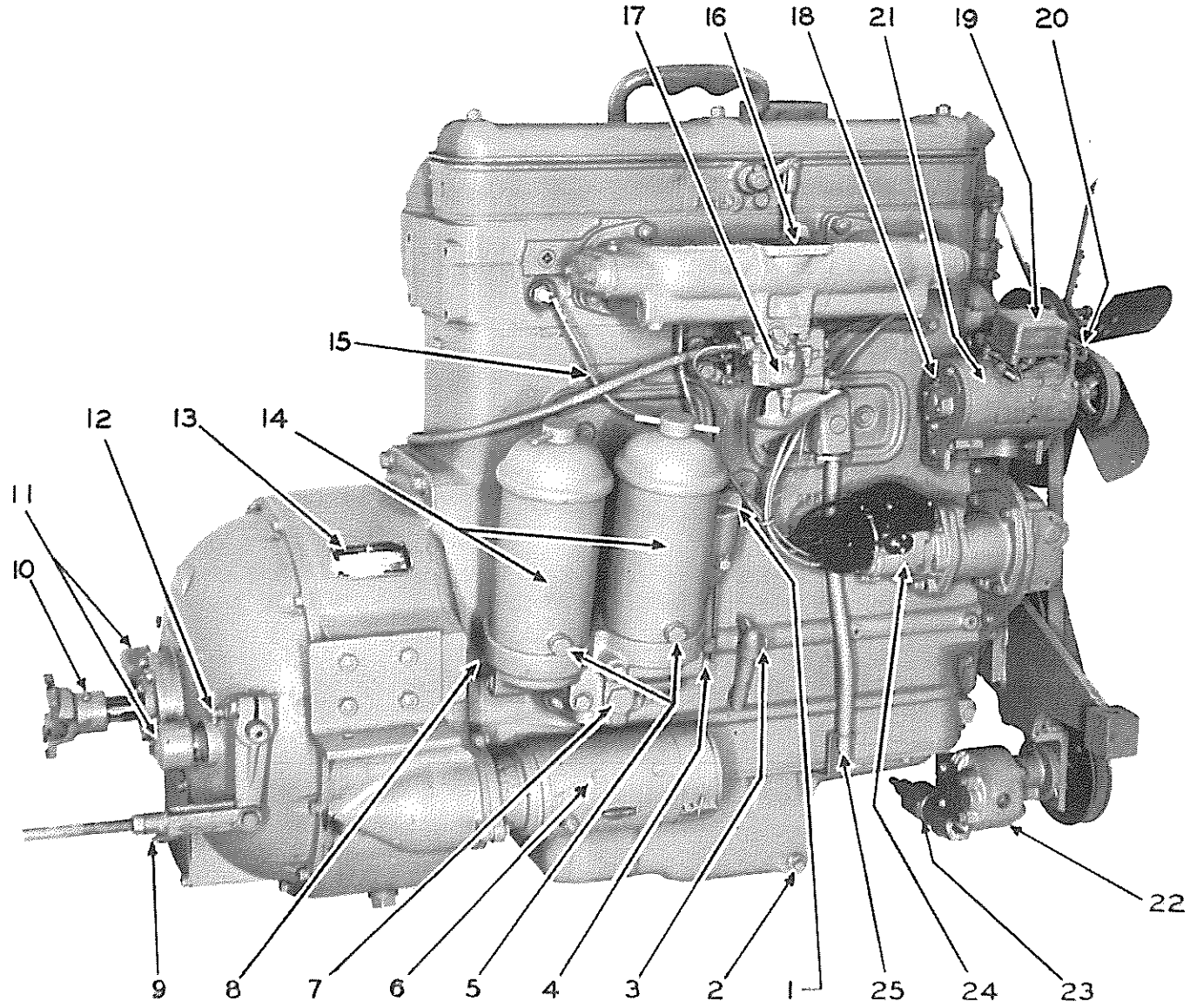
GM-4055C ENGINE (GENERATOR SIDE)

REF.	DESCRIPTION
1.	Engine oil filter
2.	Air box drain tube
3.	Clutch pilot bearing lubrication fitting
4.	Slip yoke spline lubrication fitting
5.	Bell housing breather caps
6.	Clutch throwout cross shaft lubrication fitting
7.	Water temperature sender
8.	Exhaust manifold
9.	Air vent plug (Ref. 9 and 10 must be opened when refilling drained engine)
10.	Thermostat elbow drain cock
11.	Voltage regulator
12.	Generator adjustment bracket
13.	Hydraulic relief valve
14.	Hydraulic pump
15.	Generator
16.	Generator lubrication fitting
17.	Engine oil pressure sender
18.	Cab heater hose outlet



IHC UD-14A ENGINE (INJECTOR SIDE)

REF.	DESCRIPTION
1.	Fuel oil filters
2.	Fuel oil filter drain cocks
3.	Ring gear inspection cover
4.	Clutch pilot bearing lubrication (Remove cover. Fitting in fly-wheel)
5.	Injection pump oil filler
6.	Engine block water drain cock
7.	Primary fuel oil pump
8.	Primary fuel oil pump filter screen
9.	Fuel oil sediment bowl
10.	Engine oil drain plug
11.	Injector pump overflow pipe
12.	Fuel oil pressure gauge
13.	Fuel oil injector pump oil level cock
14.	Hydraulic relief valve
15.	Hydraulic pump
16.	Engine timing pointer
17.	Water pump driver
18.	Water pump packing flange
19.	Fan belt adjustment flange
20.	Water thermostat elbow
21.	Engine crankcase breather tube (in back of manifold)
22.	Valve cover
23.	Water temperature sending unit
24.	Compression release lever
25.	Fuel oil filter air vent cocks



IHC UD-14A ENGINE (GENERATOR SIDE)

REF.	DESCRIPTION
1.	Engine crankcase oil filler pipe
2.	Crankcase oil drain plug
3.	Crankcase oil level dip stick
4.	Engine oil filter base drain plug
5.	Engine oil filter case drain plug
6.	Starter
7.	Filter by-pass valve
8.	Engine oil pressure sending unit
9.	Clutch throwout bearing lubrication fitting
10.	Slip yoke spline lubrication fitting
11.	Clutch bell housing breather caps
12.	Clutch throwout cross shaft bearing lubrication fittings
13.	Power unit serial number plate
14.	Engine oil filters
15.	Engine serial number
16.	Engine air intake
17.	Carburetor
18.	Generator lubrication cup
19.	Voltage regulator
20.	Generator belt adjustment bracket
21.	Generator
22.	Hydraulic pump
23.	Hydraulic relief valve
24.	Magneto
25.	Crankcase breather tube

SECTION 1

GENERAL INSTRUCTIONS TO OPERATOR

1. INSPECTION BEFORE UNLOADING GRADER.

a. General.

Before unloading the grader check it thoroughly 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.

b. Before Starting Diesel Engine.

Check oil level in the crankcase. (For IHC diesel see page 66. For GM diesel see pages 39 and 59.) Add lubricants as required. (See page 67 for IHC oil specifications; see page 40 for GM oil specifications; see page 4A for capacities of water and lubricants.)

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). (For IHC see pages 71 and 88. For GM see pages 39, 53 and 55.)

Open fuel valve under diesel fuel tank. (See Ref. 13, page 44.)

c. Hydraulic System.

Consult hydraulic section on page 142, paragraph b., for oil specifications.

Check oil level in oil reservoir. Fill to oil level shown on page 142, paragraph c.

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 IHC engine starting instructions, pages 63 and 64. See GM starting instructions, pages 39, 43, 45, 59 and 61.)

Test brakes before moving off car. Move grader slowly off rail car or trailer 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 pages 6, 7 and 8 for points to be lubricated and lubricant specifications.)

Fill brake master cylinder with fluid and retest brakes. (See page 121.)

Check tire pressures. Do not over or under inflate tires. (See Decalcomania on main frame, also page 141.)

Check clutch pedal clearance. (See pages 129, paragraph b., and 132, paragraph b., for all adjustments, including clutch brake.)

STANDARD EQUIPMENT: All-wheel drive and steer, hydraulic control throughout, including steering; Diesel motor with electric starter, battery and generating unit; upholstered seat; 13-foot moldboard; hydraulic foot-operated service brake, and hand-operated mechanical parking brake on drive shaft. Single 13.00 x 24, 10 ply low pressure tires. No cab or hood sides for engine are included as standard equipment.

OPERATING WEIGHTS (APPROX.) LBS.
(With GM4-71 Dry Clutch)

No Scarifier:
Total weight 22,850
With Scarifier:
Total weight 24,050

DIMENSIONS

Wheel base	19' - 8-1/4"
Over-all length	26' - 3-1/4"
Over-all height, no cab	8' - 8"
Over-all height, with cab	10' - 4"
Over-all width	8' - 0"
Turning radius	34' - 6"

APPROX. SPEEDS IN M.P.H.
(At 1800 RPM; UD-14A Engine)

1st	1.98	6th (Traveling speed)	17.82
2nd	3.21		
3rd	4.69	Low reverse	2.01
4th	6.84	High reverse	6.96
5th	11.10		

BLADE

Length, standard	13' - 0"
Width (vertical height moldboard and bit)	24"
Thickness, moldboard	3/4"
Max. blade reach beyond tire	89-1/2"
High lift (max.)	90°

CIRCLE

Diameter	5' - 2"
Circle center to front axle	8' - 8"

ATTACHMENTS

SCARIFIER (Oval Type)

(Hydraulically Controlled)

Weight (Approx. shipping) lbs.	1300
Number of teeth	11
Spacing, center to center	4-1/2"
Total swath	46"

All teeth are hooked; have removable points; measure 1" x 3" and are made of hardened alloy steel.

SNOW PLOW (Hydraulically Controlled)

Giant "V" Type

Plowing width	9' - 2"
Height	7' - 2"
Over-all width	12' - 7"
Weight (Approx. shipping) lbs.	3200 * / 3500**

SNOW WING (Hydraulically Controlled)

Weight (Approx. shipping) lbs.	3470
Blade length	14' - 0"
Over-all storage width	9' - 6"
Over-all storage height	10' -11"

BULLDOZER (Hydraulically Controlled)

Weight (Approx. shipping) lbs.	1650 * / 1950**
Length	9' - 0"
Height	40"

NOTE: * Weight of attachment with operating parts already mounted on grader.
** Weight of attachment complete, including all necessary operating parts.

ENGINES

	DIESEL	DIESEL	DIESEL
Make	GMC	GMC	IHC
Series	4-71	4-71	---
Model	4080	4055C	UD-14A
Number of cylinders	4	4	4
Bore and stroke	4-1/4x5"	4-1/4x5"	4-3/4x6-1/2"
Governed speed - RPM	2000	1900	1800
Horsepower at governed speed	120	115	100
Cubic inch displacement	283.7"	283.7"	460.7"
Location of engine serial number	On block-upper right hand blower side		On block behind oil filters
Electric starter	Yes	Yes	Yes
Electric system	12V	12V	12V
Ignition	Compression	Compression	Compression
Cooling system with heater	9 gallons	9 gallons	11 gallons
Oil filter capacity	2 quarts	2 quarts	2 quarts each
Air cleaner oil cup	4-1/2 quarts	4-1/2 quarts	2-3/4 quarts
Fuel injection pump	None	None	1/2 pint
Type of lube oil and fuel	See engine sections, pages 40, 41, 65 and 75		
Oil pressure, hot engine, full throttle	40-45 lbs.	40-45 lbs.	40-45 lbs.
Fuel tank capacity	53 gallons	53 gallons	53 gallons
Hydraulic oil capacity (entire system)	24 gallons (no Scarifier) . 25 gallons (with Scarifier)		

TORQUE CONVERTER:

Make	Allison	----	----
Model	370	----	----
Weight	215 pounds	----	----
Oil capacity	11 quarts	----	----

NOTE: All fluid capacities are approximate.

GEAR LUBRICANT CAPACITIES (See Page 5 for Specifications)

Front axle gear carrier	15 quarts
Rear axle gear carrier	12 quarts
Rear axle pivot case (right and left)	6 gallons (each case)
Transfer case and transmission	14 quarts

NOTE: Transmission and transfer case oil compartments interconnected.

Specifications Subject to Change Without Notice

EXTREME PRESSURE LUBRICANTS (APPROVED LIST)

(For Use in Front and Rear Axle Housings, Transfer Case, Transmission, and Rear Axle Pivot Cases)

We recommend that the owner use the lubricant shipped with the machine in the above 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 housings, use a regular flushing oil in preference to kerosene, gasoline, or other thin fuels.

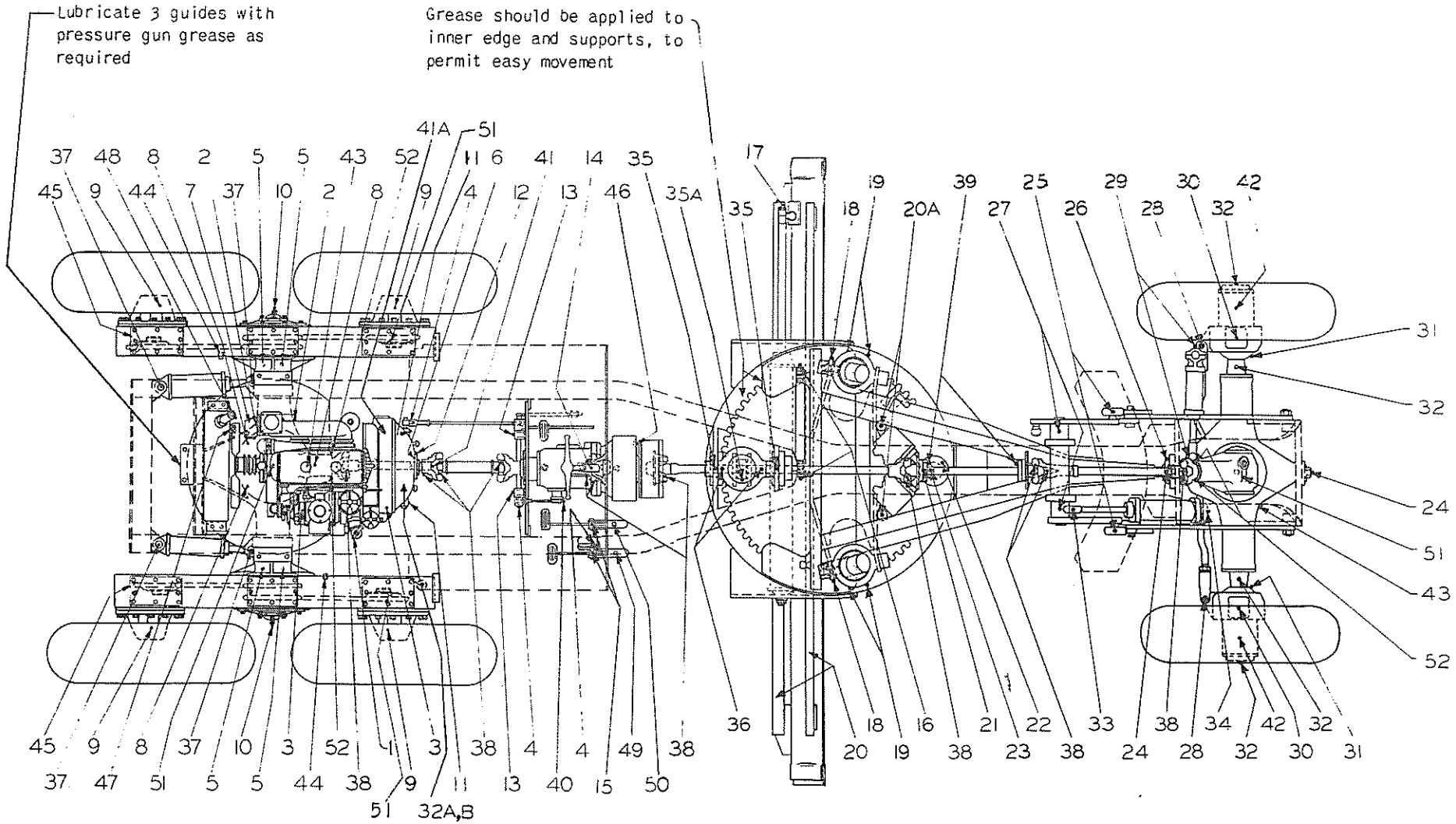
We recommend the following brands of EXTREME PRESSURE LUBRICANTS for summer and winter use in Austin-Western Graders where the LUBRICATION CHART specifies its use.

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 22°F.		Extreme Pressure Summer Lubricants For Temperatures of 22°F. and Above		MANUFACTURER
NAME	NO.	NAME	NO.	
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, 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 Lube	E.P. SAE-90	Shell Spirax E. P.	E.P. SAE-140	Shell Corp., New York, 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, N. Y.
Veedol Lub.	E.P. SAE-90	Veedol Lub.	E.P. SAE-140	Tidewater Oil Co., New York, 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 Angeles, Calif.

Refer to Pages 7 and 8 for Lubrication Chart Key



LUBRICATION CHART

Ref.	Point of Lubrication:	Remarks:
1.	IHC UD-14A diesel engine	See page 6
1.	GM 71 series diesel engine	See page 39 and separate General Motors Operator's Manual
2.	Generator)	
3.	Starting motor)	Add 2 or 3 drops of oil every 8 hours of operation. (See page 46 or 66)

LUBRICATE DAILY (8 to 12 HOURS OF OPERATION)

	Air cleaners (IHC UD-14A or GM 71 series engine)	Check oil level daily. (See page 48 or 70
4.	Pins, rods, levers, parts with oil holes, etc	Occasionally lubricate with a few drops of motor oil
5.	Bearings - pivot case	(Six strokes of lubricator) General-purpose pressure gun grease "Lithium" type preferred) (One fitting at top and one fitting at bottom - each side)

LUBRICATE WEEKLY (50 to 60 HOURS OF OPERATION)
Two strokes of lubricator at each grease fitting
(General-purpose pressure gun grease "Lithium" type preferred)

6.	Clutch - throwout bearing	Pressure gun grease
7.	Pump - hydraulic	For pump instructions, see page 14
7A.	Bearings - fan hub (see engine sections)	Pressure gun grease
8.	Bushing - circle (rear axle)	Pressure gun grease
9.	Bearings - rear wheels	Pressure gun grease
10.	Bearings - rear axle shaft	Pressure gun grease
11.	Clutch - throwout shaft	(One stroke of lubricator) Pressure gun grease
12.	Bearing - clutch shaft	Pressure gun grease
13.	Clutch - pedal cross shaft	Pressure gun grease
14.	Bearing - steering post	Pressure gun grease
15.	Pedals - brake and circle latch	Pressure gun grease
16.	Ball - high lift link (on lift arm and circle)	Pressure gun grease
17.	Ball - side shift (on blade)	Pressure gun grease
18.	Balls - blade lift rams (on circle)	Pressure gun grease
19.	Balls - blade lift rams (upper and lower sockets)	Pressure gun grease
20.	Rods - blade side shift (upper and lower)	Clean with diesel fuel and lightly oil to prevent corrosion and setzing
20A.	Bearings - pivot pins (circle reverse hydraulic motor)	Pressure gun grease
21.	Bearing - pinion shaft (circle reverse hydraulic motor)	Pressure gun grease
22.	Bearing - pinion (circle reverse hydraulic motor)	Pressure gun grease
23.	Bearing - crank pin (circle reverse hydraulic motor)	Pressure gun grease
24.	Pivot shafts - front and rear (front axle)	Pressure gun grease
25.	Balls - scarifier lift	Pressure gun grease
26.	Ball - draw bar (socket and cap)	Pressure gun grease
27.	Bearings - scarifier lift	Pressure gun grease
28.	Tie rod ends - front axle	Pressure gun grease
29.	Balls - front steering ram	Pressure gun grease
30.	Trunnion bearings - front axle (upper)	Pressure gun grease
31. 32.	Steering knuckles - front axle	Pressure gun grease Grease level can be determined by removing pipe plug (31) in lower side of each trunnion socket.
32A.	Torque converter	Check oil level when oil is hot (engine running at idle) and add oil of type specified in torque converter section, page 60.
32B.	Tail-shaft governor reservoir "DAILY"	NOTE: Every 500 hours, drain and refill. See page 59. check oil level at plug. Add oil if necessary using engine oil. See torque converter section, page 61. NOTE: Every 100 hours, drain and refill with engine oil.
33.	Ball - scarifier ram	Pressure gun grease
34.	Bearings - scarifier ram base	Pressure gun grease
35.	Bearings - high lift (front and rear)	Pressure gun grease
35A.	Bearing - piston rod end (high lift ram)	Pressure gun grease
36.	Bearings - pivot (high lift ram)	Pressure gun grease
37.	Bearings - rear steering rams	Pressure gun grease

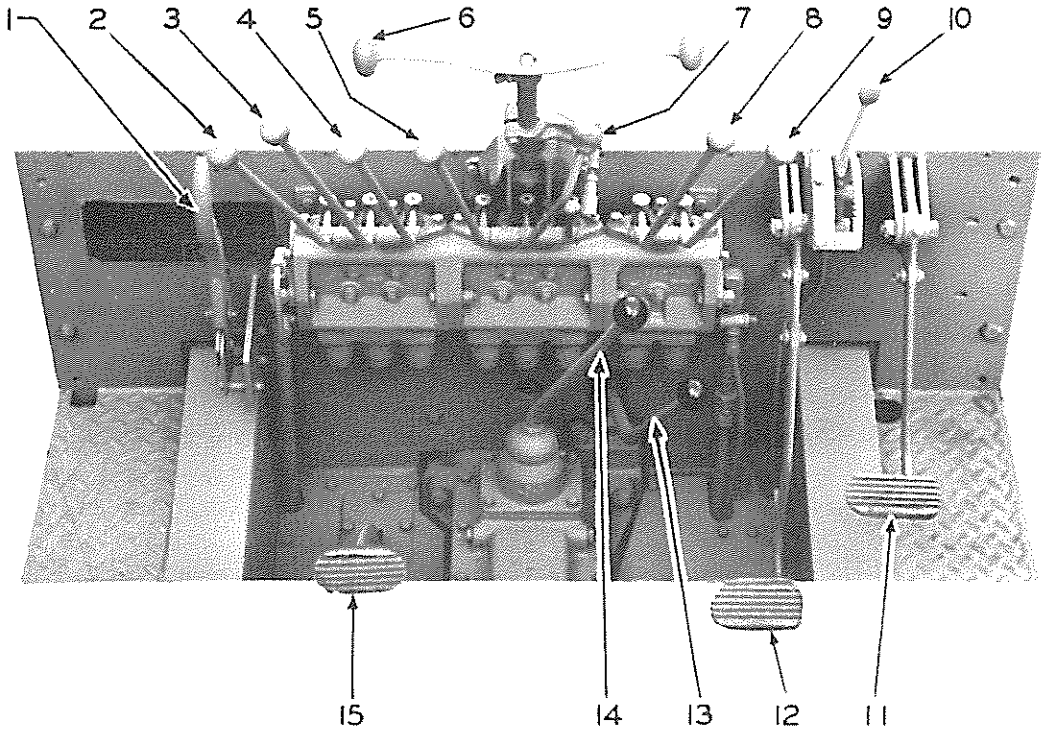
LUBRICATE MONTHLY (200 HOURS OF OPERATION)
Two strokes of lubricator at each grease fitting
(General-purpose pressure gun grease "Lithium" type preferred)

38.	Universal joints - propeller shafts	Pressure gun grease
39.	Bearing - propeller shaft support	Pressure gun grease
40.	Clutch brake	Pressure gun grease
41.	Clutch - pilot bearing (GM 71 series engine)	Pressure gun grease See page 130.
41A.	Clutch - pilot bearing (IHC UD-14A engine)	Pressure gun grease See page 130.

(Continued)

Ref.	Point of lubrication:	Remarks:
	LUBRICATE ONCE PER YEAR (APPROXIMATELY 2000 HOURS OF OPERATION)	
42.	Bearings - front wheels	Remove the wheel drive flanges and check bearing adjustment. Adjust bearings if necessary. Inspect grease compartment and replenish with wheel bearing grease. Also check when overhauling. (See page 106, paragraph 138.)
	CHECK WEEKLY (50 to 60 HOURS OF OPERATION)	
43.	Gear carriers (front and rear axle)	When temperatures are 22° F. and above, use SAE-140 extreme pressure lubricant. When temperatures are below 22° F., use SAE-90 extreme pressure lubricant. NEVER MIX GRADES OR KINDS OF EXTREME PRESSURE LUBRICANTS. If in doubt, drain, flush, and refill.
44. 45.	Pivot case - rear axle NOTE: Approximate capacity of each case is 6 gallons.	Check high level oil plug (44) every 50 hours of operation and refill at cover (45) if necessary with SAE-140 extreme pressure lubricant. When temperatures are below 22° 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. NOTE: Drain and flush every 1000 hours of operation (or at least twice a year). Refill with extreme pressure lubricant.
46. 46.	Transfer case) Transmission) NOTE: The transfer case filler plug determines the oil level in both the transfer case and transmission case, as both oil compartments are interconnected. Approximate capacity is 14 quarts.	Check every 50 hours of operation and refill if necessary with SAE-140 extreme pressure lubricant. When temperatures are below 22° 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. NOTE: Drain and flush every 1000 hours of operation (or at least twice a year). Refill with extreme pressure lubricant.
47. 48.	Hydraulic oil	Check oil level pet cocks (47) and refill with SAE-10W for temperatures of 22° F. and above. For temperatures below 22° 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 page 52 or 100.
	CHECK EVERY 4 WEEKS	
49. 50.	Master cylinder - circle latch) Master cylinder - brake)	Check the hydraulic master cylinder and refill with genuine Lockheed #21 brake fluid. (See page 119, paragraph c., also page 155, paragraph 187.)
	CHECK PERIODICALLY	
51.	Vent plugs - gear carriers (front and rear axle); - also rear axle pivot cases	Keep air vent in plug open to prevent accumulation of air pressure. CAUTION: Do not remove unless for cleaning because of dirt or dust stoppage.
52.	Bearings - pinion shafts (front and rear gear carrier)	After repairing or overhauling front gear carrier unit, be sure to remove the two pipe plugs (52) (front carrier only) and inject about one pint of SAE-140 extreme pressure lubricant. If you do not do this you may start out with dry pinion bearings. After repairing or overhauling rear gear carrier unit, but before bull gear is installed, place unit on floor or table with opening up. Pour about one pint of SAE-140 extreme pressure lubricant into case. Lift case toward vertical position using the universal joint yoke as a pivot point, and at the same time, turn case sideways. This will let the lubricant flow thru the cast oil passages to the outboard pinion bearing.

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



2. OPERATING CONTROLS.

The operator should thoroughly 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. (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 11 for shift chart for speeds).

(14) TRANSMISSION GEAR SHIFT. (See page 11 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 IHC engine see instructions on page 63 and 64. To start GM engine see instructions on page 39, 43, 44, 45 and 59.

3. *FUNCTION OF THE "A-W" POWER GRADER.*

The A-W 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, this grader:

(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 blade 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 A-W 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 25 for left hand high lift or bank cutting operation.

5. *PREPARING GRADER FOR BLADE OPERATION.*

After completely lubricating and fueling the grader (page 6, grader; pages 66 and 67 IHC diesel; or pages 39 and 59 GM-71 series diesel), and learning the location and method of the various controls (page 9) proceed as follows:

(1) Adjustment of Blade Tilting Links.

Loosen the four vertical and the two horizontal bolts at the links (20), page 153.

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.

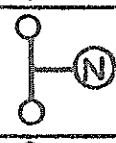
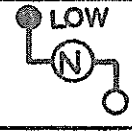
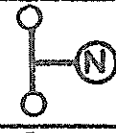
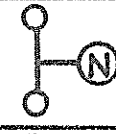
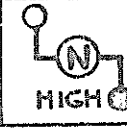
One of either length may be put on either right or left moldboard end and none on the other moldboard end.

The standard length moldboard is 13 ft. (Bits are 6 ft. and 7 ft.)

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.

SPEEDS	MAIN TRANSMISSION	AUX. TRANS.	M.P.H.
1			1.98
2			3.21
3			4.69
4			6.84
5			11.10
6			17.82
R			2.01
R			6.96

6. *GEAR SHIFT CHART.*

The 99 power graders are fitted with six forward speeds and two reverse.

The 1st and 2nd speeds are generally used when ditching, heavy road maintenance, bulldozing, and finishing. (When performing heavy work place the hand throttle in wide open position).

The 3rd and 4th speeds are used for heavy to light maintenance work and snow removal. Adjust throttle to suit operating conditions.

The 5th and 6th speeds are used for transporting machine overland.

CAUTION: Do not disengage clutch or shift into neutral when descending hills. Do not clash gears when shifting. (Stop the machine when shifting).

SECTION 2

EARTH ROAD CONSTRUCTION

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

NOTE: For all operating purposes and intent, the photos and illustrations shown in this section will apply similarly to A-W graders fitted with "Six Driving Wheels".

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 perceptible amount to full flow of nine gallons of oil per minute.

The A-W 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 A-W may be quickly and easily turned at the end of the section.

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

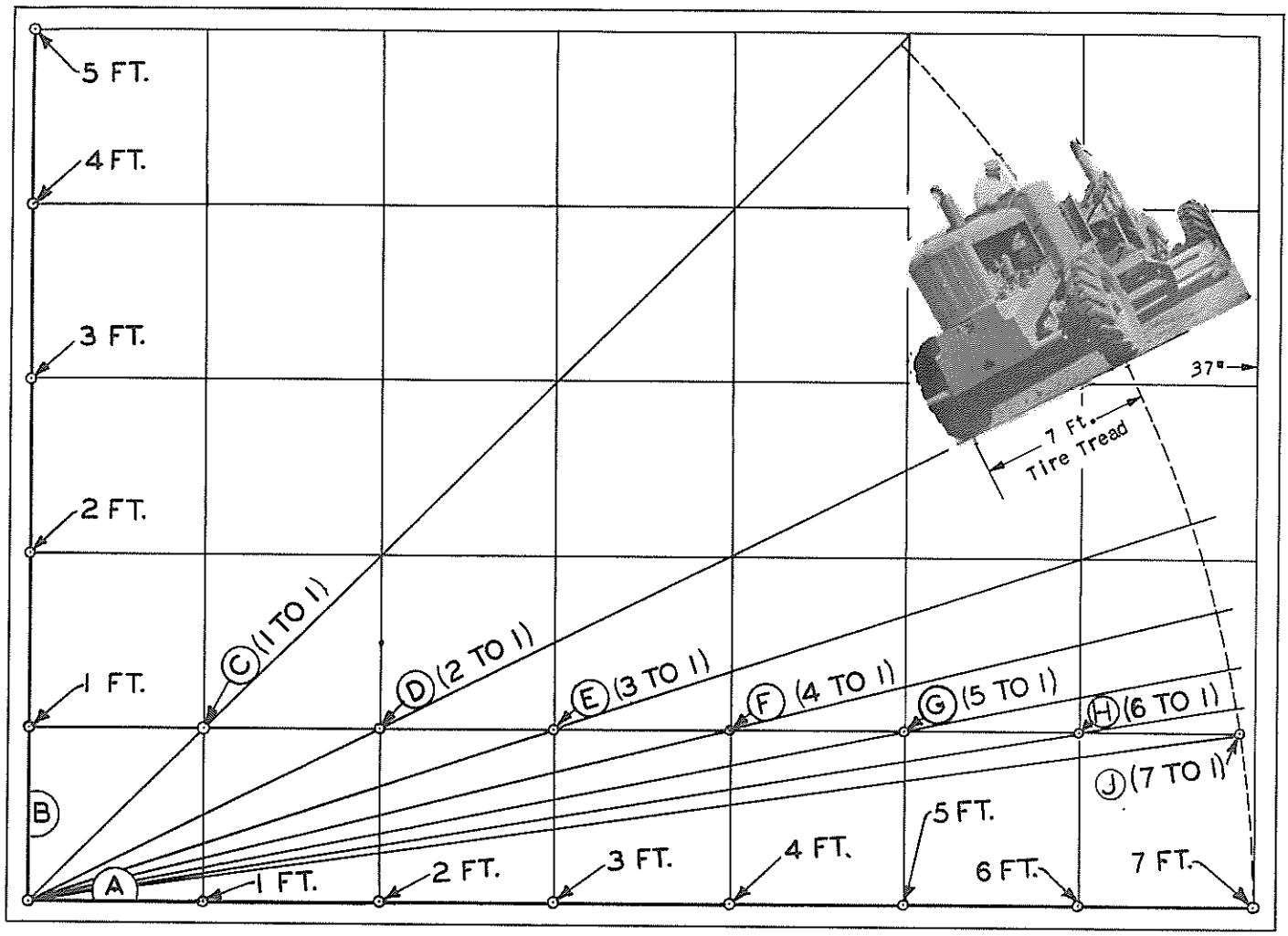
When operating an Austin-Western power grader, *always "ride the bank" with all wheels,* in order that the grader may be placed in position to most effectively load the engine for maximum work. The reason for this is that All-Wheel Steer and All-Wheel Drive make it possible to effectively hold and load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

Follow these suggestions when grading with an A-W grader 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 13, 23, 24, and 26 to 30 inclusive.

8. *GRADING ON (3 to 1) SLOPE.*

The front and rear wheels are steered in order to place the frame in offset postion. (Maximum of 2 to 1 slope).



9. GRADING SLOPE CHART.

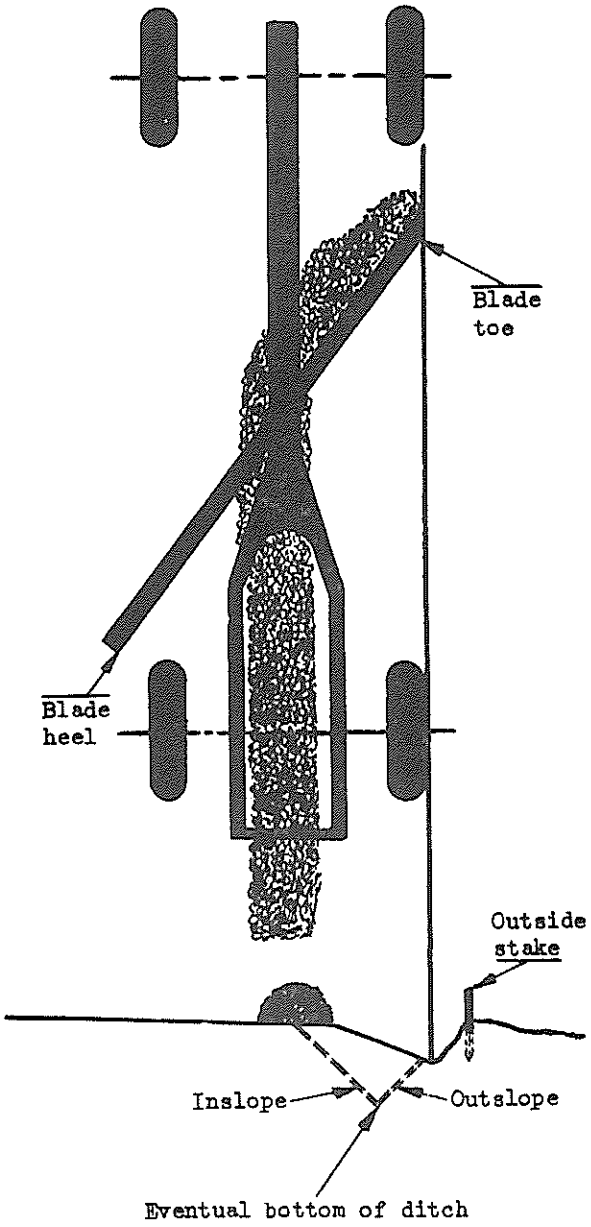
This chart has purposely been made 7 inches wide because the center distance from the right rear tire tread to the left rear tire tread is about 7 ft. One inch spacing on the lower horizontal line (A) represents one foot. One inch spacing on the right and left vertical lines (B) represent one foot.

(C) This line represents a (1 to 1) slope. All bank sloping work from perpendicular to horizontal may be done with the A-W moldboard in the high lift position. See pages 26 to 30 inclusive.

(D) This line represents a (2 to 1) slope. By placing all driving wheels on the slope, grading may be very satisfactorily done from line (D) down and thru lines (E), (F), (G), (H), and (J), when soil conditions permit. 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 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 driving wheels. The engine, in turn, will be in position to drive the grader at its fully loaded capacity.



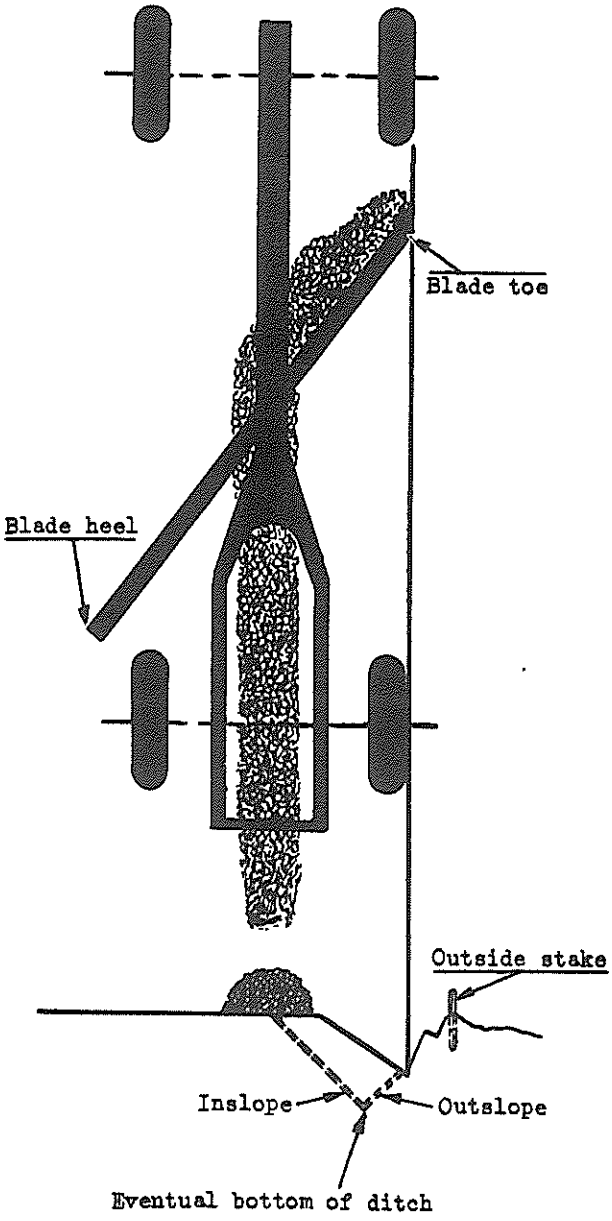
10. STARTING A NEW DITCH.

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.

NOTE: Page 9 shows the locations of all control levers, such as (2), (4), and (3) listed above. Keep this in mind when reading the text as shown on the following pages.



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.

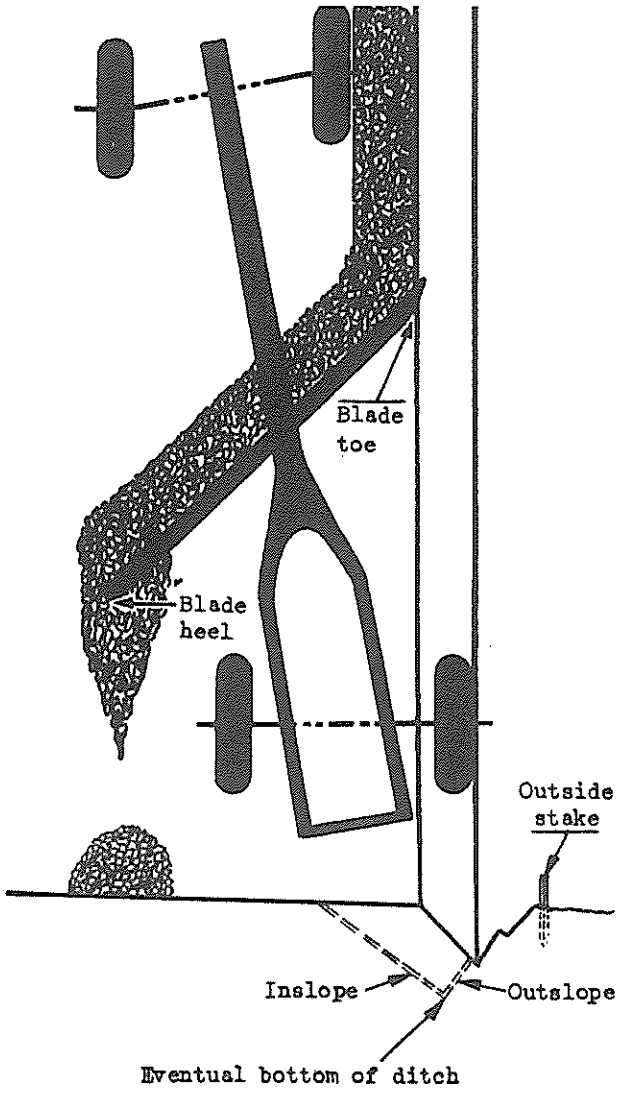
NOTE: All consecutive ditch cuts are made in the same fashion as shown. Remember, as ditch progresses deeper, the point of blade must follow the dotted line to eventual shape of the ditch slopes and bottom of ditch. This means that when another ditch cut is made, both front and rear wheels must be positioned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

To perform this operation, proceed as follows:

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

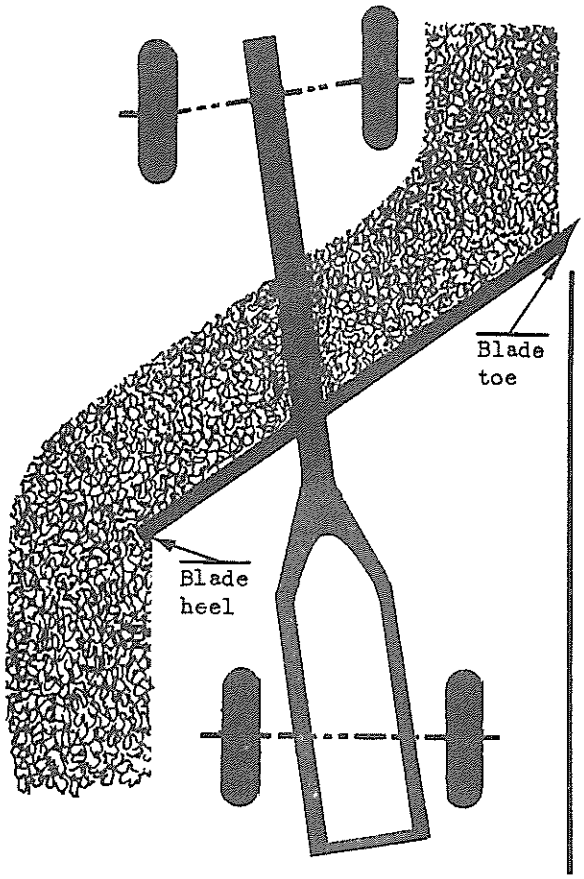
(2) Rotate circle, lever (2), and shift the moldboard sideways, lever (4), sufficiently to reach the windrow.

(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 all rear wheels on the other side. The job will be finished quicker if this is done because the full engine power is used effectively.

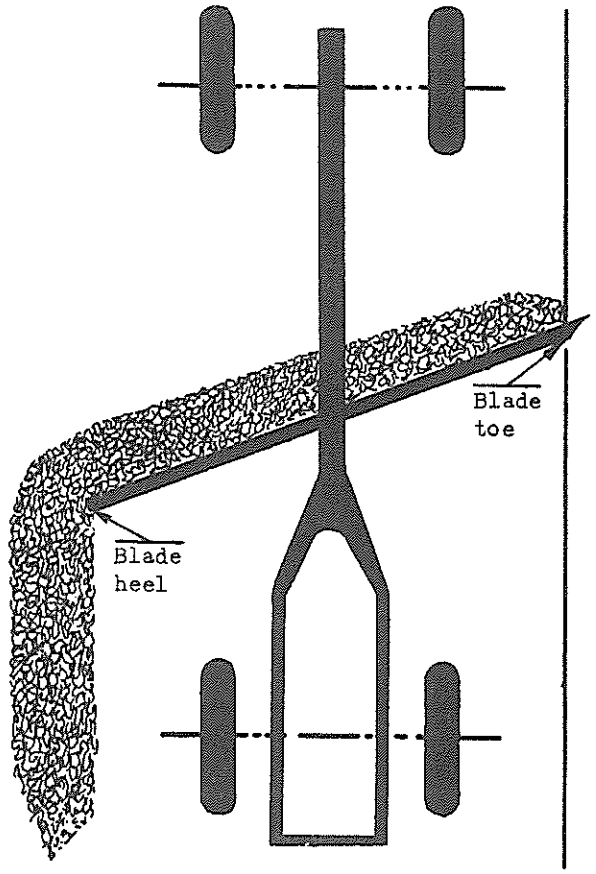
13. THIRD PASS, OR WINDROW MOVE-OVER.

14. WINDROW MOVE-OVER IN BLOW SAND.



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

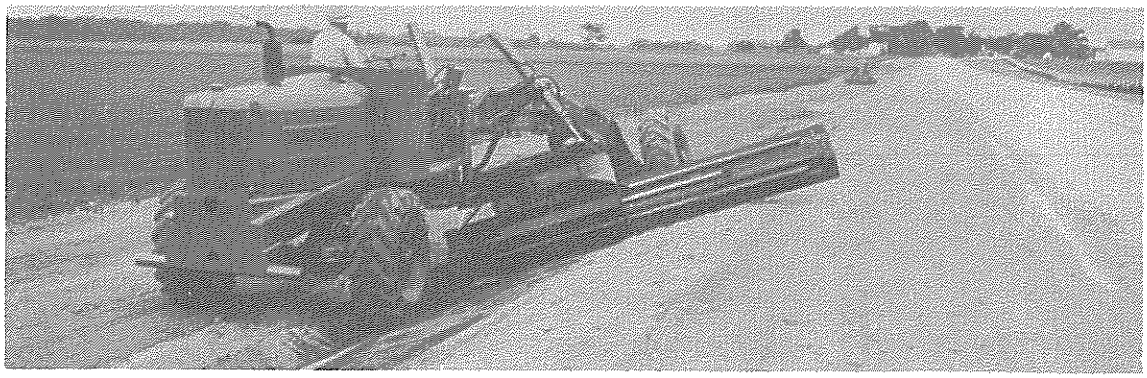
(2) Rotate circle, lever (2), and side shift, lever (4), to suit conditions, approximately as shown. Guide grader with front steer, lever (6), missing windrow with both front and rear wheels.



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 ram piston rod, lever (5), is retracted to position the circle to the extreme right side.

(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.

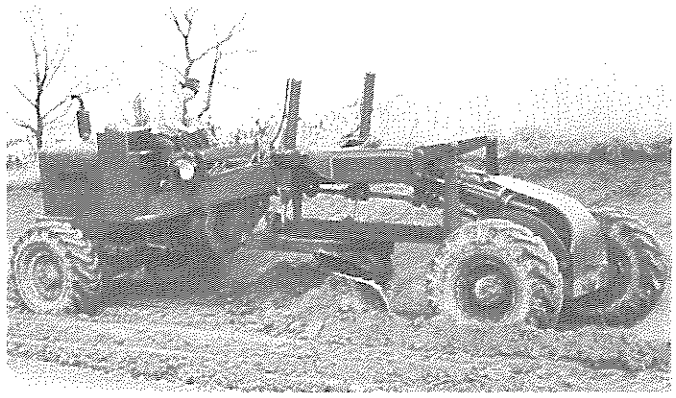
18. FLAT BOTTOM DITCH.

Circle side shift ram piston rod, lever (5), is almost fully retracted. 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 A-W power grader.



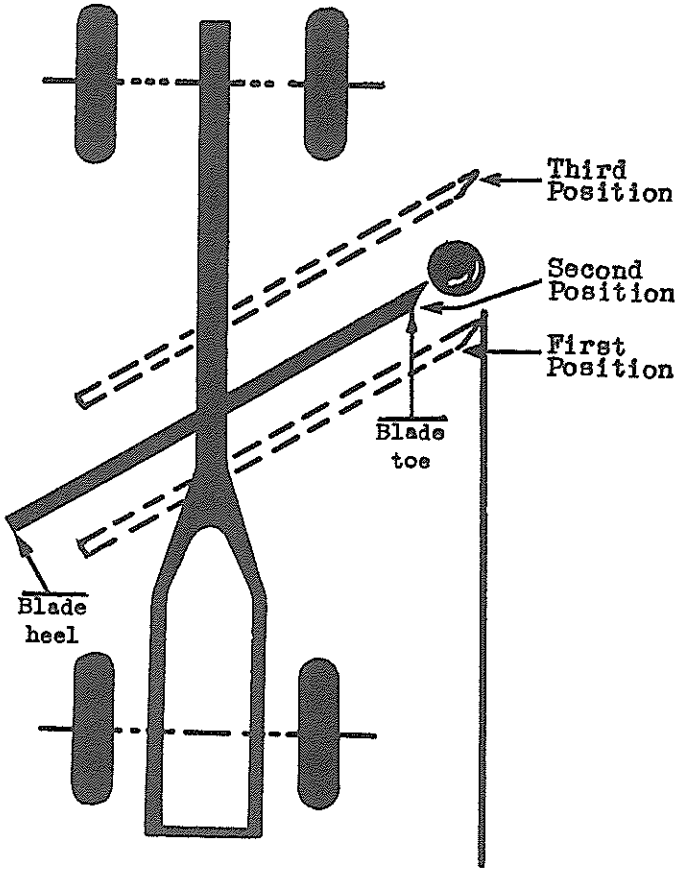
20. GRADING IN REVERSE.

(Full Reversible Circle)

(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.

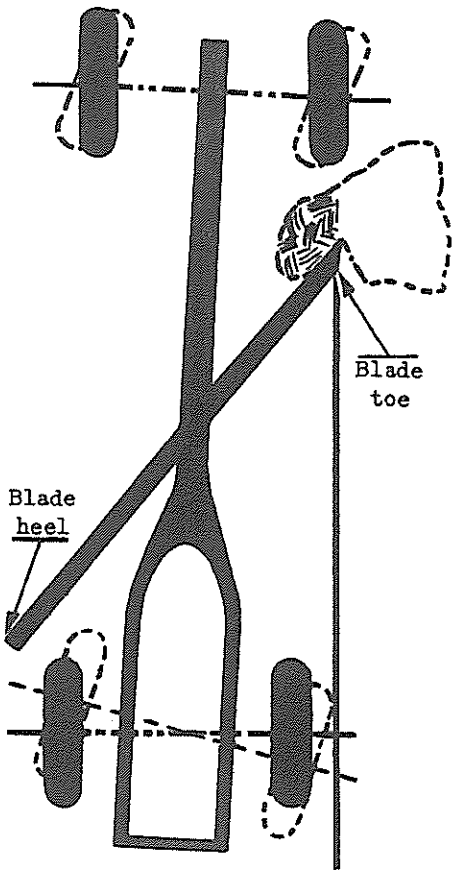
(2) Moldboard is side shifted, lever (4), so end of it just clears back side of scarifier block. The circle should be on a level with the machine both fore and aft, as well as sideways, in which position cutting edge is clearing ground approximately 2 inches. Caution should be taken not to foul tires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

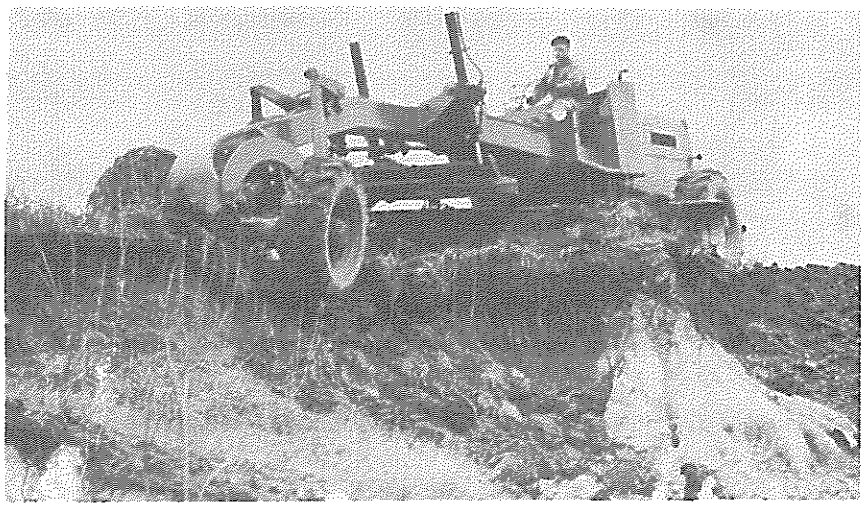
(3) Use rear steer, lever (7), for guiding machine when grading in reverse.



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.

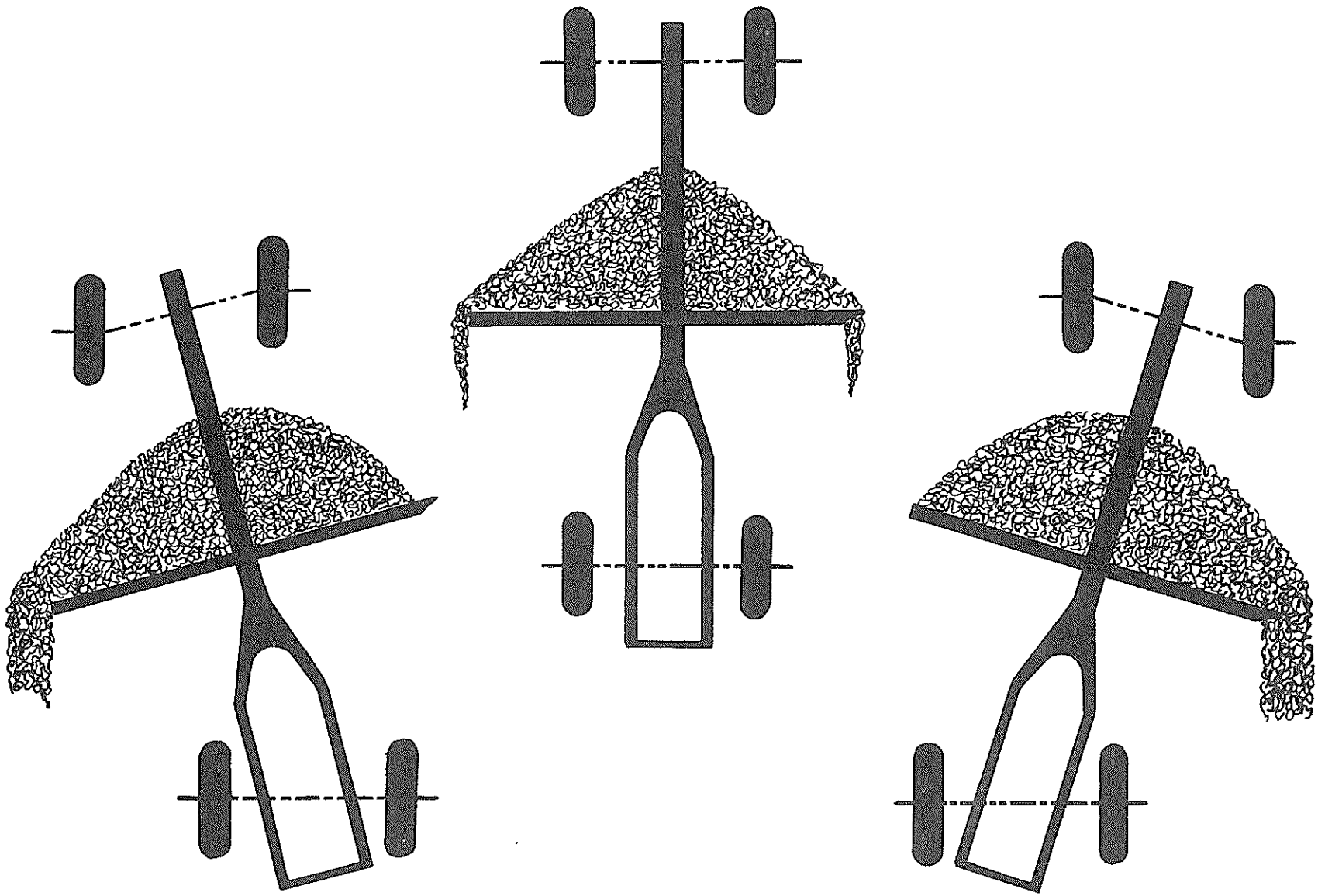




22. BACKING OUT.

(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.



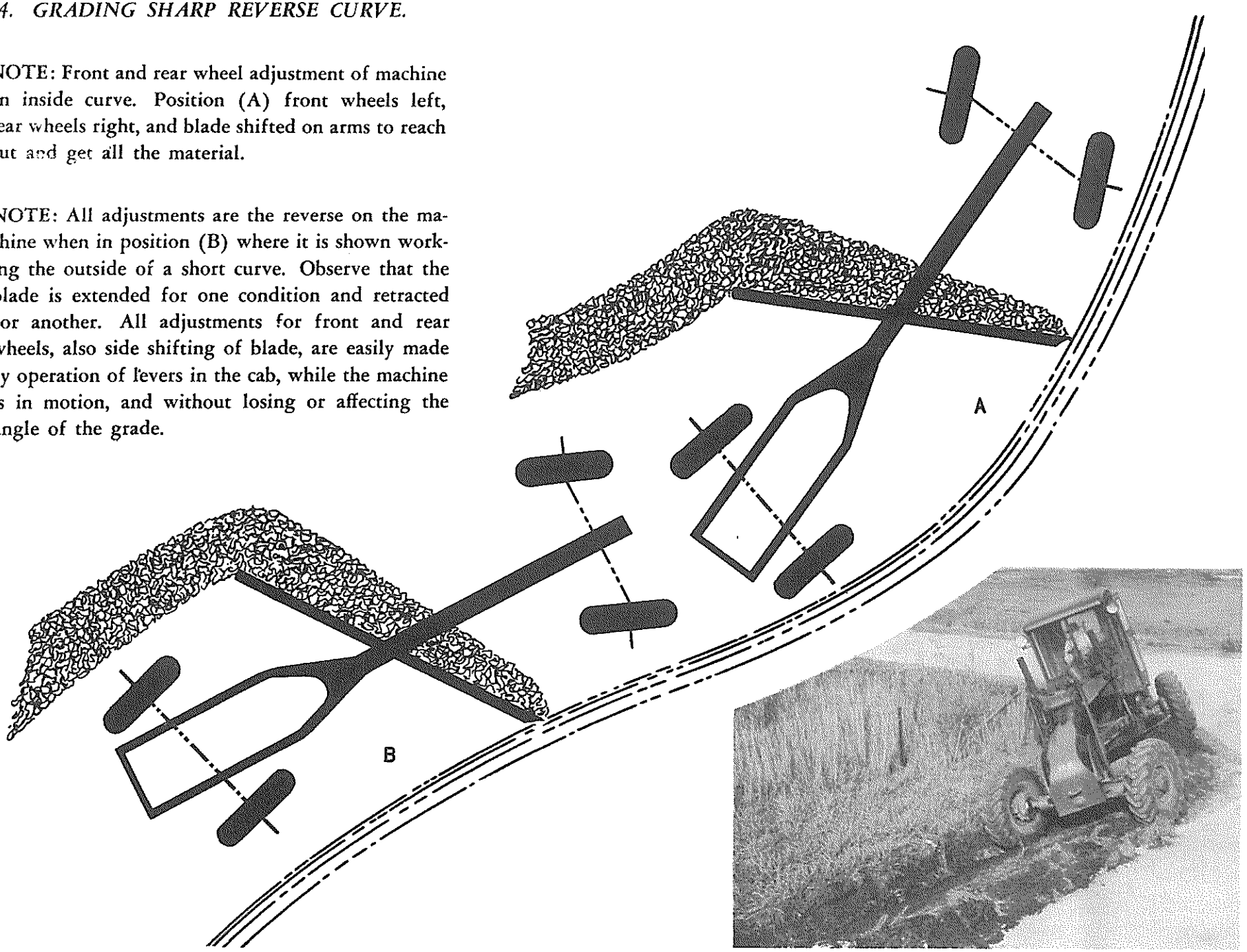
23. CUTTING HIGH AND FILLING LOW PLACES.

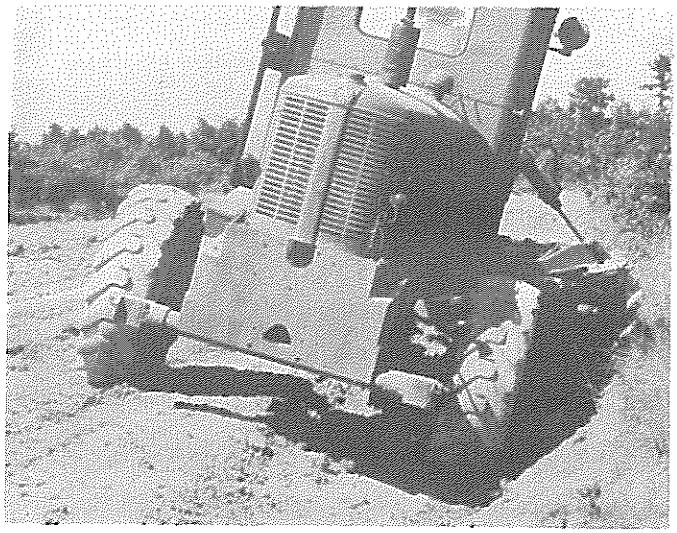
This operation is performed easiest by setting the blade square across the frame and controlling the "drifting" by adjusting the rear wheels to suit. The rear wheel adjustment responds to a valve in the cab. It is simple and easy.

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.



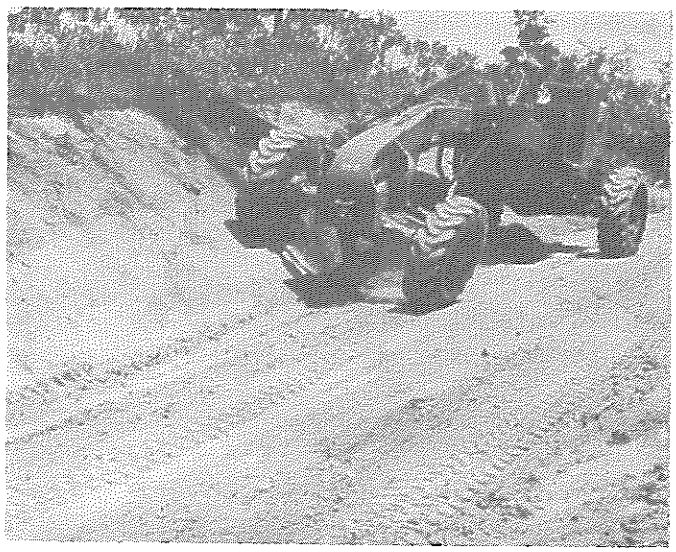


25. GRADING THE OUTSLOPE OF A LOW BANKED DITCH.

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

The rear drive wheels are steered to the right sufficiently to permit the right rear wheels to drive and ride the bank slightly. Most of the windrow passes to the left side of the right rear tires, 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 wheels riding the bank slightly. It is driving on smooth ground because the windrow is delivered to the left of it. All wheels effectively travel on smooth ground, permitting the work to be finished in the shortest possible time.

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

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

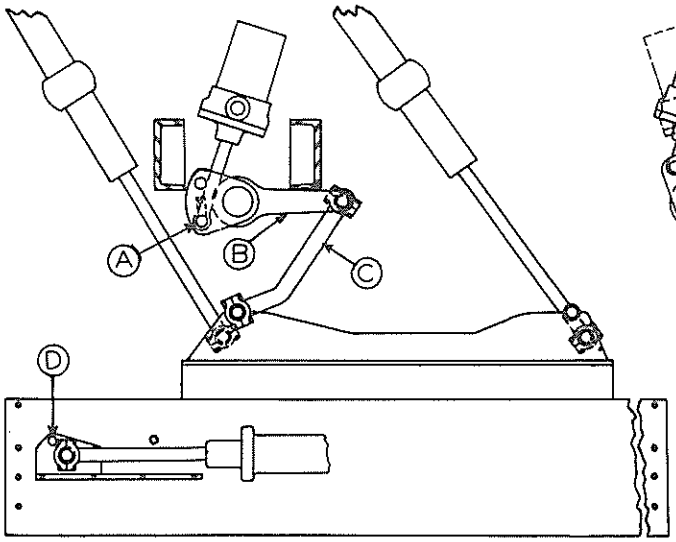
(2) The right front wheel is located close to the bank ahead.

(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 wheels. 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.

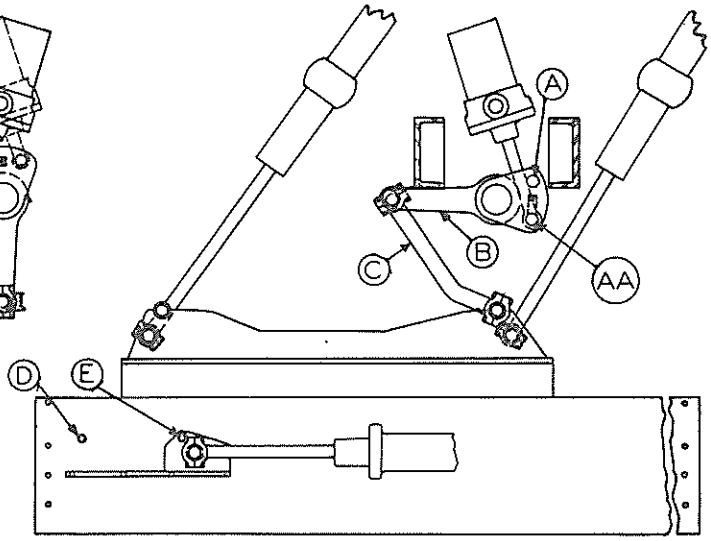
The surprising feature is that the operator *can cut more or can cut less at the bank, as he wishes, by steering the rear wheels only.*

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 A-W 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 A-W power graders are assembled with the moldboard and controlling linkage parts in position for right hand operation, as shown in drawing above.

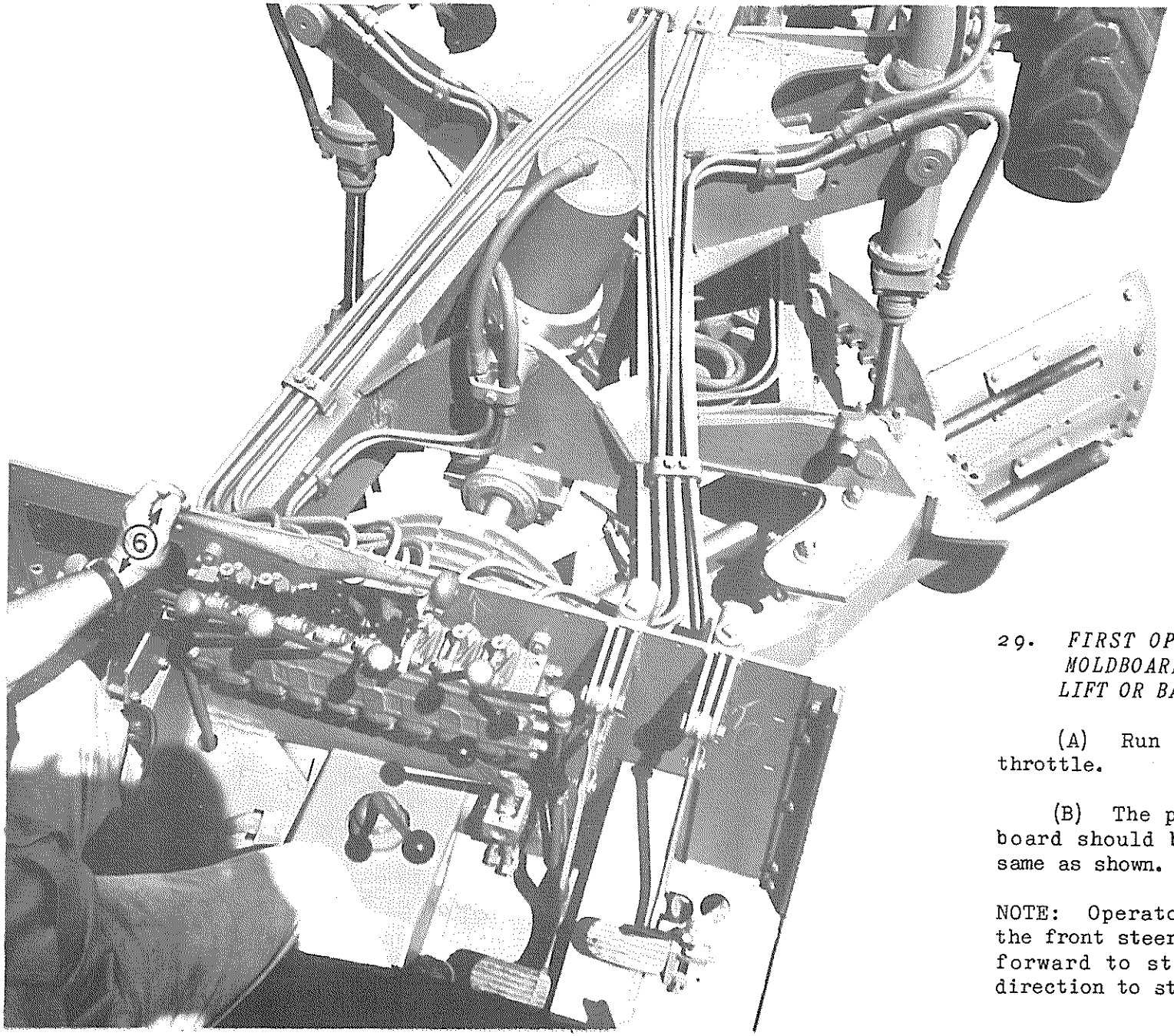
As viewed from the operator's seat, the top of the circle side shift cylinder will be tilted toward the right. The removable pin (A) is located in the lower hole as shown.

Arm (B) is contacting the bottom side of the right frame rail (this is explained on page 28). 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 30). 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 A-W 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.

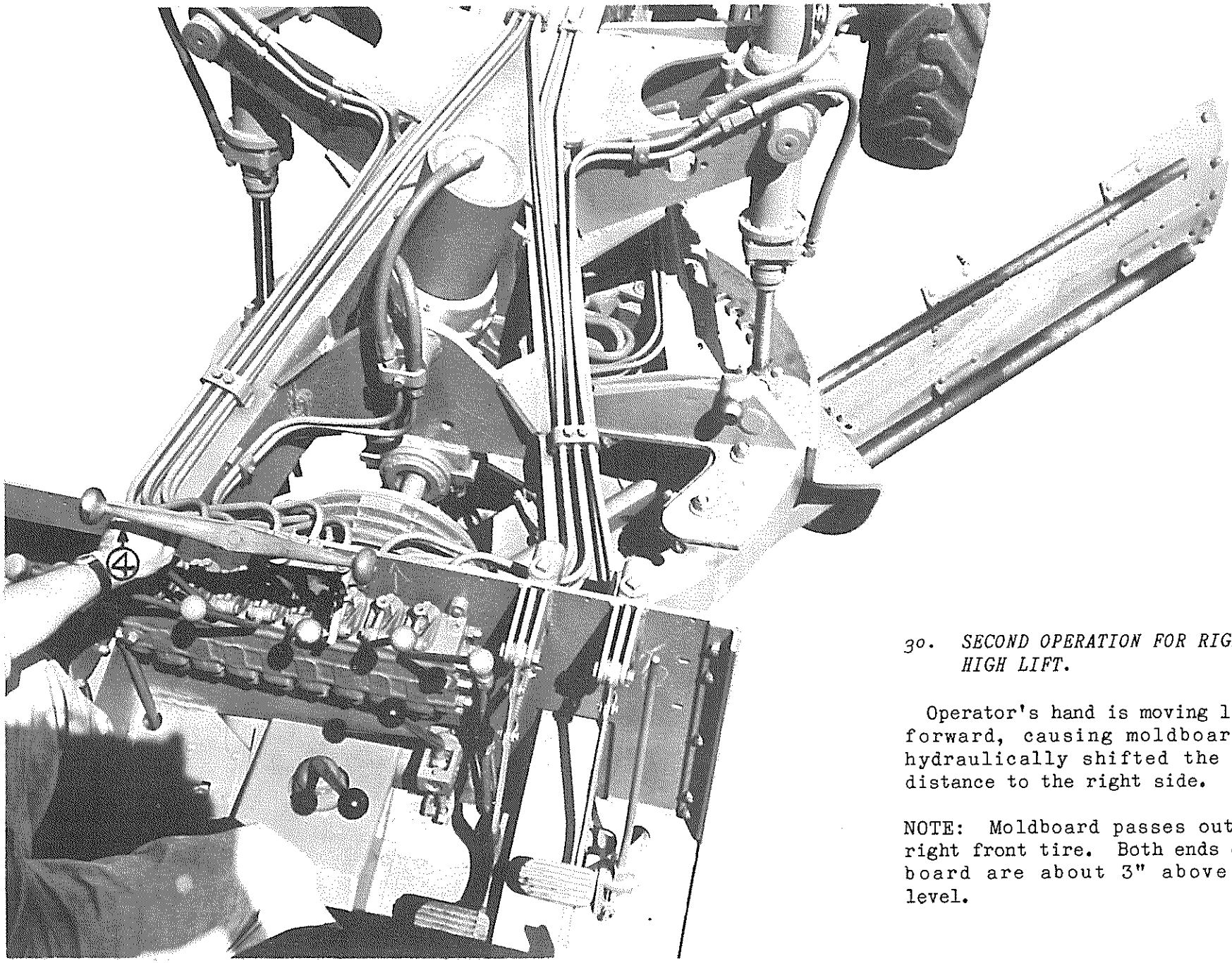


29. *FIRST OPERATION FOR PLACING MOLDBOARD IN RIGHT HAND HIGH LIFT OR BANK SLOPING POSITION.*

(A) Run engine at wide open throttle.

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

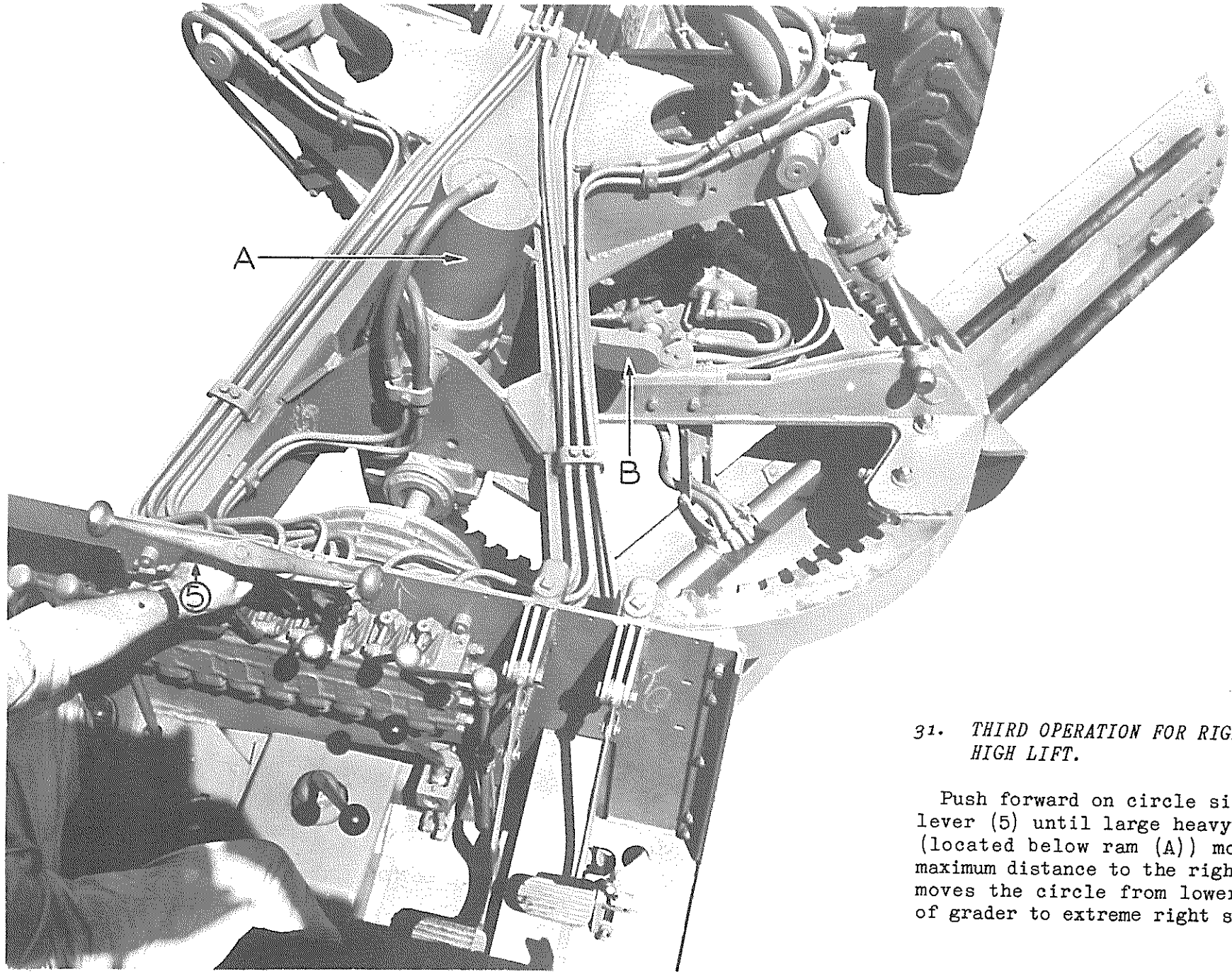
NOTE: Operator's left hand is on the front steering lever (6). (Push forward to steer right; opposite direction to steer left.)



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

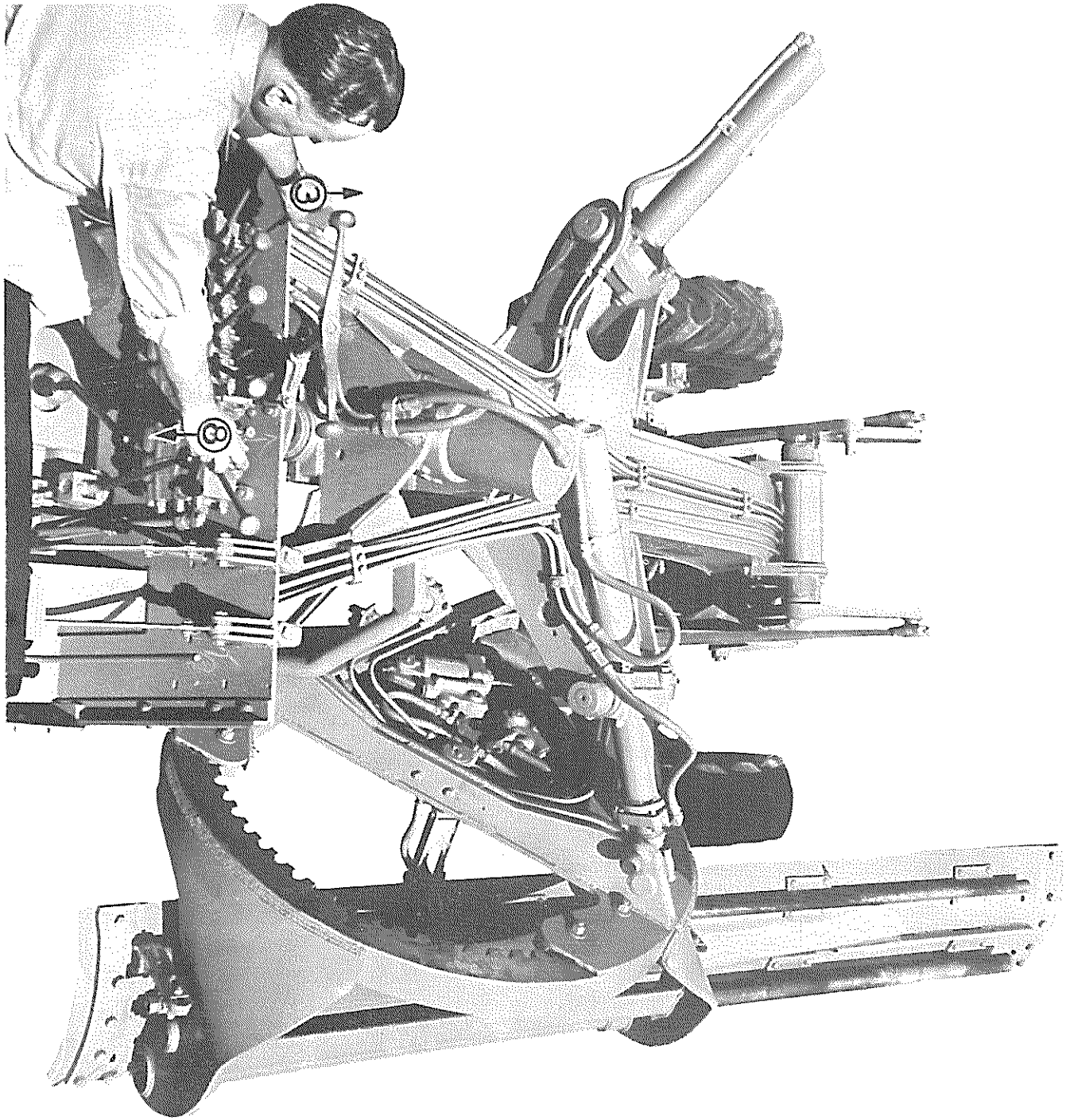
Operator's hand is moving lever (4) forward, causing moldboard to be hydraulically shifted the maximum distance to the right side.

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.

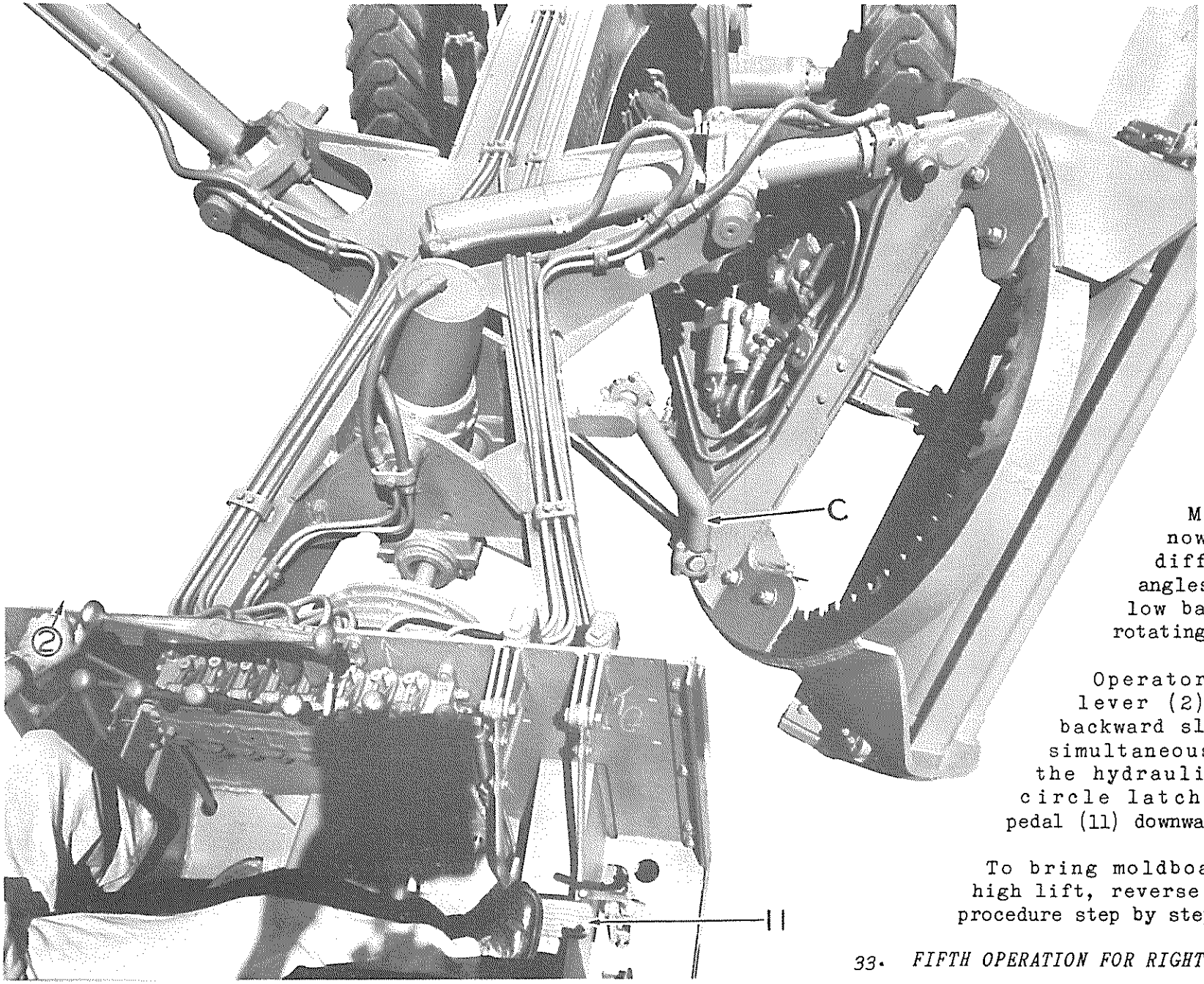


32. FOURTH OPERATION FOR RIGHT HAND HIGH LIFT.

(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.

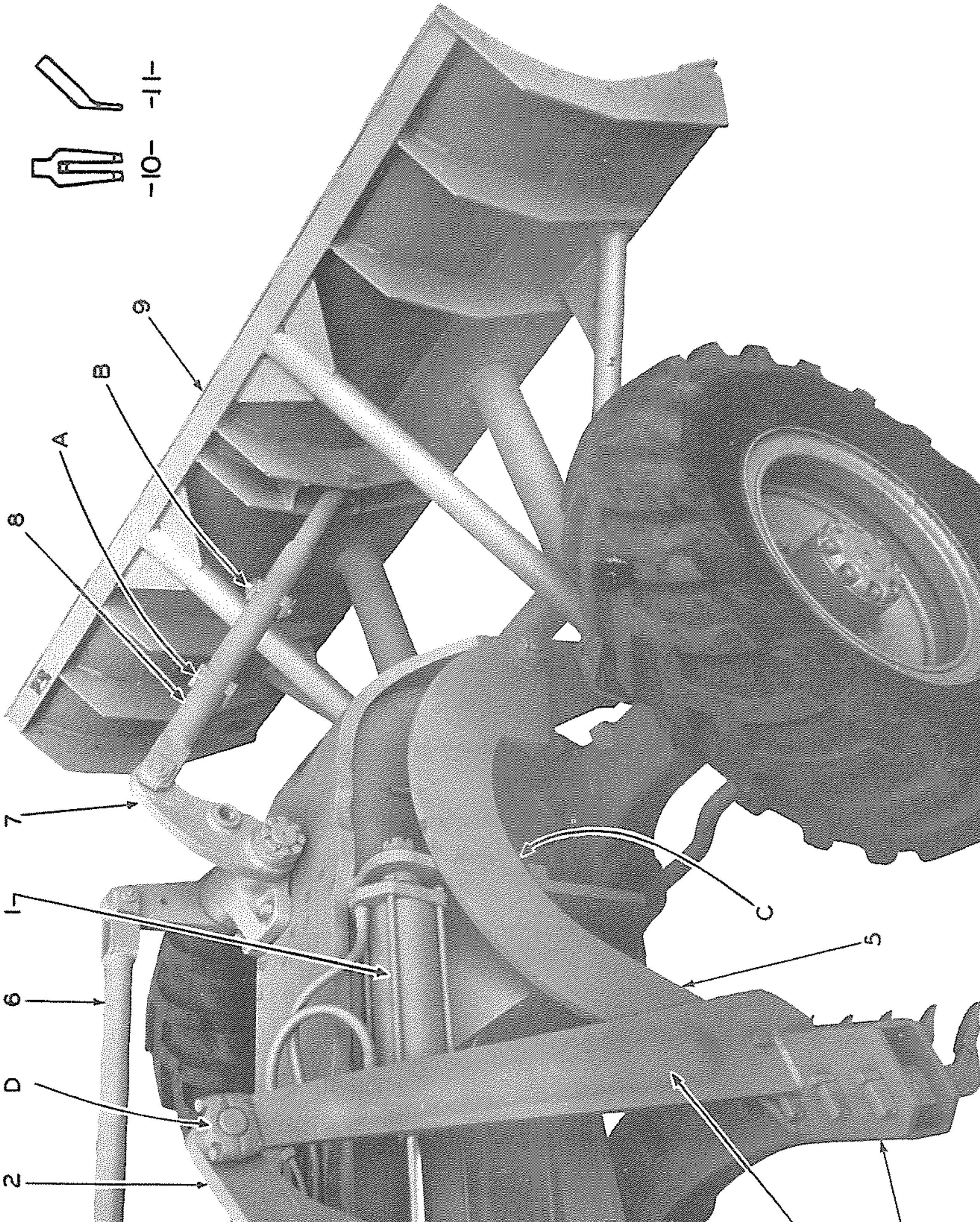


Moldboard may now be placed in different cutting angles, for high and low banks, etc., by rotating circle.

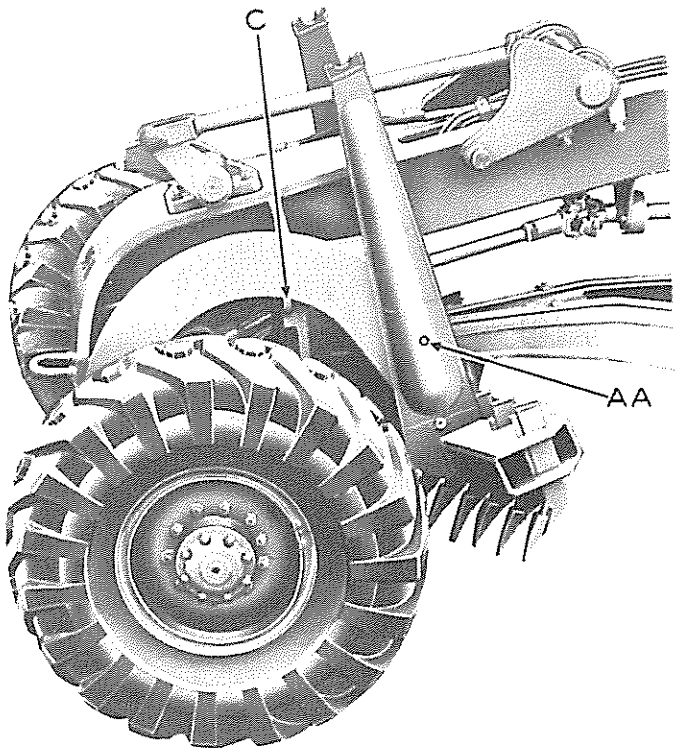
Operator should move lever (2) forward and backward slightly, while simultaneously unlocking the hydraulic controlled circle latch. Push foot pedal (11) downward.

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

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



Scarifier and Bulldozer



34. SCARIFIER AND BULLDOZER.
(See page 31)

a. General.

This grader 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 general-purpose pressure gun grease ("Lithium" type preferred); two strokes of lubricator every 50 hours of operation.

b. To Fit Grader With Scarifier Only.

Parts (1) to (5) inclusive shown on page 31 are required.

c. To Fit Grader With Bulldozer Only.

Parts (1), (2), (6), (7), (8) and (9) inclusive are required.

d. To Operate Scarifier.

The photo on page 31 shows 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 9, 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 with driver (11). 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).

If scarifier teeth become worn or broken they may be easily replaced without removing tyne. Tooth driver (10) is provided with each scarifier attachment.

e. To Operate Bulldozer.

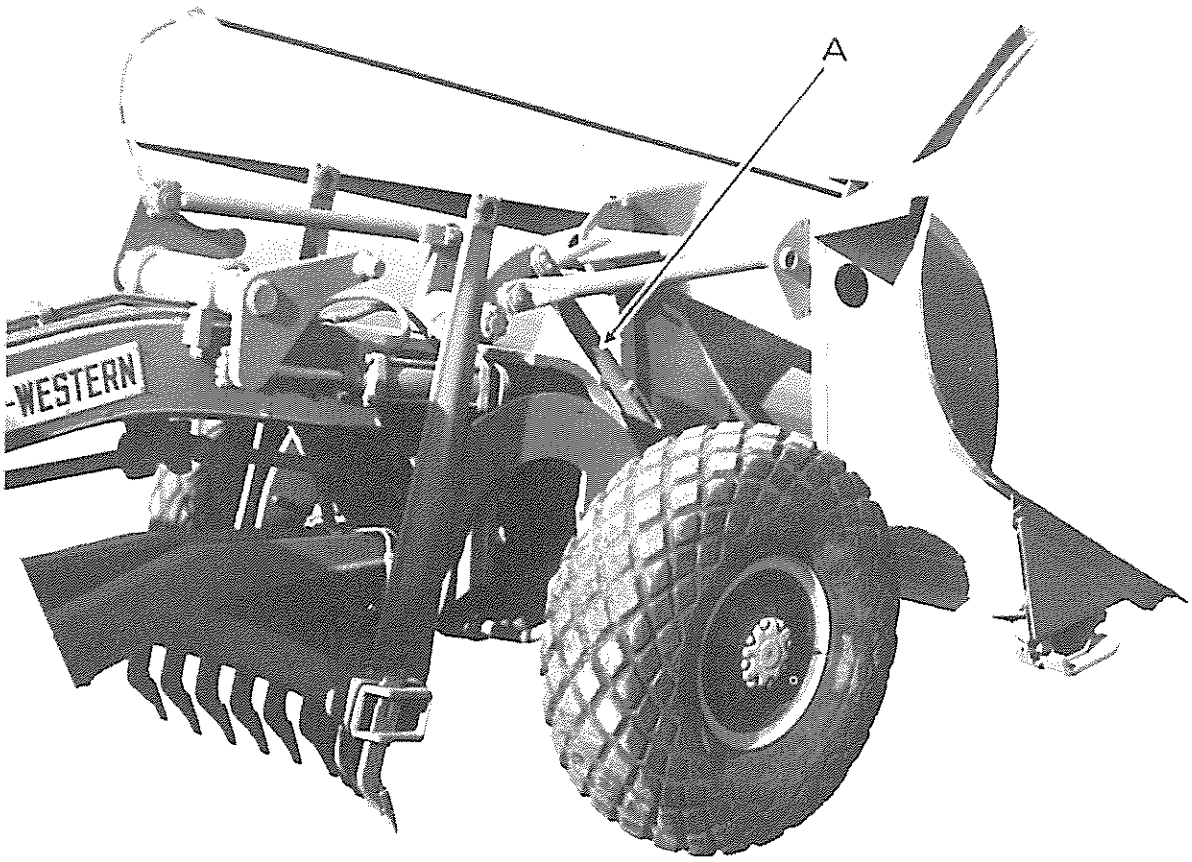
(1) To change over from scarifier to bulldozer operation, turn outward both scarifier draft beam support levers (C), page 31. (One on each side of grader.)

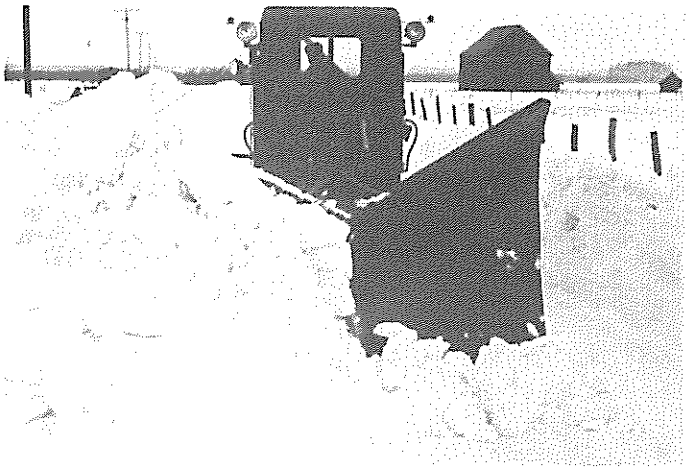
(2) Lower the scarifier draft beams against the levers (C).

(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) above.

(5) Lower the bulldozer blade (9), page 31, 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.





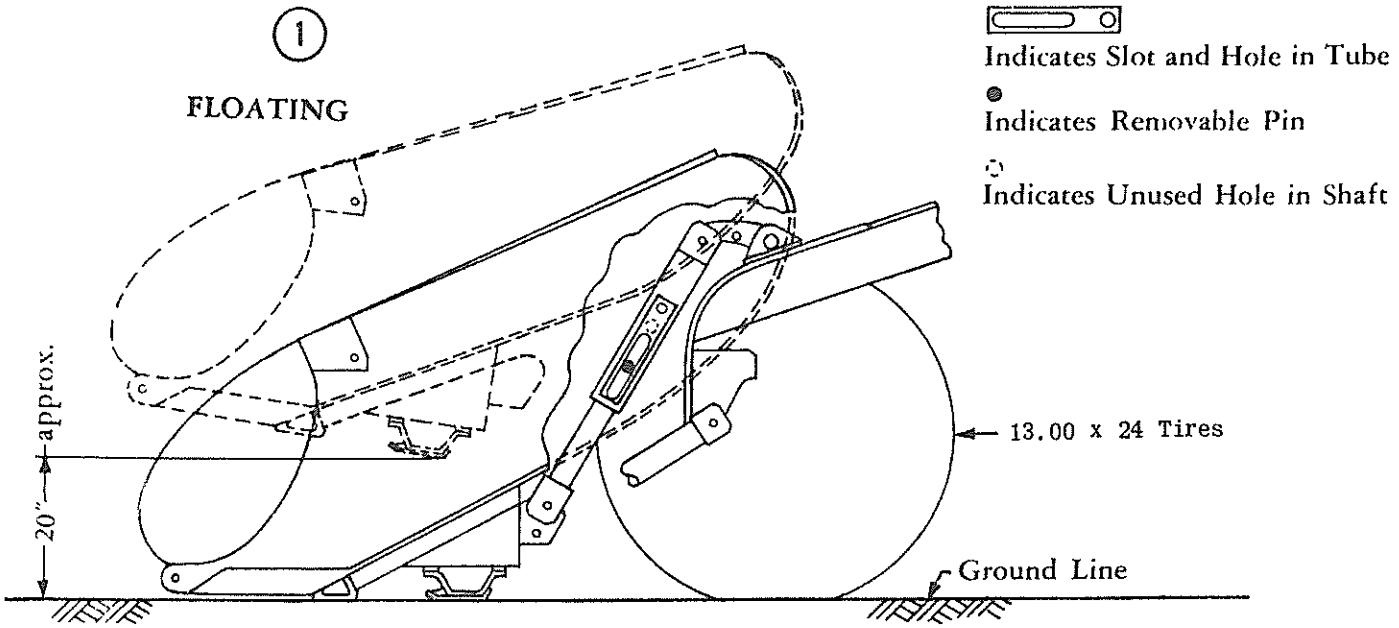
35. GIANT "V" SNOW PLOW.

The parts groups (1), (2), (6) and (7), Page 31, must be on the grader in order to attach and operate the giant "V" plow attachment.

A pin through the slotted hole in the telescopic tube (A), shown above, 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 reaches the lowermost point of the slot in telescopic tube (A).

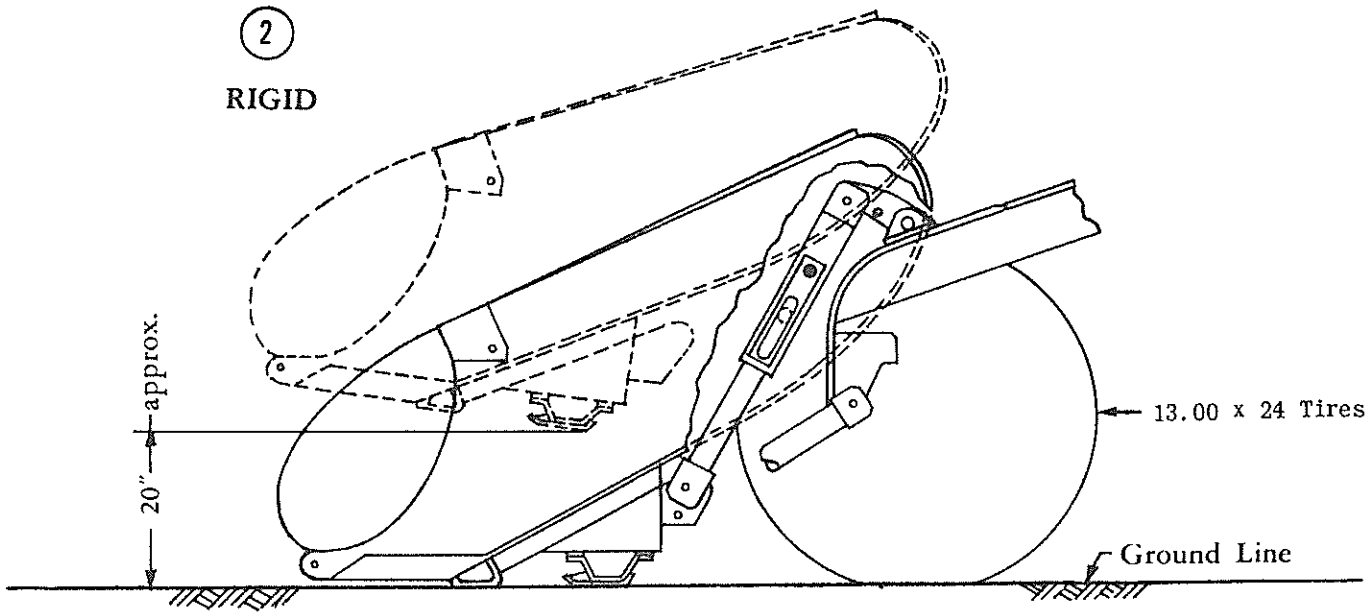
NOTE: Lubricate all grease fittings with general-purpose pressure gun grease ("Lithium" type preferred); two strokes of lubricator every 50 hours of operation.



Pin Setting:

Pin is inserted thru tube slot and inner shaft hole.

This setting provides floating action in operating position. Ground clearance, with plow lifted, is approximately 20 inches. When ram is at end of stroke, with plow on ground, blade can float up 7 inches approximately and down 2 inches approximately.



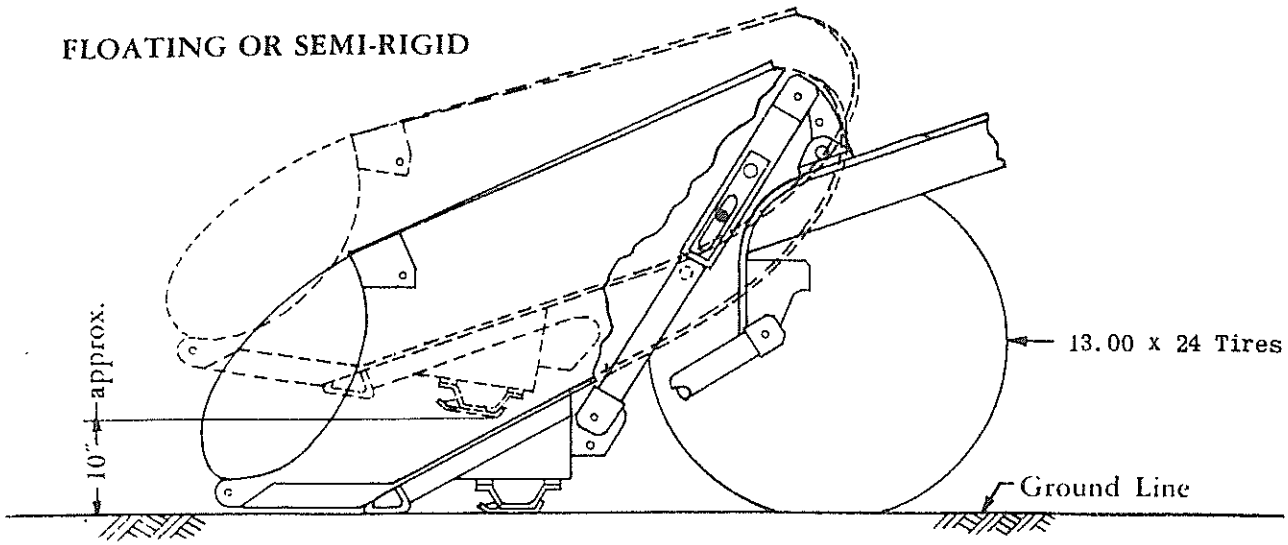
Pin Setting:

Pin is inserted thru tube hole and outer shaft hole.

This setting provides rigidity in operating position. Ground clearance, with plow lifted, is approximately 20 inches. Cut below grade is approximately 2 inches.

(3)

FLOATING OR SEMI-RIGID



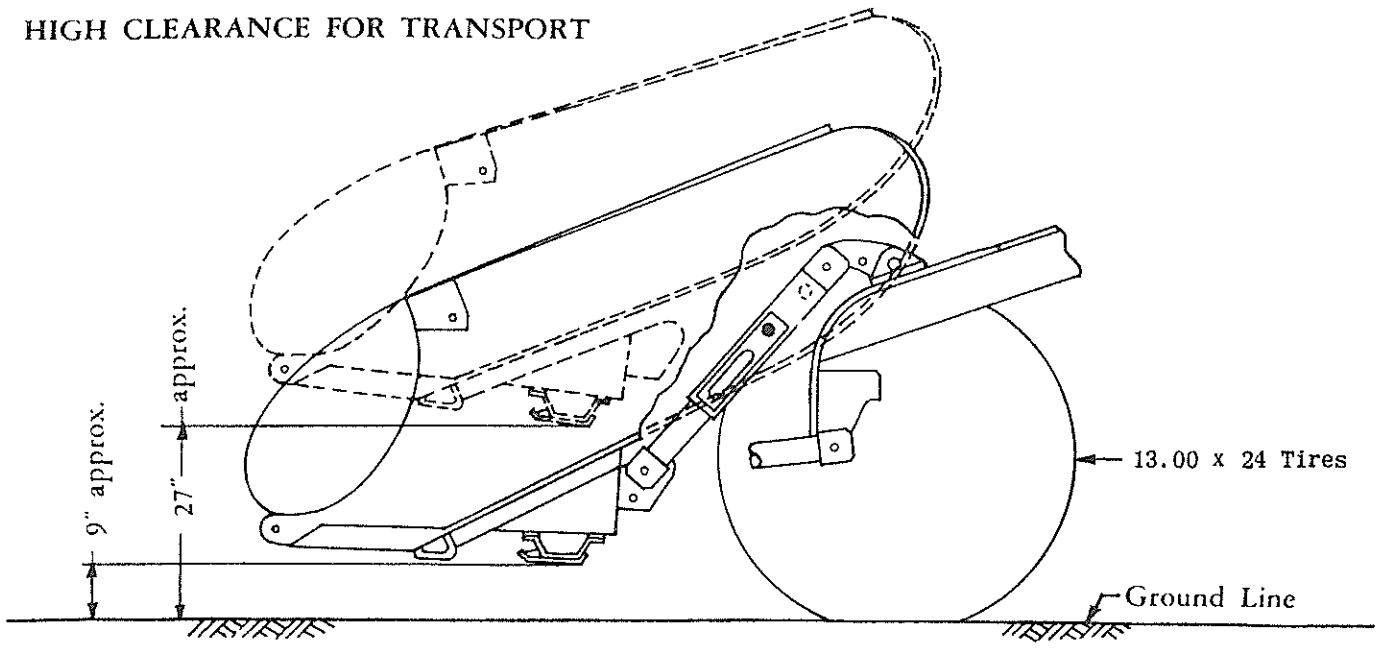
Pin Setting:

Pin is inserted thru tube slot and outer shaft hole.

This setting provides the same type of floating action as shown in #1 diagram Sufficient ram stroke remains to hold the plow rigidly against the work, permitting downward float only. Ground clearance, with plow lifted, is approximately 10 inches.

(4)

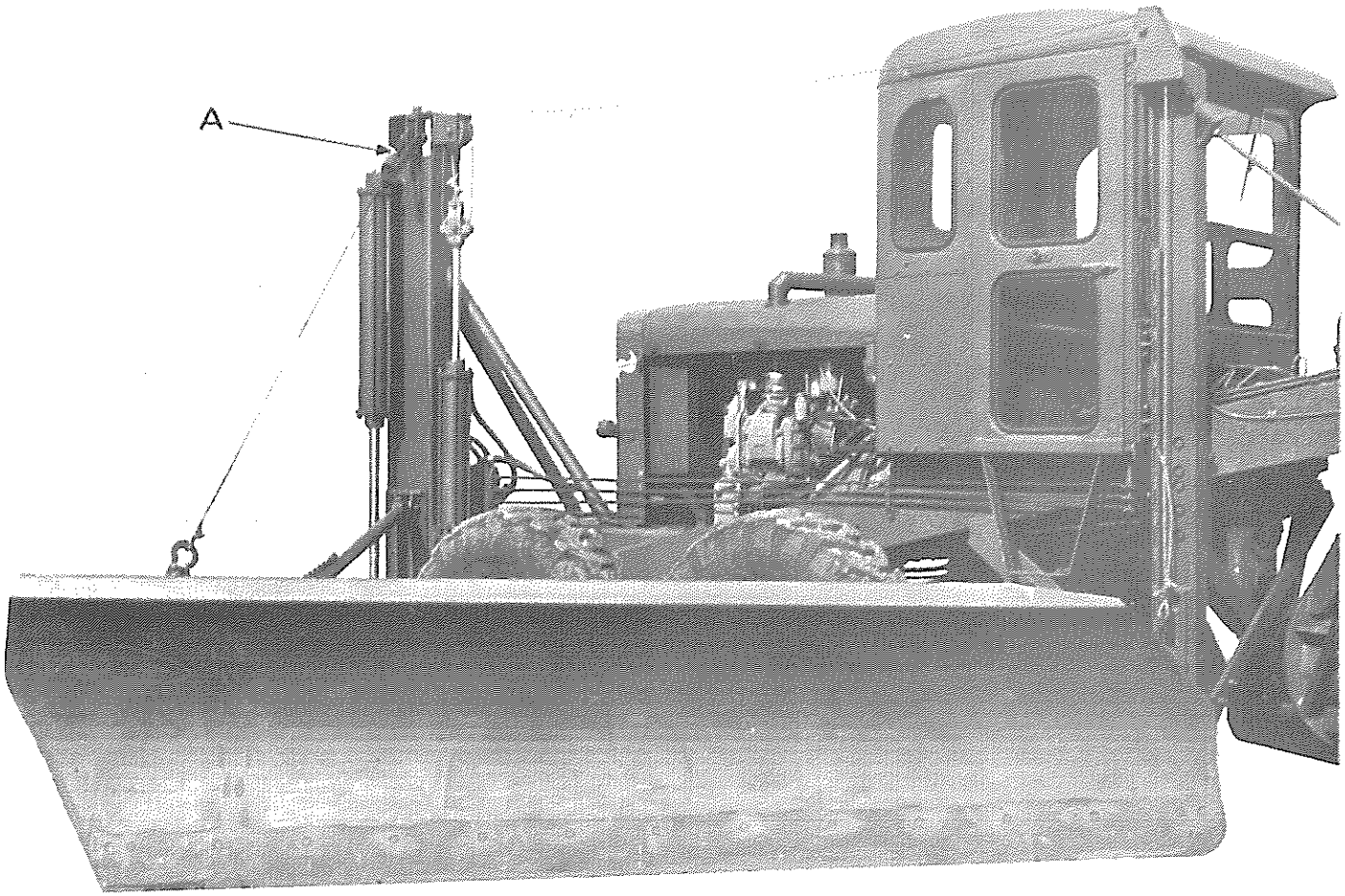
HIGH CLEARANCE FOR TRANSPORT



Pin Setting:

Pin is inserted thru tube hole and inner shaft hole.

This setting provides high clearance for transporting. It is necessary to block up plow to insert pin. Ground clearance, with plow lifted, is approximately 27 inches. Plow cannot be lowered to ground.



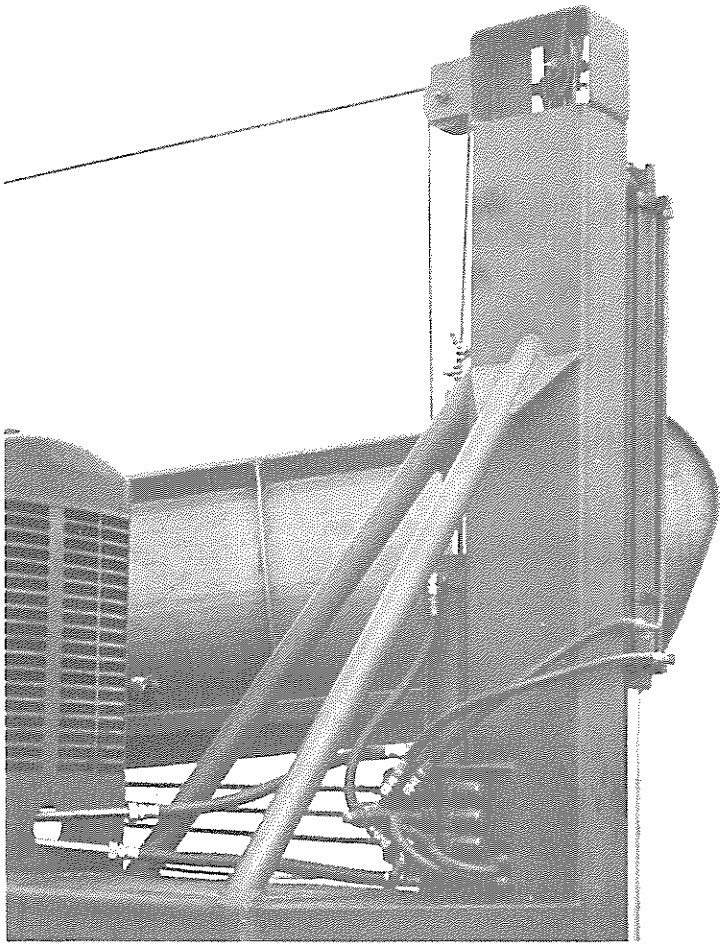
36. SNOW WING.

NOTE: For all operating purposes and intent, the photos, illustrations, and text in this section will apply similarly to either 99L or Super 99 graders.

The complete snow wing attachment consists of a rear mast, front bracing, brackets and slide, control mast and wing assembly, all of which can be assembled on the grader in a few hours with common tools. (Each wing assembly has installation instructions included with the unit.)

The snow wing hydraulic system is mounted on the rear mast and need never be removed except for replacement. (See page 149 for control valve maintenance.)

Simple hydraulic hose connections to the present grader system are made with equipment provided. (See page 37.)



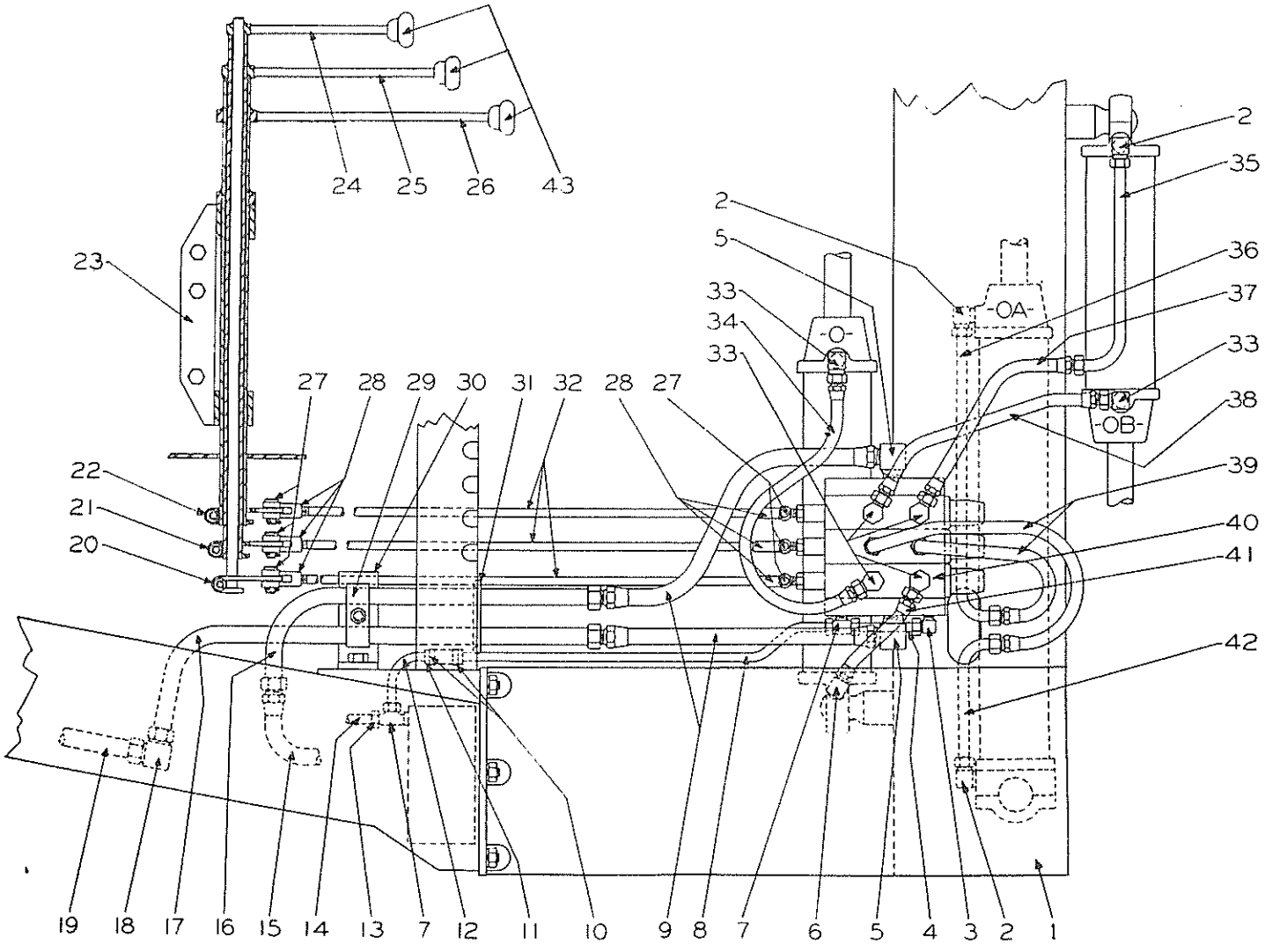
All wing movement is done with cable systems and hydraulic rams, one located inside the rear mast and one mounted on the outside of the rear mast. The base, or inside end, of the push rod assembly is raised and lowered by a hydraulic ram located on the rear mast.

All control handles are mounted on a mast in the right front corner of the cab. Control rods run back to the valve bank from the lower end of the control mast.

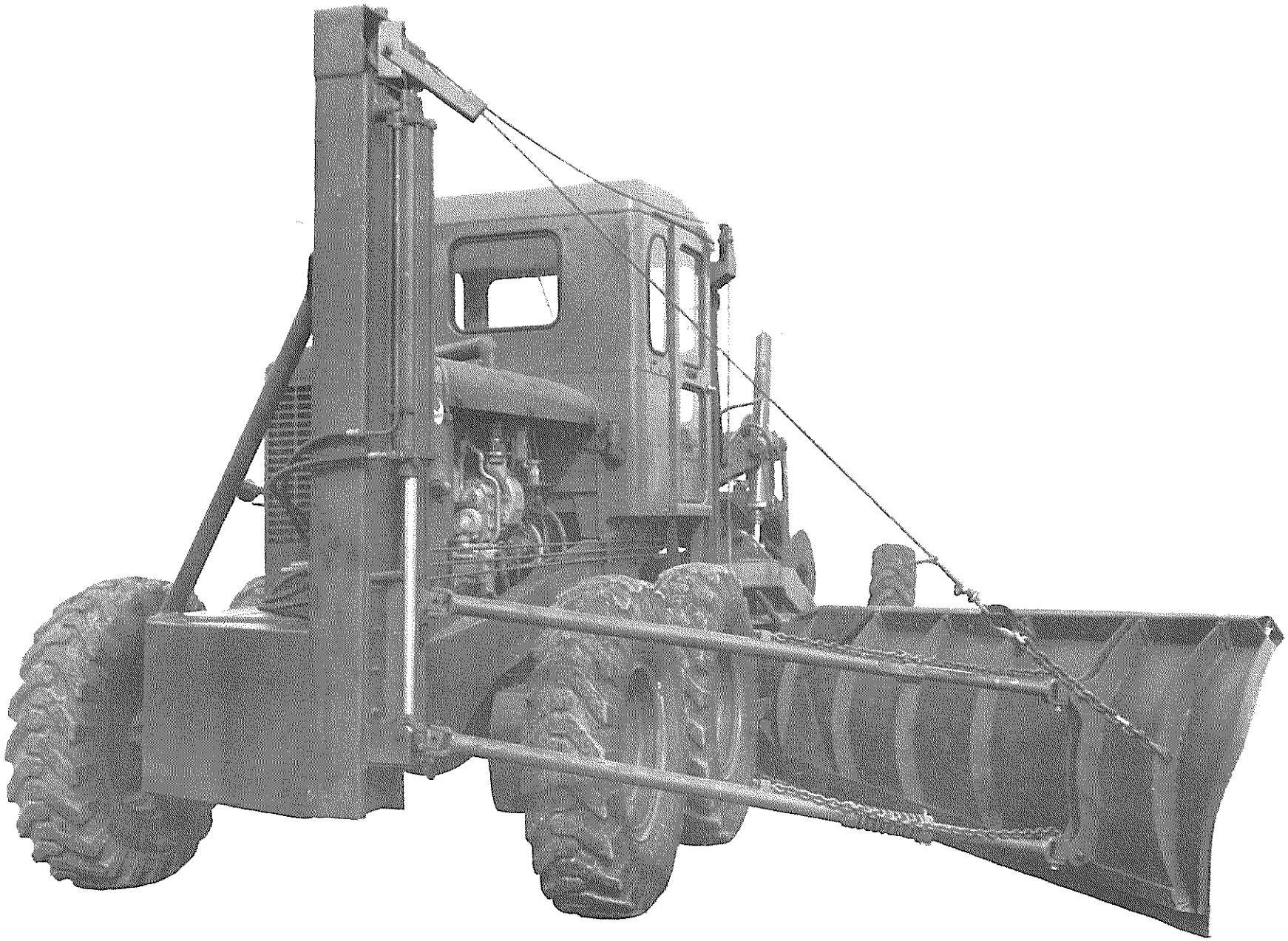
To raise any part of the wing, the control handle is pulled to the rear, and to lower, the control handle is pushed forward.

The rear end of the wing may be swung inward over the rear wheels permitting passage through a space 11 feet high, 10 feet wide, with an over-all machine length of approximately 30 feet. To accomplish this, the wing is first lowered to the ground. Both pins are removed from the telescopic rods and the forward end of the wing is raised about 2 feet off the ground. The rear lift ram is retracted and when the wing is high enough to reach, the loose end of the lift chain is inserted into a slotted bracket located on the fairlead at (A), page 36.

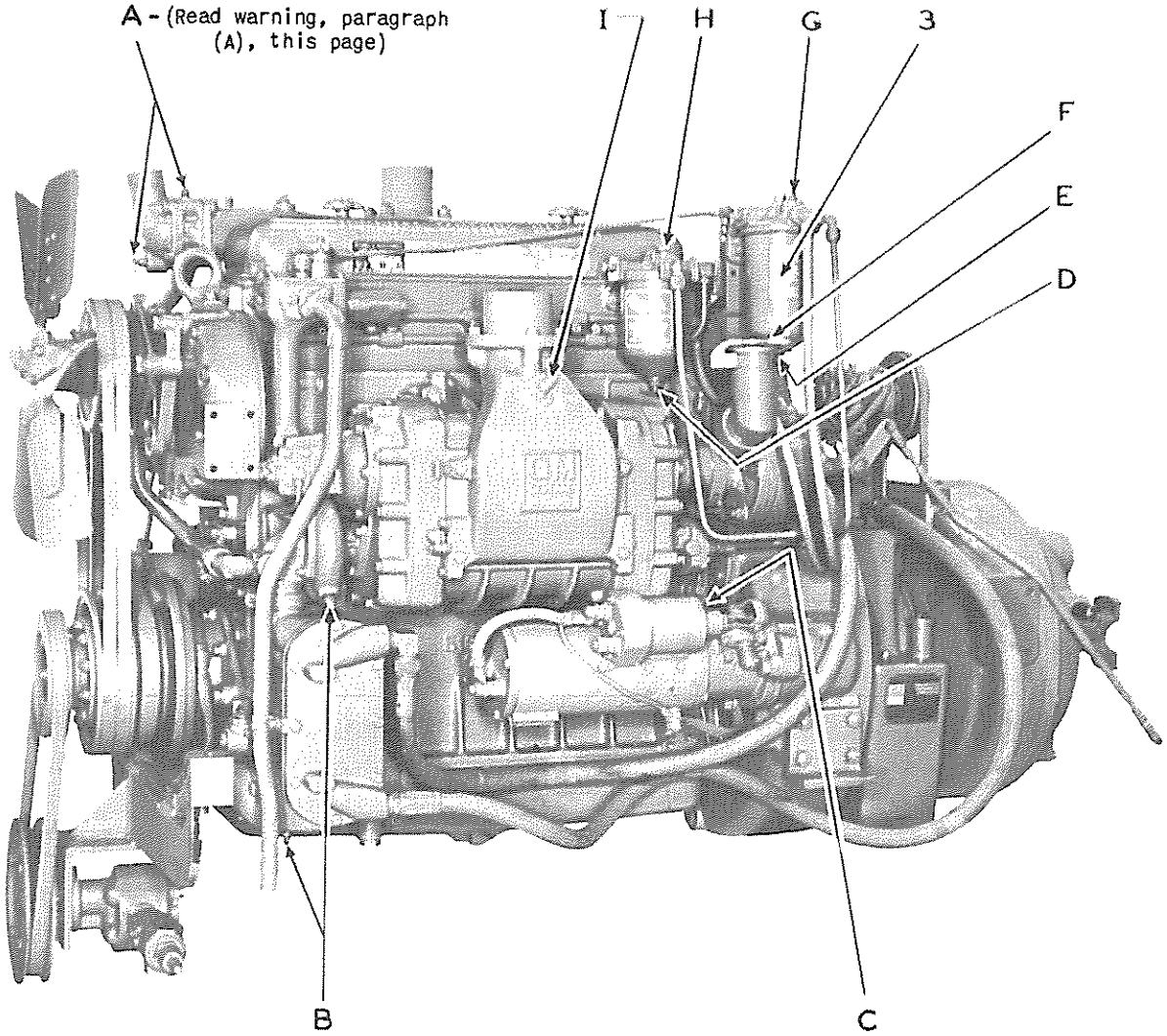
NOTE: Lubricate all grease fittings with general-purpose pressure gun grease ("Lithium" type preferred); two strokes of lubricator every 50 hours of operation. Occasionally hand oil all moving parts not provided with grease fittings.



Snow Wing Hydraulic System (Piping Diagram) and Controls



Rear Mounted Snow Wing



37. BEFORE STARTING GENERAL MOTORS DIESEL ENGINE. (Please read paragraph 60, page 59)

a. Install (or close) cooling system drain cocks or plugs. (See (B) above.) Fill cooling system with soft water to within 2" of overflow outlet. At freezing temperatures, use a non-evaporating type of anti-freeze.

WARNING: Be sure to open points (A) in order to permit air in system to be bled off, otherwise steam pockets will develop, causing the cylinder sleeves and pistons to score and seize due to overheating.

b. Fill crankcase (F) with lubricating oil to "Full" mark on dip stick (C). See page 40 and General Motors Operator's Manual for recommended oils. If engine has not been operated for considerable time, remove valve cover and pour one quart of engine oil over valve mechanism. Fill oil bath type air cleaners to indicated level with clean engine oil.

c. Fill fuel tank with high-speed diesel engine fuel. (See page 41 and General Motors Operator's Manual.) Prime fuel system of secondary fuel filter.

d. Check lubrication of all moving parts of entire engine. (See "Lubrication Chart" in General Motors Operator's Manual.)

38. SELECTION OF "HEAVY-DUTY" LUBRICATING OILS.

Satisfactory long-time operation of Heavy-Duty Engines requires use of specially compounded "Heavy-Duty Lubricants". These superior oils provide better lubrication, possess more heat resistance, and counteract sludge formation more effectively than regular or premium motor oils. Heavy-Duty oils hold foreign matter in suspension and, thus, allow the contaminants to be drained out of the crankcase when the lubricating oil is changed.

Several types of "Heavy-Duty" lubricating oils are provided by the petroleum industry for the varying service requirements of gasoline and diesel engines.

Only "Heavy-Duty" lubricating oils complying with MIL-O-2104 specifications should be employed in engines manufactured by the Detroit Diesel Engine Division.

The recommended lubricating oil viscosity grade when operating under normal conditions, at normal temperatures, is SAE 30. However, when prolonged exposure of the engine to temperatures below freezing is unavoidable, it is permissible to use the following lighter grades in order to facilitate starting.

Atmospheric Temperature	Viscosity Grade
+30° to 0° F.	SAE 20W
0° to -20° F.	SAE 10W

NOTE: FOR COMPLETE COLD STARTING INSTRUCTIONS CONSULT OUR NEAREST AUTHORIZED DISTRIBUTOR OR DEALER

All mineral oils deteriorate in service and it is, therefore, necessary to renew the crankcase content at regular intervals to dispose of the acidic and resinuous materials formed. The frequency of these oil changes depends upon the severity of engine service, the quality of the lubricant, and the efficiency of filtration.

It is recommended that new engines be started with 100 hour oil change periods. The interval may then be gradually increased, following the recommendations of the oil supplier (based on analysis of the drained oil) until the most practical oil change interval has been determined.

TO PREVENT DILUTION OF THE FRESH REFILL OIL SUPPLY FLUSHING OILS OR OTHER SOLVENTS SHOULD NEVER BE USED IN OUR ENGINES!

Heavy-Duty lubricants will always appear dark-colored in use due to their exceptional ability to hold fine carbon particles in suspension. Therefore, the color of the oil can no longer be used as an indicator for proper filter action. The removal of abrasive dust, metal particles, and carbon must be ensured by periodic replacement of the absorption filter elements. OIL FILTER ELEMENTS MUST BE CHANGED AT EVERY OIL CHANGE.

Selection of a reliable oil supplier, strict observation of his oil change period recommendations, and proper filter maintenance will ensure trouble-free lubrication, thus longer engine life for your G.M. Diesel Engine.

NOTE: This entire page is a copy of Service Bulletin issued by General Motors Corporation.

39. SELECTION OF DIESEL FUEL OILS.

The quality of the fuel oil used for high-speed diesel engine operations is a dominating factor for satisfactory engine life. Suitable fuel oils must be clean, completely distilled, well-refined and non-corrosive to fuel system parts.

To permit efficient combustion, the fuel oil selected must meet the volatility and ignition quality requirements of the engine which are governed largely by speed, load and atmospheric temperature. To avoid excessive deposit formation and premature wear, the sulphur content of the fuel oil must be as low as possible.

Distillation range, cetane number and sulphur content are, therefore, the three most important properties of high-speed diesel engine fuel oils.

The large variety of fuel oils marketed for diesel engine use may be divided into four classes with their main properties as listed below in Table 1.

CLASS	DISTILLATION		CETANE NUMBER	SULFUR CONTENT
	90% BOILING POINT (MAX.)	FINAL BOILING POINT (MAX.)	(MIN.)	(MAX.)
	—OR—			
A	550°F	575°F	45	0.25%
B	575°F	625°F	45	0.50%
C	625°F	675°F	40	0.50%
D	675°F	725°F	40	*0.75%

TABLE 1

In view of the large influence exerted upon combustion by the temperature of the intake air, and the various fuel oil requirements for different types of engine operation, the proper class of fuel oil should be selected from Table 2 below.

TYPE OF ENGINE APPLICATION	AMBIENT AIR TEMPERATURE			
	ABOVE +80°F	ABOVE +40°F	ABOVE 0°F	ABOVE —20°F
Industrial Use	C	C	B	A

TABLE 2

----------NOTES----------

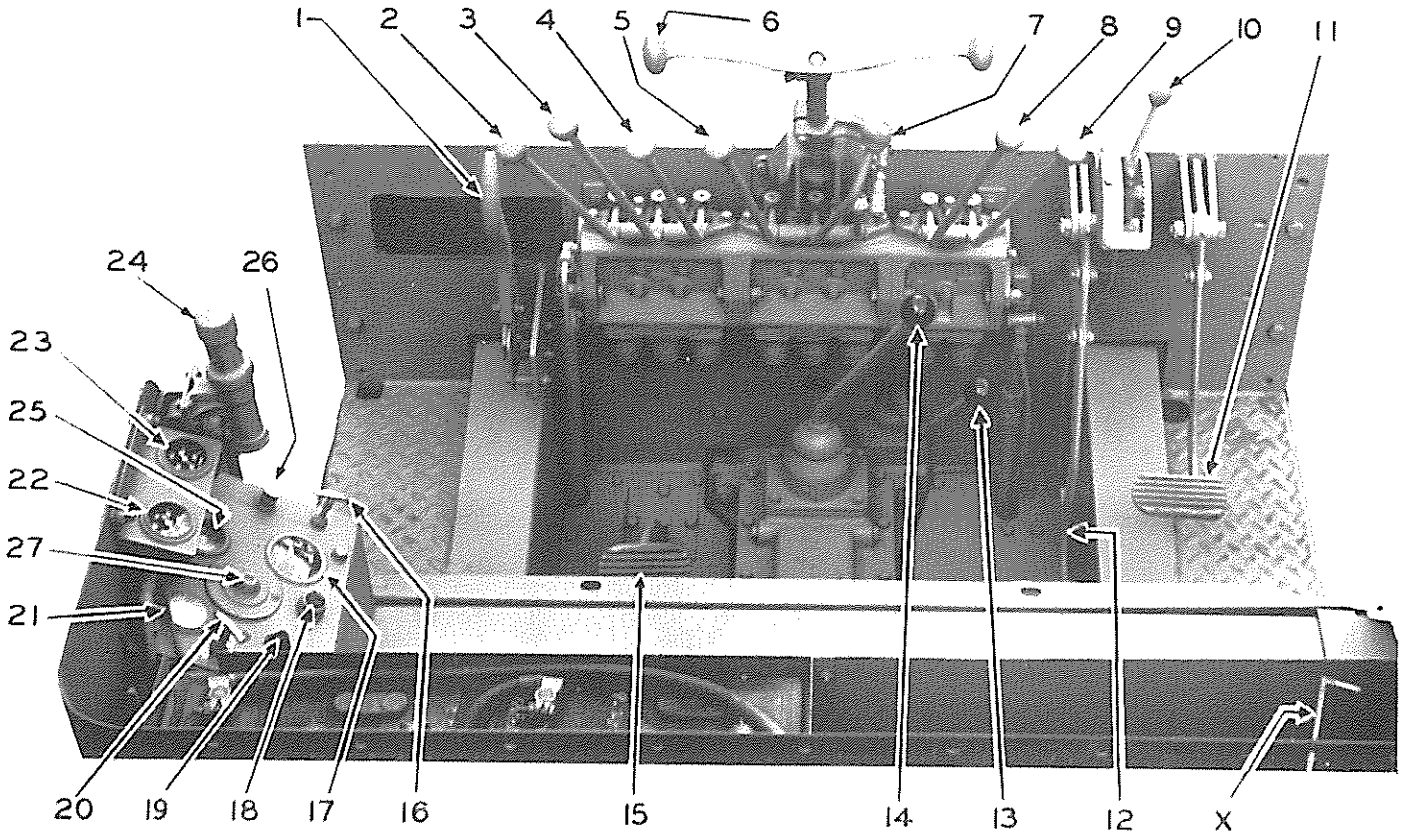
Engine operation at altitudes above 5000 feet requires use of next lighter class of fuel oil.

During cold weather engine operation, the "cloud point" (the temperature at which wax crystals begin to form in the fuel oil) must be below the lowest expected fuel temperature to prevent clogging of the fuel filters by wax crystals.

*Where use of fuel oils with higher sulphur content than 0.5% cannot be avoided, lubricating oils of the "Heavy-Duty" S-1 type should be employed. (See "List of Heavy-Duty Oils" Form 7SE126.)

At temperatures below -20°F consult your nearest G.M. Distributor or Dealer, since particular attention must be given the cooling system, lubricating system, fuel system, electrical system, and cold weather starting aids for efficient engine operation.

NOTE: This entire page is a copy of Service Bulletin issued by General Motors Corporation.



40. INSTRUMENTS AND CONTROLS.

The operator should thoroughly 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
13.	Transfer case gear shift
14.	Transmission gear shift
15.	Clutch pedal

REF.	DESCRIPTION
16.	GM engine fuel shut-off (IHC choke)
17.	Water heat indicator
18.	Horn button
19.	Starter button
20.	GM engine emergency shut-off control
21.	Engine oil pressure indicator
22.	Converter oil pressure gauge
23.	Converter oil temperature gauge
24.	Chevron starting capsule chamber
25.	Ammeter
26.	Chevron starting primer
27.	Light switch

41. STARTING THE ENGINE.

a. Place transmission shifting lever (14), page 42, in disengaged or neutral position.

b. The diesel fuel line from the supply tank to primary filter (3), page 39, is equipped with a shut-off valve located under fuel tank. Item (13), page 44. Make sure this valve is open.

c. After the operator has checked over the engine and accessories and top vented and filled the fuel filters (G) and (H), page 39, place the engine speed control lever (10), page 42, in one fourth open position of the notched quadrant. (Pull lever back.)

. Next press down on clutch pedal (15) then the starter button (19). The engine should start in about 3 seconds if engine is warm. Never operate the starting motor more than five seconds at a time. Allow starting motor to cool one minute and repeat the starting operation.

d. At air temperatures below 40° F., starting of this engine requires use of a cold starting aid consisting of a starting fluid primer. (Drain the transmission and refill it with an oil that flows readily at temperatures encountered.) The photo on page 42 shows the location of the "Chevron" starting chamber (24) and hand primer (26). To operate this starting expedient proceed as follows:

(1) Unscrew (counter-clockwise) upper chamber cap of puncturing tool (24). Place one or two capsules of fluid (large or small, depending upon requirements established by trial) in the chamber. Screw (clockwise) upper chamber cup tightly onto the lower chamber. Adjust engine throttle lever (10) to starting position. Push puncturing plunger to bottom, thus puncturing capsule(s) and releasing fluid. Unlock primer plunger (26) by turning counter-clockwise. Simultaneously crank engine (starting button (19)) and pump primer plunger (26) until engine starts. Continue to pump primer plunger until engine runs normally on regular fuel and until all fluid in entire applicator is injected into engine.

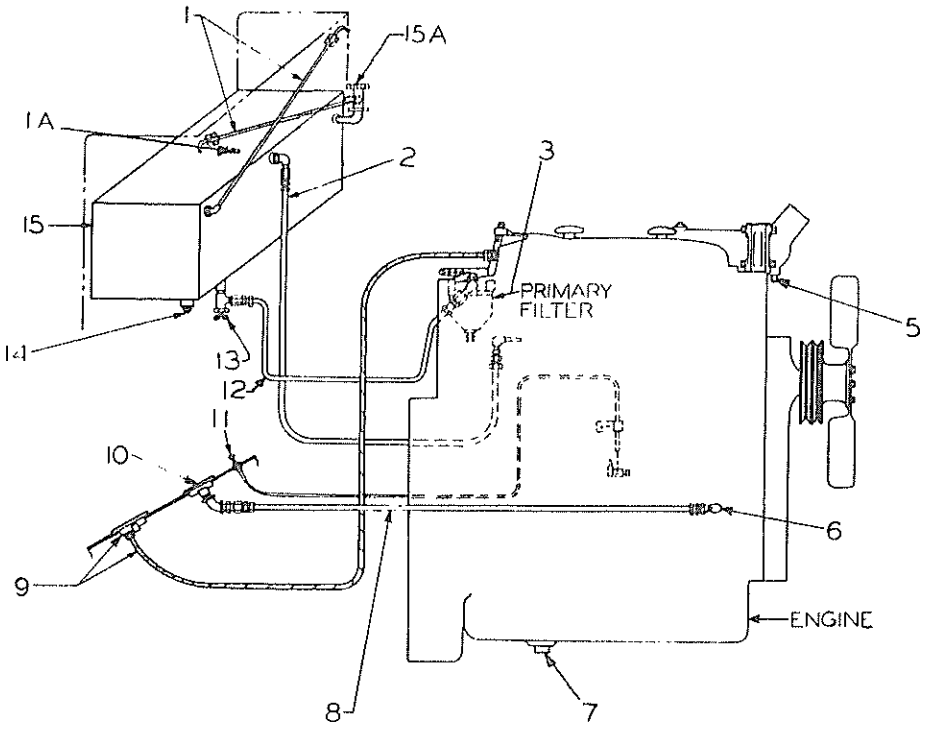
(2) Relock primer plunger (26). Again unscrew upper chamber cap of puncturing tool (24). Remove and discard empty capsule(s), observing precautions against fire and toxic hazards and cutting hand on barbs near bottom end of puncturing plunger. Again screw upper chamber cap (24) tightly into lower chamber. Occasionally remove the lower screen, located inside the chamber, and carefully clean out all broken pieces of capsules. Also remove the fitting which screws into the intake manifold (I), page 39, and clean the small nozzle hole. Clogged nozzles, pipes, or base will prevent fuel from flowing into the intake manifold and result in hard starting.

PRECAUTIONS: Chevron starting fluid is highly inflammable, explosive, and toxic. Gelatine capsules dissolve in water and soften at high temperatures. Puncturing plunger carries barbs near bottom to help retract empty capsules from lower chamber. Therefore safe handling of fluid, capsules and plunger requires extreme caution in avoiding: Proximity of fluid capsules to open flame, sparks or hot surfaces. Spillage or leakage of fluid. Breathing of fumes from fluid. Contact of capsules with water. Subjection of capsules to high ambient temperatures (about 120° F.). Cutting of hand by barbs on puncturing plunger. "Chevron Starting Capsules" may be procured from your fuel oil supplier. These capsules are made by the California Oil Company, Barber, New Jersey, and sold under the trade name "Chevron Starting Capsules".

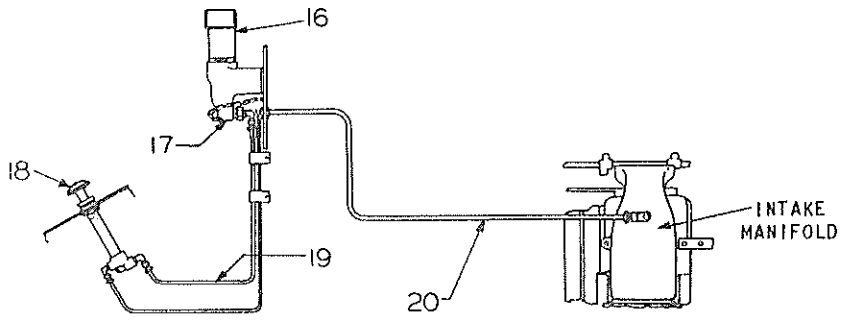
e. After the engine has started, check the oil pressure gauge. It should register approximately 50 pounds in 5 seconds time. If the engine is cold, the oil may be thick and viscous and will probably show a high pressure on the gauge for the first minutes of operation.

Operate the engine at minimum speed until the water temperature gauge starts to move.

Desirable cooling water temperature: 160-185° F. Check engine coolant level. AVoid prolonged engine idling. Keep air box drain lines open. See number (19), page 2A, and (2), page 2C.



Fuel and Oil Lines



Ether Starting System

REF.	*DESCRIPTION*
1.	Tank air vent pipes
1A.	Fuel tank measuring plug
2.	Fuel return line to tank
3.	Primary fuel oil filter
5.	Water thermostat drain plug
6.	Engine oil gallery pressure fitting
7.	Engine crankcase pan drain plug
8.	Oil gauge hose
9.	Water temperature indicator
10.	Oil pressure indicator
11.	Engine emergency shut-off control
12.	Diesel oil main fuel line to filter
13.	Fuel tank needle valve
14.	Fuel tank drain plug
15.	Diesel fuel tank
15A.	Filler tube cap with gasket
16.	Chevron ether starting capsule chamber
17.	Chevron chamber clean-out screen
18.	Chevron ether starting primer
19.	Chamber to primer ether line
20.	Primer to manifold ether line

NOTE: See Repair Parts Catalog for repair part numbers and full description of all items shown on this page

Fuel System for GM 71 Series Engine

f. Engine Fails to Start at Temperatures Above Freezing (32° F.).

(1) Throttle not in starting position, improperly adjusted, or emergency shut-off control button not pushed down. CORRECTION: Check adjustment and open throttle. (See General Motors Operator's Manual.)

(2) Fuel tank empty. Fuel supply valve closed. Fuel supply insufficient. CORRECTION: Check for choked fuel oil filter elements as follows:

(a) Disconnect fuel return line near arrow (2), page 44, and place exposed end of hose into a suitable can. Then run engine at approximately 1200 R.P.M. and measure fuel being returned from fuel return manifold. At 1200 engine R.P.M. the return should be approximately 1/2 gallon per minute at 15 pounds gauge pressure.

(b) When checking flow, observe if air is being pumped through the fuel system which will be indicated by air bubbles mixed with the fuel and will appear as foam on the fuel. If air is present, correct this condition by tightening all fuel connections on suction side of fuel pump.

(c) Check for dirt or chips in fuel lines. Check for choked injector filters. See if fuel pump is working properly. (Consult the General Motors Operator's Manual for further assistance.)

42. STOPPING THE ENGINE.

The engine should idle for at least five minutes before being stopped, the idling being necessary so the engine may cool off gradually and uniformly.

When an engine is running under load there are parts of it that will be hot, particularly the top of piston and bottom of the cylinder head.

Stopping suddenly without allowing the engine to cool will cause the water close to these hot spots to boil, creating steam with probable distortion of engine parts.

After the engine has been idled a sufficient length of time, push speed control lever (10), page 42, forward. (If engine does not stop, pull up on the engine emergency stop control (20), page 42, and hold it there until the engine is completely stopped.)

43. BEFORE STARTING THE DAYS OPERATION. (Every 8 hours of operation)

a. Check the oil level with the bayonet gauge (C), page 39, in the crankcase. Stop the engine and let it stand for at least five minutes, before reading the oil level, as shown on the bayonet gauge.

b. Check air cleaner and see that all joints and connections are air tight. Clean the oil cup and refill with fresh oil, the same weight as used in the crankcase.

In very dusty conditions, this may be necessary every two or three hours to clean the cup and refill with fresh oil.

c. Check radiator (read paragraph (a), page 39). Refill with fresh clean water or suitable anti-freeze to within 2" of top. If water with high mineral content is all that is available, add a neutralizing agent as shown in the General Motors Operator's Manual.

Check the fins and passages between the tubes of the radiator and make sure that they are free from any foreign substance that the fan may have drawn in.

d. Check the fan belt tension. See that the belt slack is 3/4" to 1". (See page 72 as example for checking.)

e. Make a visual inspection for loose connections, loose nuts, bolts, cap screws and oil and fuel lines.

f. Check fuel oil supply.

g. Every 50 hours: Drain small quantity of fuel from both fuel oil filters, (see (D) and (E), page 39), to remove water and sediment.

44. AFTER EVERY 100 HOURS OF OPERATION.

a. Change the oil in crankcase with the recommended oil (see page 40).

Change oil filter elements (see page 47, paragraph 47).

Drain the old oil out of the crankcase while the engine is hot.

b. Apply a few drops of oil along the surface of the flexible tube for the emergency stop control and with the fingers flex the tubing a little to allow the oil to penetrate through the wire.

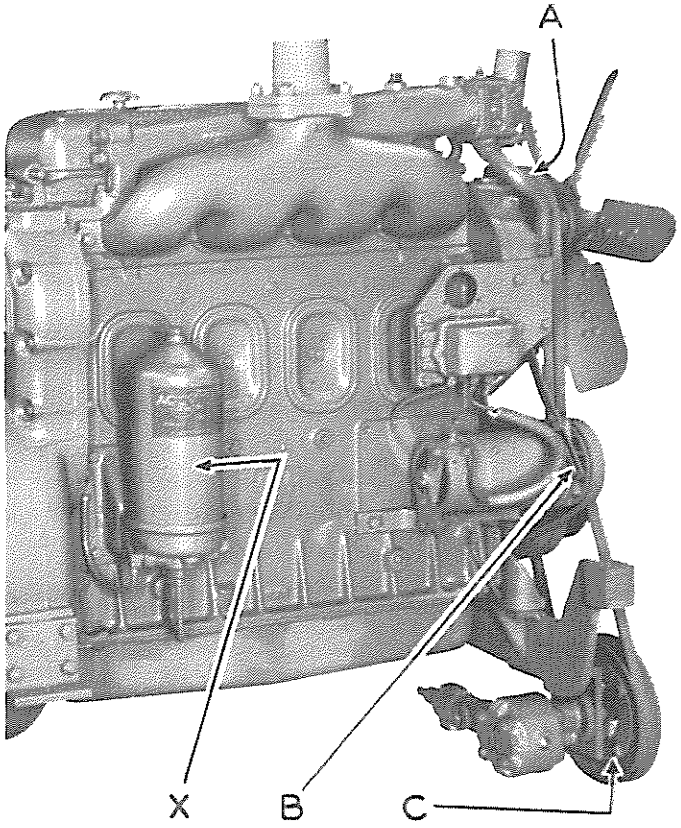
c. Clean air cleaner top tube and element by washing in fuel oil.

d. Drain one fourth pint of fuel oil out of cocks (D) and (E), page 39.

e. Oil generator and the starting motor with a few drops of engine oil.

Do not oil excessively.

Check the water level of the batteries.



In freezing weather, do not add water to batteries after shutting down operation.

Add water at the start of operation to avoid freezing.

f. Engine Tune-up.

(1) After first 100 hours and every 500 hours thereafter, check valve lash and readjust to .009" hot.

(2) Check injector timing, adjust governor if necessary and check injector rack position.

Consult General Motors Operator's Manual for performing engine tune-up adjustments.

45. AFTER EVERY 500 HOURS OF OPERATION.

a. Replace secondary fuel oil filter element. (See (H), page 39.)

b. Replace primary fuel oil strainer. (See (G), page 39.)

c. Drain water and sediment from fuel oil tank.

d. Check fan, generator, and hydraulic pump belt tension. (See photo at left.)

(1) To tighten fan belts, loosen the two cap screws (A), then move slotted bracket upward until belts have about 3/4" total movement at one side.

(2) To tighten generator belt loosen cap screw at (B), then move generator outward, until belt has about 3/4" total movement at one side.

(3) To tighten hydraulic pump belt, remove four cap screws (C), and front pulley flange.

Then remove shims as required at center of flanges.

Then reinstall outer flange and cap screws (C). Belt deflection should be not more than 1/2" total movement at one side.

46. AFTER EVERY 1000 HOURS OF OPERATION.

a. Clean the outside of the engine by washing with kerosene, distillate, or a grease solvent. If the dirt is thick, allow to soak for ten minutes, then wash off the dirt with hose and water.

b. Remove the oil pan, wash out any sludge and clean the oil pump suction screen. Inspect the inside of the engine. Check the oil suction screen for tightness.

c. Flush the radiator with standard flushing compound. (Read paragraph (a), page 39.)

d. Inspect the battery cables and all electric wiring. Replace frayed, worn, or oil soaked wires with new ones of the same dimensions.

e. Consult General Motors Operator's Manual for further instructions relative to "Preventive Maintenance".

47. LUBRICATING OIL FILTER.

The life of this 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 filter 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. Changing Oil Filter Elements. (100 hour intervals)

(1) Stop the engine.

(2) Remove the oil filter base drain plugs and allow the filter to drain completely. (See (X) on photo, page 46.)

Clean off the filter case to prevent dirt dropping into the base.

Unscrew and remove the filter top, or cover.

Remove the old element.

Wipe out the base and case with a cloth dampened with kerosene.

See that the case gasket is in position.

Install the drain plug or cap in the filter base, and install the new filter element.

Replace the filter top carefully. Draw it up tight.

> CAUTION: Do not drive or force the retaining bar through the oil filter, but carefully screw the bar through the filter and into the base threads. Before tightening the retaining bar, the top should be turned slightly on the gasket to assist in properly seating the top; then tighten the retaining bar securely.

(3) Check the oil level at (C), page 39, in the crankcase to see that the oil is up to the proper level. Refer to "Lubrication Specifications" on page 40.

(4) Start the engine and see that the oil pressure indicator is registering pressure. (See page 4A for pressures.)

(5) Inspect the filter for oil leaks.

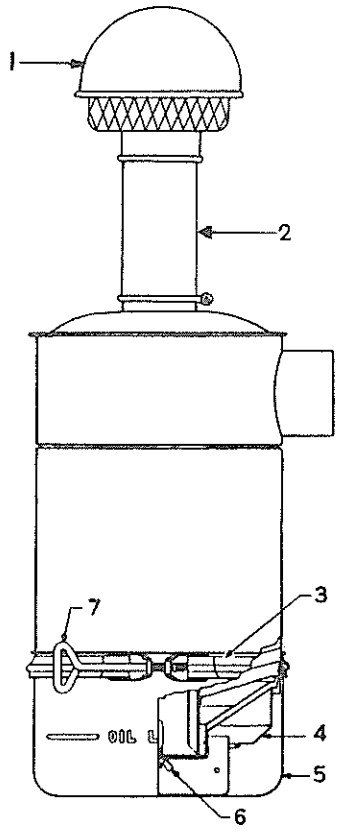
NOTE: To avoid delays, you should carry extra elements (also gaskets) on hand for replacement at the proper time. Cleaning the old elements is not satisfactory.

Consult General Motors Operator's Manual for further information.

48. 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 Specifications" on page 40.

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.



49. 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 passes to the oil cup (5), where it goes through a bath of oil. As the air rises to the intake manifold it passes through 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 (5).

b. Refilling Oil Cup (Daily).

Loosen clamp screw (7) and remove the cup (5). Remove the two wing nuts (6) and lower the tray (4) for cleaning purposes.

Clean and completely refill the oil cup every day, or after every eight hours of operation (every two or three hours when operating under dusty conditions). Refill the oil cup (5) to the oil level bead with the grade of oil specified on page 40. (Fill the inner cup also.)

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 40 hours of operation, particularly if the air is heavily laden with dust, chaff, or lint, remove the entire air cleaner from the engine, completely disassemble it and wash the parts thoroughly in kerosene.

Be sure to clean out the air intake pipe.

After all the parts have been thoroughly cleaned, replace the air cleaner body on the power unit. Make sure all joints are air-tight and pipes lined up.

Replace the air intake cap.

Completely 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 (3).

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 checked every 40 hours and 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 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.

> CAUTION: Failure to service the air cleaner as explained in paragraphs (b), (c) and (d), will result in dust entering the engine, causing rapid premature wear to the internal engine parts, such as piston and sleeve groups, also valves and crank shaft assembly. The costs are borne by the owner, including labor parts installation.

50. 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 mechanic 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 a qualified electrical mechanic do the actual work, as he 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 one battery 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.

b. Specifications.

The wiring diagram of this 12 volt wiring system is shown on page 50.

The "Positive" side of the batteries is grounded at the starter.

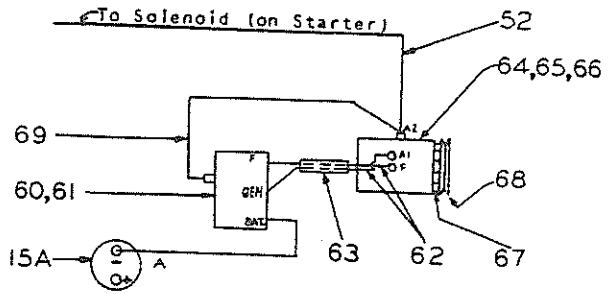
The starter is solenoid operated, with starter switch button located at the operator's position (see (19), page 42).

The standard generator, with standard regulator, is 12 volt, 375 watt capacity. Also see General Motors Operator's Manual for further general instructions.

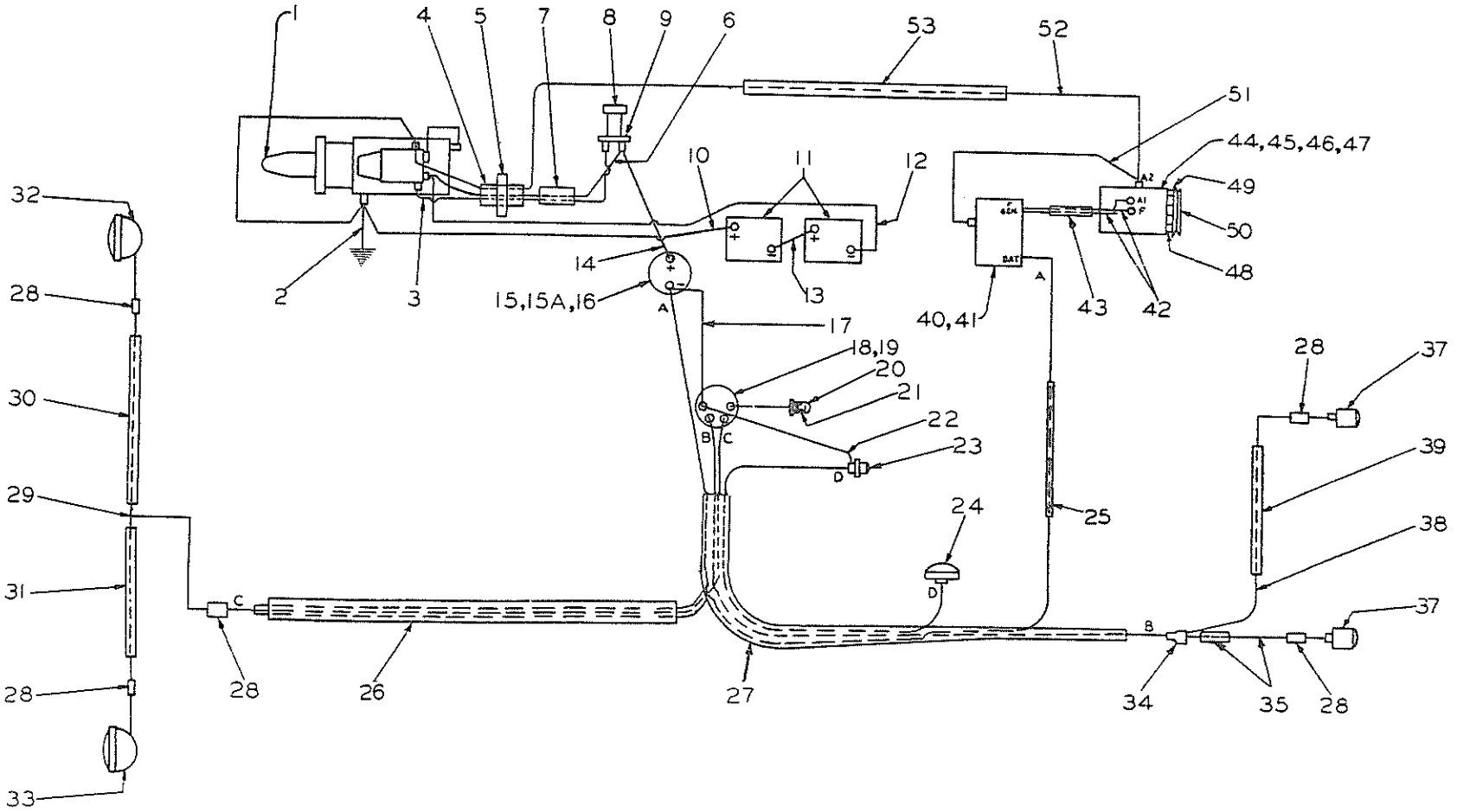
Extra heavy duty generator equipment is available where additional load is placed on the electrical system. Consult Parts Catalog for information.

For accessory wiring diagram, see page 51 of this manual.

NOTE: See Repair Parts Catalog for repair part numbers and full description of all items shown on the page. For other electrical accessories for GM4-71 engine, see page 51.

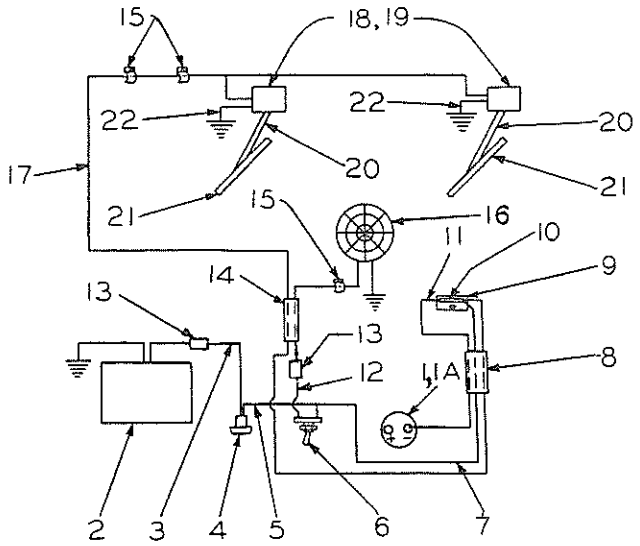


Wiring for Extra Heavy Duty Generator

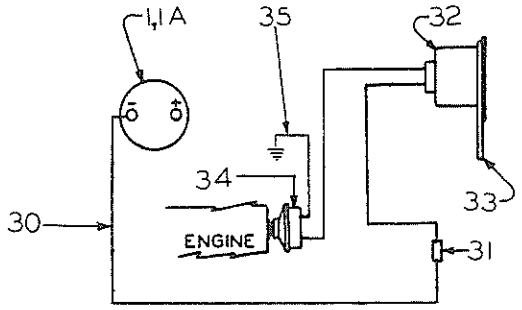


Wiring Diagram for GM4-71 Engine

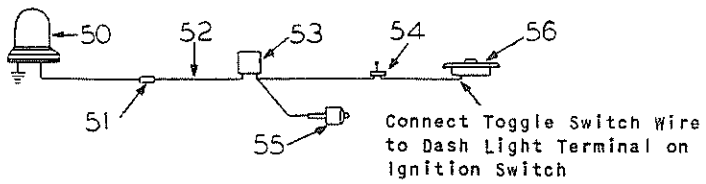
NOTE: See Repair Parts Catalog for repair part numbers and full description of all items shown on this page.



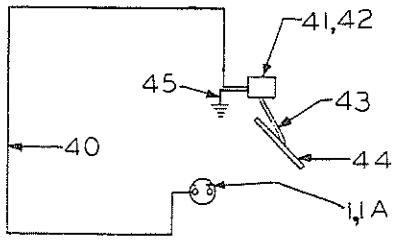
Wiring for Heater and Defroster; also Dual Windshield Wipers



Wiring for Hourmeter



Wiring for Flasher Warning Light



Wiring for Rear Window Wiper

Accessory Wiring Diagram
(for GM4-71 Engine)

51. STORAGE BATTERIES.
(Located Back of Operator's Seat)

a. New storage batteries should be registered with the nearest battery service station.

b. The batteries store the current produced by the generator and energize the starting motor and the electrical controls that are part of the electrical system. See that the batteries are kept fully charged. In extreme cold weather, the terminal voltage of a battery drops as much as 30%, and it is sometimes advisable for quick starting to connect an additional six volt battery in series. The additional battery should be removed as soon as engine is started. Connect the batteries to the unit. See Wiring Diagram, page 50. On initial start be sure to polarize generator.

Check the electrical connections on the ammeter, starting motor, starting switch, generator, and voltage regulator.

Keep all battery terminals clean and tight. Loose connections cause the voltage regulator to chatter, which may result in early failure of the regulator. If terminals show a tendency to corrode, clean and apply a thin coat of vaseline. Keep the outside of the battery clean. Neutralize any electrolyte on the surfaces with a cloth saturated with ammonia or bicarbonate of soda (one pound of soda to one gallon of water), then wash off and dry.

c. Vent Holes. Keep vent holes in battery filler caps open.

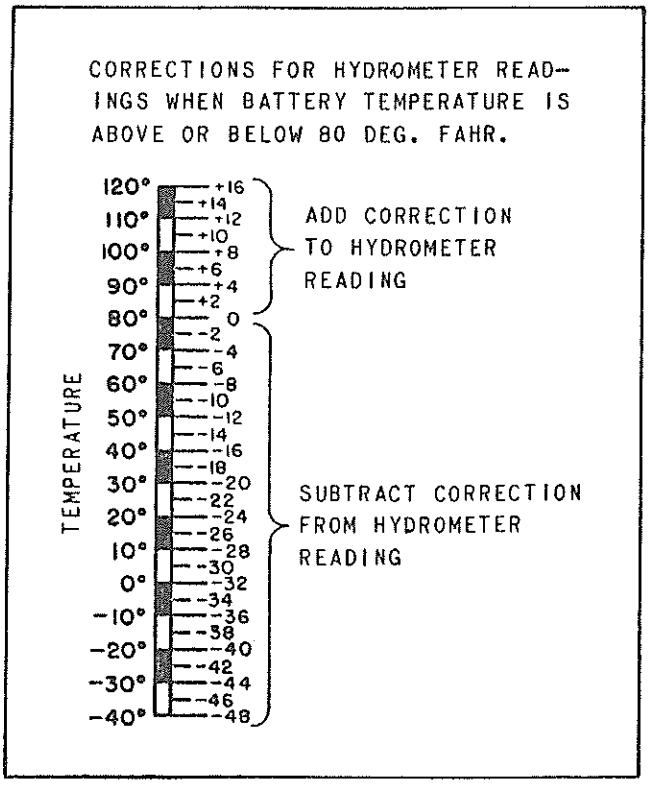
d. Electrolyte Level. The electrolyte in each cell should be 3/8" above the separators. Keep the electrolyte up to this level at all times to prevent battery failure. When the electrolyte falls below this level, pure distilled water should be added. Never use hydrant water or any water which has been 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.

e. Specific Gravity of Electrolyte. 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.

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).

If the specific gravity of the electrolyte is less than the required figure in the chart, the generator charging rate should be increased, or the battery should be recharged with standard auxiliary battery recharger.



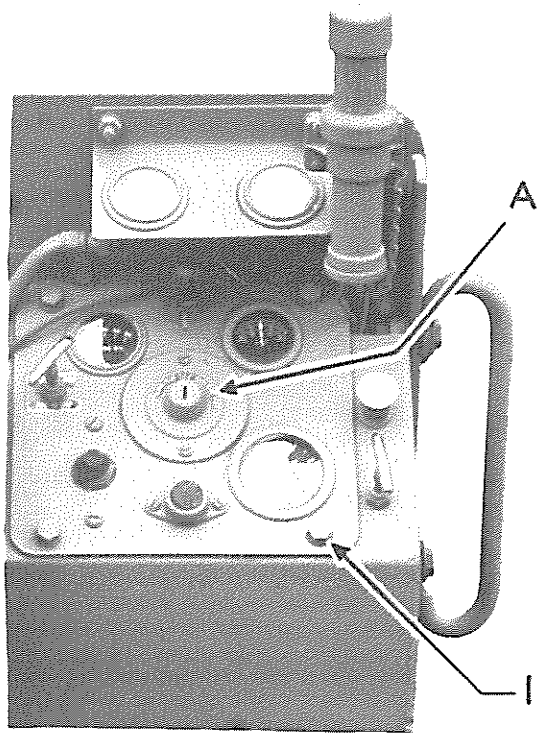
Hydrometer Reading Correction Chart

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.

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.

All cells should show approximately the same specific gravity reading. Wide variation indicates something wrong. See your nearest battery service station.

f. 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.



52. INSTRUMENT PANEL.

To replace the 15 amp. fuse under switch (A), shown on photo above, remove the four cap screws (1), after which the panel may be lifted up and tipped over, exposing the fuse block. Access to underside of instrument panel may also be accomplished through removable panel on outside of cab wrapper sheet.

53. 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 the by-pass type prevents circulation to the radiator and allows the coolant to circulate only through the cylinder head and around the cylinders of the engine. When an efficient operating temperature has been reached, the thermostat is wide open and the by-pass is closed, allowing the coolant to circulate through the engine block, cylinder head, and radiator.

b. Rust Prevention.

Suitable treatment of the water for corrosion prevention will reduce rusting 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 through 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 thoroughly 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 drain in the bottom of the radiator. Allow the system to drain.

Close the drain. Fill the cooling system with a solution of two pounds of ordinary baking soda mixed with sufficient water to fill system. Following directions in paragraph (a), page 39.

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 drain in the bottom of the radiator.

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 operation conditions. Soft, or rain water is recommended as it does not contain minerals which form scale and eventually clog the passages. (See paragraph (a), page 39.)

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.

54. EXTREME HEAT OPERATION.

The engine will operate satisfactorily in extreme temperatures without additional adjustments.

a. Lubrication.

Particular care should be given to the engine crankcase to see that it is kept to proper level with lubricants of correct grade, shown on page 40.

b. Fuel System.

Keep the diesel fuel tank well filled to avoid condensation of moisture within the tanks. Be sure the vents at the fuel tank are open and the cap is on tight.

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. Keep radiator filled with clean, soft, fresh water. Radiator fins must be kept free of accumulated dirt, leaves, insects, etc. Remove the hood sides to assist in better ventilation at the radiator core fins. When operating in extreme dust conditions, check the air cleaner as often as necessary to insure against accumulation of dirt. Keep oil cup, upper elements, and upper tube clean.

(Please read complete instructions shown on pages 48 and 49, under "Air Cleaner".)

55. COLD WEATHER OPERATION.

If the engine is to be operated in temperatures of 22° F. or lower, observe the following precautions:

a. Lubrication.

Be sure to use the correct grade of oil in the engine crankcase as shown on page 40.

b. Fuel System.

(1) Fill the diesel fuel tank at the end of the day's operation to avoid condensation of moisture in the tank. (See page 41.)

First and second stage fuel filters (G) and (H), page 39, should be checked and elements replaced at start of winter season. Suction lines from fuel tank to filter should be checked for air leaks. Low pressure fuel lines should be checked and replaced if there are any signs of deterioration or cracks.

(2) Only highest grade fuel oil (see page 41) for winter operation should be specified when ordering, and a definite check should be made that the specified fuel oil is being delivered. Fill the fuel tank at end of the day's operation, to prevent moisture from collecting in the tank. A quantity of fuel should be drained from the fuel supply tank and if there is any rust or corrosion, the tank should be drained completely and flushed. Fuel storage tanks should be checked for possible rust or corrosion and if necessary, a filter installed on the outlet connection.

c. 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. In extreme cold weather the terminal voltage of a battery drops as much as 30% and it is sometimes advisable for quick starting to connect an additional six volt battery in series. The additional battery should be removed as soon as the engine is started.

d. Cooling System.
(See page 4A for capacities)

(1) Keep the radiator filled with a good anti-freeze mixture ("Ethylene Glycol"), or if the system is drained nightly, the introduction of warm water added slowly will facilitate starting. (See paragraph (a), page 39.)

(2) When operating temperature is 32° F., (0° C.) or lower, there is danger of the water freezing in the cooling system. To overcome this condition use one of the recommended anti-freeze solutions.

Before filling the cooling system with anti-freeze, drain and clean the system as described on page 53, paragraph 53. Refill system following instructions in paragraph (a), page 39, 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 drain at the bottom of the radiator and points (A) and (B), page 39. Remove the radiator filler cap. See that the drain is not plugged and that the water drains out completely. Anti-freeze solutions. Never mix anti-freeze solutions, as it will be difficult to determine how much protection against freezing the solution has.

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

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. Replenish solution when necessary at your responsibility.

(4) IF NO ANTI-FREEZE IS AVAILABLE drain the cooling system completely after operation. Before refilling (read paragraph (a), page 39), cover the radiator completely, start the engine, and fill the system immediately with water. This will prevent the raidator from freezing during the warm-up period.

56. OPERATING PRECAUTIONS.

a. SAFETY FIRST! Never fill the fuel tank when near an open flame or when the engine is operating. When pouring in the fuel keep the funnel and container in contact with the metal of the tank to avoid the possibility of an electric spark igniting the fuel. Never light matches near the tank vent, as the air within several feet is permeated with a highly explosive vapor.

b. Never operate the engine under load until it is thoroughly warmed up.

The engine speed control lever should be adjusted to suit the load to be handled. Refrain from slipping the tires.

Never operate the engine at more than the no load engine speed. Excessive speeds are harmful.

Operate a new engine with a light load for the first thirty to thirty-six hours at about three-quarter throttle.

c. The fuel tank is provided with air vent tubes. These vents should be kept open to assure a proper flow of the fuel.

d. Immediately after the engine starts, check the oil pressure indicator to see if it is registering the proper pressure (see page 4A, for proper oil pressure). If it is not, stop the engine and inspect the oil system to find the cause of failure.

e. Check the tension of the fan belt. Tension is correct when the belt can be depressed by your thumb 3/4" midway between the pulleys. If belt tension is not correct, adjust as outlined on page 46, paragraph 45D.

For the most efficient operation, the heat indicator needle should be near 180° F.

f. Be sure to clean the air cleaner and to replace the lubricating and fuel oil filter elements at regular intervals.

g. Never operate the starting motor more than five seconds at a time. Allow the starting motor to cool a few seconds and repeat the starting operation.

h. Never pour cold water into the radiator if the engine is very hot. Stop the engine for 30 minutes, then restart it and let it idle while slowly pouring the water into the radiator.

57. STORAGE INSTRUCTIONS.

a. Preparing Engine for Storage.

When engine is to be idle for a period of time it should be stored in a dry and protected place. To leave equipment outdoors, exposed to the elements, will result in materially shortening its life.

The following procedure should be followed when the engine is placed in storage for sixty days or more. Lubrication instructions should be repeated every six months thereafter. If these precautions are not taken, there is great danger that the engine, pump, and nozzle parts will be seriously damaged by corrosion and gumming. Such damage can be very expensive and far outweigh the inconvenience and negligible expense of the protecting measures advocated.

(1) The crankshaft must be turned several revolutions every 30 days. This redistributes the oil over the internal and highly finished parts of the engine and fuel injection pump apparatus.

(2) After protecting electrical parts, wash, steam, or otherwise thoroughly clean away all dirt, grease, etc. from all external parts of the engine, and housing. Drain the motor crankcase and oil filters and refill to proper level with specified clean lubricating oil. Drain the fuel tank (15), page 44.

Drain the fuel filters. Secure a gallon can having screw top. Solder into the bottom of the can a suitable shut-off valve and connection. The suction hose (12), page 44, is to be attached to the bottom fitting of the can. Fill the can with a high quality rust preventing flushing oil. In emergencies, a flushing oil mixture of one-half kerosene and one-half good grade of light engine lubricating oil may be used.

The properties of these oils which render them useful for this type of application are:

Good Aging Stability. High resistance to gumming, oxidation, and polymerization.

Low Pour Point and Viscosity. Freedom from acids, asphalts, resins, tar, and water.

(3) Open shut-off valve at fuel can. (Remove cap from can.) Fill fuel oil filters (G) and (H), bleeding air from same. (See page 39.)

(4) Start and run the engine (at about 1/4th throttle) on the oil in the gallon can. Running the engine in this way will clean the pump together with lines and nozzles of diesel fuel oil. Whatever oil isn't burned by the engine will be by-passed into the main fuel tank and may later be drained.

Stop the engine just before the gallon can is empty. This is necessary in order that the fuel pump, together with fuel filter and lines, will be full of the clean oil while the engine is in storage.

(5) Drain and flush entire cooling system. All drains should be opened so that water or other cooling fluids will not be trapped in the system.

(6) Loosen belt tension and wrap in paper.

(7) Partially disengage clutch and block the foot lever so clutch cannot accidentally be engaged. Clutch plates may stick if allowed to remain in engaged position.

(8) Remove battery and store in a warm, dry place. A battery quickly loses its charge standing idle; consequently, it must be checked and recharged every three to four weeks.

(9) Coat every exposed or polished metal surface with a generous amount of grease or other rust preventive.

(10) Seal every entrance to engine (exhaust pipe, air filter) carefully to prevent entrance of moisture.

b. Removing Engine from Storage.

(1) Remove the protecting covers and seals covering all entrances to the engine (exhaust pipe, air filter).

(2) Fill the fuel tank with clean fuel of the proper specifications (see page 41), making sure the fuel reaches the filters (G) and (H), page 39.

(3) Remove the paper from between the belts and pulleys and adjust the tension.

(4) Drain the crankcase and refill with oil of the proper viscosity. (Page 41.)

If the engine is to be operated in temperatures of 32° F. and above, refill with clean, fresh, soft water. Follow instructions outlined in paragraph (a), page 39. If the engine is to be operated in temperatures below those indicated, anti-freeze cooling solution will be required. Check to be sure full quantity is present.

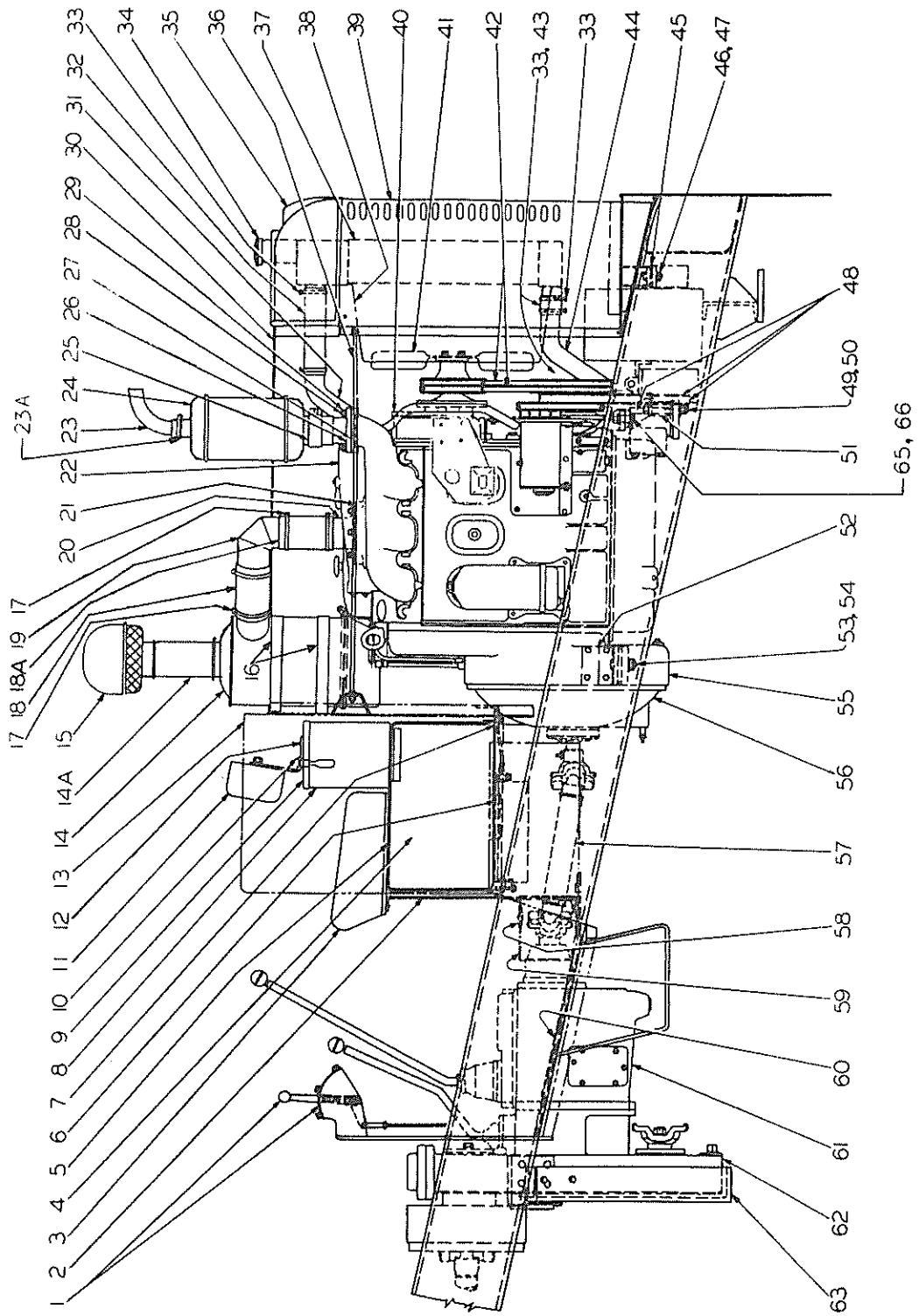
(5) Loosen air intake at top of intake manifold and pour about two tablespoons of lubricating oil into manifold.

(6) Install fully charged batteries. Be sure the proper connections are made.

(7) Crank the engine. This will relubricate the piston groups and crankshaft bearings.

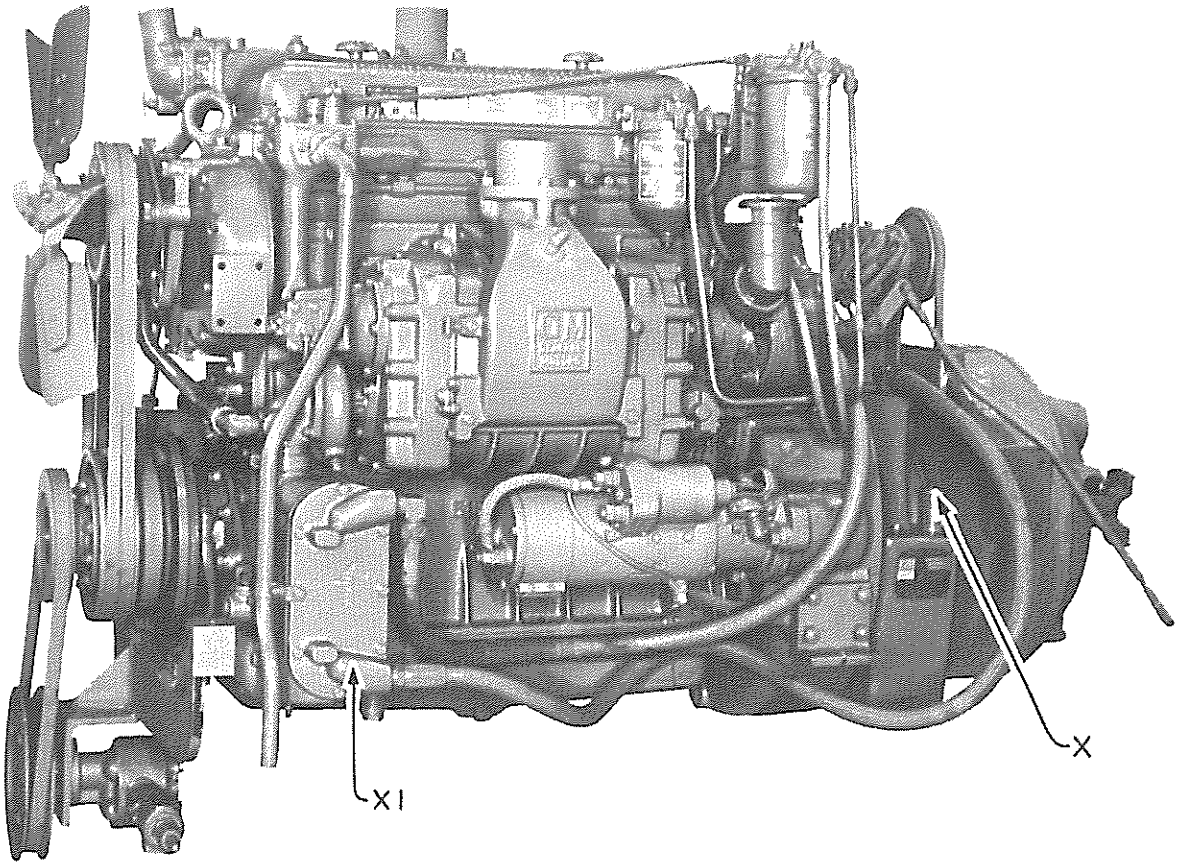
(8) Start engine and let it run slowly. (Follow instructions shown on page 43.) Observe if any intake or exhaust valves or rocker arms, are sticking or not being oiled. If so, pour several quarts of oil over the valve stems. Watch particularly for overheating of the engine, excessive vibration, or any unusual noises that may indicate something is wrong.

CAUTION: Do not accelerate the engine rapidly or operate at high speed immediately after starting.



NOTE: This drawing can be used as a guide for general arrangement applying to GM 71 series diesel engines

59. GENERAL MOTORS 71 SERIES DIESEL ENGINE (DRY CLUTCH) AND DRIVE.



Allison Torque Converter Assembled to GM4-71 Engine

60. ALLISON TORQUE CONVERTER.

In-warranty and out-of-warranty field service for the GM engines and Allison torque converters is rendered by the GM Servicing Dealer nearest you.

The Austin-Western dealer nearest you will be pleased to be of assistance to you in securing maximum life expectancy from these units. (Always consult the Allison Converter Service Manual and GM Operator's Manual packed in the tool box and shipped with the grader.)

1. Simple Maintenance.

Because the converter has only four major moving parts which are running in oil, the job of maintaining the converter is relatively simple. The oil level should be checked daily and an eye kept open for oil leaks.

2. Checking Oil Level.

How To Check Oil Level. The oil level must be checked while the converter is operating, engine idling. Withdraw the dip stick (X) shown above, wipe it off, then insert it, making certain it is "bottomed". Pull it out and check the reading. If the oil is at, or below, the add mark, bring the oil level up to the "full" mark. Do not overfill the converter, for too much oil will cause foaming and high oil temperature.

3. When To Change Oil. Oil must be changed every 500 hours of operation (or whenever oil shows traces of dirt caused by the effect of high operating temperatures.)

4. Type of Oil. (Please also read next item 4A.) For Allison converters having the external by-pass valve converters under serial #8072) is Stanotorque Converter Fluid, made by Standard Oil Co. of Indiana. The alternate suppliers are: Torque Fluid #35, made by Esso; Texaco Torque Fluid, made by Texas Company; Torque Fluid #4, made by Cities Service; RPM Torque Fluid #3, made by Standard Oil of California.

4A. Type of Oil. For Allison converters serial #8073 and up, having the internal by-pass valve, use the following oils.

For +10° F. and higher - Use hydraulic transmission fluid, Type C, where available, or MIL-L-2104A, some of which are shown in chart.

Trade Name	Marketer
Carter Heavy Duty Motor Oil SAE-10W	The Carter Oil Co.
Conoco Hyd. Transmission Fluid, Type C	Continental Oil Co.
Delvac Oil 910	Socony Mobil Oil Co.
RPM Transmission Fluid C	The California Co.
RPM Transmission Fluid C	The California Oil Co.
RPM Transmission Fluid C	Standard Oil Co. of Texas
RPM Transmission Fluid C	Stand. Oil Co. of British Columbia, Ltd.
Shell Donax T-5	Shell Oil Co.
Signal Transmission Fluid C	Signal Oil Co.
Stanolube HDM, SAE-10W	Standard Oil Co. of Indiana
Texaco TL-2969	The Texas Company
Trojan TC Fluid 250	Cities Service Oil Co.
Trojan TC Fluid 250	Arkansas Fuel Oil Corp.

For +10° F. and lower - Use a mineral base oil meeting the following specifications.

Viscosity at 100° F.	55-65 SSU
Viscosity at 210° F.	35-38 SSU
Pour Point	-30° F.
Flash Point	300° F. Min.
Copper Strip Test ASTM #D 130	Negative
Cabinet Humidity Test (Anti-rust and anti-corrosion)	Corrosion around edge of panel only
L-4 Test	Pass
Foam Test	Pass

The following oils are represented by the respective suppliers as meeting the above specifications. Responsibility for the quality of a lubricating oil and its performance in service must remain with the oil company marketing the lubricant.

Brand	Type
Esso	Torque Fluid #35
Texas Co.	Texaco Torque Fluid
Cities Service	Torque Fluid #4
Standard Oil of Calif.	RPM Torque Fluid #3
Standard Oil of Indiana	Stanotorque Converter Fluid

Since new products are continuously being tested by the oil industry, the listing may not contain all products marketed at the time of issue.

If the afore-mentioned recommended oils are not used, the converter may be damaged internally.

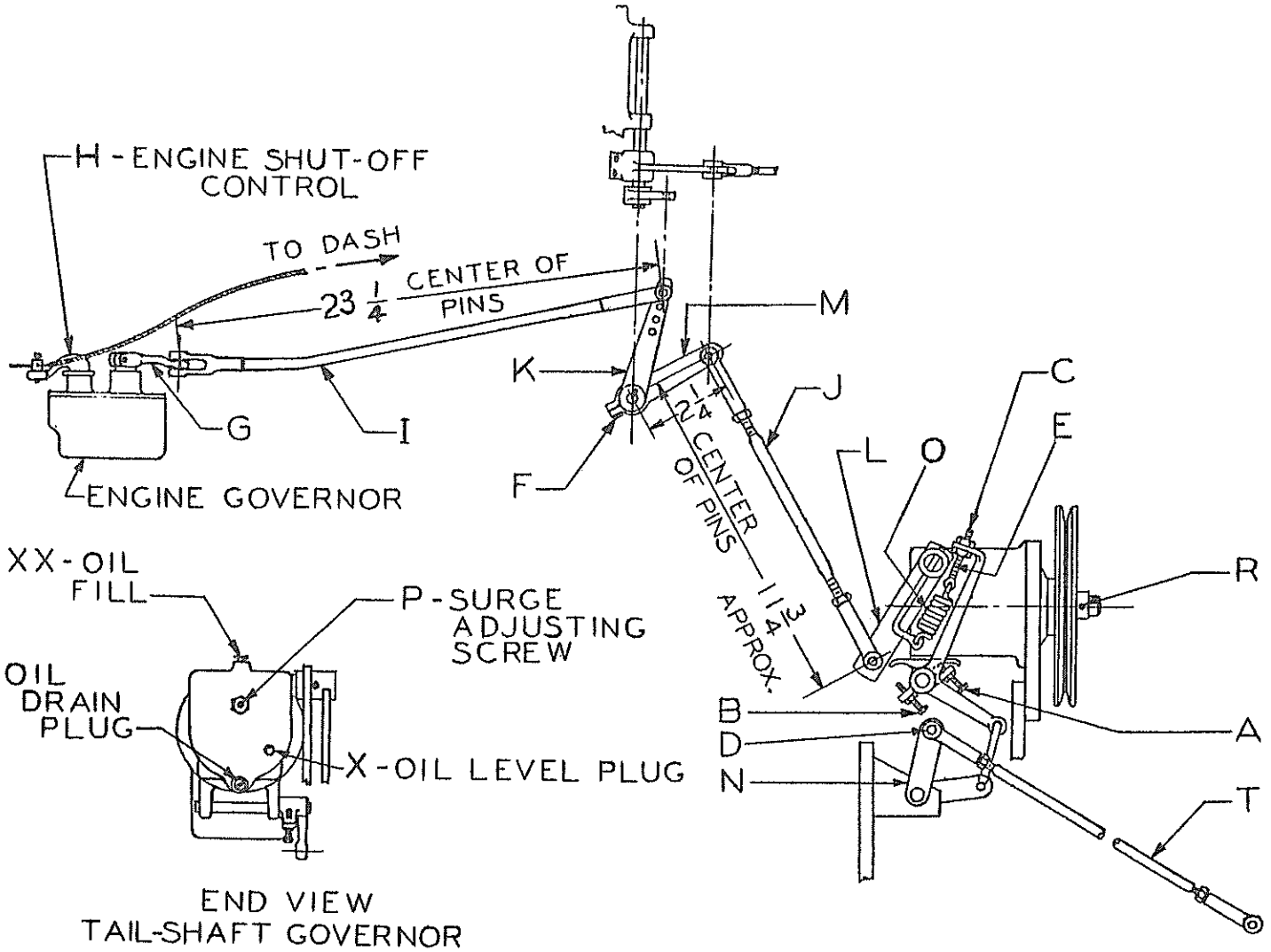
5. Starting the Allison Converter with GM Engine.

The initial warm up period is the most important part of converter operation. After the engine has been started, the throttle should be left in idle or closed position until the engine water and converter oil temperatures have reached the minimum operating temperature. This method of starting will allow the viscosity of the oil in the converter to thin down enough so it will flow freely throughout the converter's working parts.

The grader can be put to work at partial throttle and light loads after the warm up period has been completed.

Under no condition should the grader be put to work immediately after starting the engine. Always allow the engine ample time to warm up at low throttle setting.

6. Always consult the Lubrication and Preventive Maintenance section, as shown in the General Motors Diesel Engine Operator's Manual, packed in the tool box and shipped with the grader. (For example, information is shown relative to maintenance that should be applied to the oil cooler and which is a very important item as applied to satisfactory "Torque Converter" and "Engine" operation. (See page 59, reference (X1) for location of oil cooler.)



61. TAIL-SHAFT GOVERNOR.

The above illustration shows "Torque Converter" tail-shaft governor linkage adjustment and other data.

a. If engine surges it can be corrected by adjusting surge screw (P) in or out, as the condition might require. Be sure to tighten jam nut after adjustment has been made.

b. Be sure socket head set screw (R) on governor pulley is securely tightened to eliminate any chance of pulley becoming misaligned causing premature belt failure.

c. Be sure to fill tail-shaft governor with engine oil at (XX) until it shows the proper level at oil level plug (X).

1. Disconnect control rod (I) at engine governor control and operate governor by hand. Check engine RPM at (G) by holding governor arm open to determine if engine develops approximately 2200 RPM. Stop engine.

2. Check belt on governor drive for proper tension and alignment of pulley to be sure the belt does not contact the opening in the converter housing.

3. Attach rod (I) to engine governor arm at (G) and to the top hole in arm (K). This arm is keyed to the cross shaft at the rear of engine block. Control rod (I) is approximately 23-1/4" between pin centers.

4. Disconnect engine throttle control rod (T) at pin (D).

5. Adjust eyebolt (C) to obtain about 1/4" gap at point indicated by (E). This distance may vary plus or minus 1/4", depending on variation in connecting linkage. It may be necessary to adjust idling screw (A) to obtain this adjustment. At this time, spring (O) must be free so it can be moved easily, but not a loose adjustment.

6. Adjust control rod (J) to approximately 11-3/4" from pin centers and connect arm (M) at cross shaft on rear of engine block and lever (L) on tail-shaft governor.

7. Loosen lock bolt (F) on arm (M).

8. Move lever (N) toward wide open throttle position. This will bring adjusting screw (B) against bumper plate. (This adjustment (B) is for full RPM and the threaded portion should extend through the lever arm about 3/8".)

9. Move arm (K) to bring engine governor to wide open position. (This is toward rear of engine block.)

10. With lever (N) and arm (K) held in wide open position, tighten lock bolt (F) on arm (M) securely. This insures the tail-shaft governor of having full travel on the engine governor.

11. With governor linkage completely assembled, check travel of arm (K) to be positive of full travel on engine governor. At this time, if more travel is required, it can be obtained by backing full RPM adjustment screw (B) away from the stop.

12. Attach engine throttle control rod (T) at pin (D).

13. Start engine. Test tail-shaft governor action. To check the governor action, place transmission in 3rd gear and low range, set hand brake, and step on foot brake pedal. Open throttle to about the 4th notch on the throttle quadrant, or approximately 1/4 open position. Engage clutch. Governor will now respond under these simulated load conditions.

14. Check engine governor to be sure it has full travel at (G). Use tachometer and check RPM of engine, which should be about 1650 RPM under these conditions.

15. Idle engine, and check RPM at idle speed. The engine should idle at approximately 900 RPM. If this idle cannot be obtained, it may be necessary to change eyebolt adjustment (C).

16. Engine shut-off control (H) is the only means provided for shutting off engines equipped with tail-shaft governor.

Install endless belt on tail-shaft governor drive. (Use genuine A-W part.) To install this belt it is necessary to remove the propeller shaft (clutch to transmission), the clutch and clutch shaft, and the clutch cover from the unit.

62. ENGINE OPERATION.

a. Engine Speed Control Lever.

Lever (10), page 42, 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 (X), page 42, converts the diesel engine into a gasoline engine for starting.

c. Choke Button.

The choke (16) 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 (19) completes the electric circuit between the battery and the starting motor, causing the starting motor to crank the engine. See paragraph 63, -e., this page.

e. Oil Pressure Indicator.

The oil pressure indicator (21) shows whether the lubricating oil is circulating through the engine. (See page 4A for oil pressure.)

f. Ammeter.

This instrument (25) indicates the charging rate of the generator or the rate at which the battery is being discharged.

g. Heat Indicator.

The heat indicator (17) 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.

63. STARTING ENGINE IN 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 (13), page 44. Make sure this valve is open.

c. Place the compression release lever (X), page 42, in the gasoline (starting) position. Pull toward the operator.

d. Place the engine speed control lever (10), page 42, 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. The engine is equipped with an electric starter, set the choke (16), page 42, part way open and press starter button (19).

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. Excessive choking will flood the engine with gasoline and make it hard to start.

g. During extreme cold weather, when engine is cold, set the choke in fully choked position, then depress starter button (19), page 42, for a time interval of about three or four crankshaft revolutions. Then set choke 1/4 to 1/3 open and crank engine until it starts.

h. As soon as the engine starts, the choke (16) should be adjusted to where the engine operates steadily, and as the engine warms up, push the choke all the way down.

i. Check the engine oil pressure indicator (21) to see if oil is circulating through the engine. If not, stop the engine immediately and determine the cause of the oil pressure failure.

j. 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.

64. 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 (X), page 42, toward the 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. The carburetor is automatically cut out when on diesel, and is ready for use again when stopping on gasoline. The magneto is timed with the engine and is permanently connected. The ignition switch is operated automatically by the starting mechanism. The engine may start noisily when diesel operation begins, but the noise will be eliminated as the engine warms up.

65. REGULATING ENGINE SPEED.

a. The engine speed control lever (10), page 42, 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 1800 RPM; low idle speed is 500 to 600 RPM.

66. 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 (X), page 42, out to the gasoline (starting) position.

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

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

e. After the engine stops, push the compression release lever (X), page 42, back to the diesel position to permit the starting valves to cool in their seats.

67. 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 68 and 69. Drain the crankcase while the oil is warm so it will drain freely and completely.

68. OIL FILTERS.

To obtain the full benefit from the filters, the elements should be replaced each time the oil in the crankcase is changed. Cleaning the old elements is not satisfactory.

69. 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.

70. 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.

71. LUBRICATION WHEN SHIPPED.

Engines shipped to destinations in the United States, Canada and Mexico, are filled with thinned out 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 page 66.

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 page 66.

72. 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 page 66. 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 66). 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, 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

MO (Motor Oil)—According to anticipated air temperature. Oils which qualify under Military Specification MIL-L-2104A are recommended.
CL (Pressure-gun grease)—Use as chassis lubricant, all temperatures.
MG (Magneto grease)—All temperatures.

APPLICATION	KEY	CAPACITY	ANTICIPATED AIR TEMPERATURE				
			Above +90°F.	+90°F. to +45°F.	+45°F. to +32°F.	+32°F. to +10°F.	Below +10°F.
Crankcase	MO	16 quarts	SAE-40	SAE-30	SAE-20	SAE-10W	SAE-10W
Air cleaner	MO	5½ pints	SAE-40	SAE-30	SAE-20	SAE-10W	SAE-10W
Fuel injection pump	MO	½ pint	SAE-40	SAE-30	SAE-20	SAE-10W	SAE-10W
Generator	MO		SAE-20	SAE-20	SAE-20	SAE-20	SAE-10W
Cranking motor	MO		SAE-20	SAE-20	SAE-20	SAE-20	SAE-10W
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	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	Very light electric motor oil, or SAE-10	KEROSENE

Point of Lubrication — Lubricant — Hours

FUEL INJECTION PUMP

Oil filler . . . . . MO . . .

Oil level valve 10
Open oil level valve to check oil level. If oil does not appear, add oil through the oil filler until oil appears at the valve opening.

Oil drain plug 240
Remove the drain plug and drain the pump each time the crankcase oil is changed. Refill at the filler until oil appears at the level valve opening.

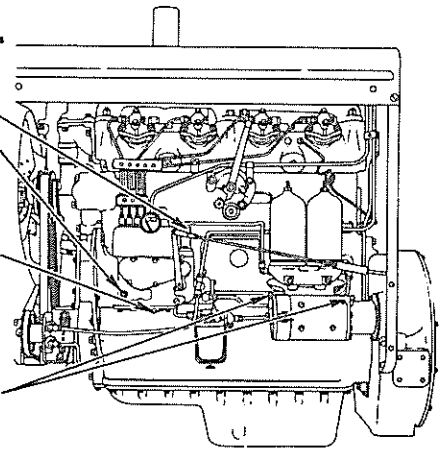
Cranking motor . . . . . MO . . .
Occasionally put a few drops of oil in each of two oil cups.

Crankcase oil filler . . . . . MO . . .
Unscrew the filler cap. Fill the crankcase to the "FULL" mark on the crankcase oil level gauge.

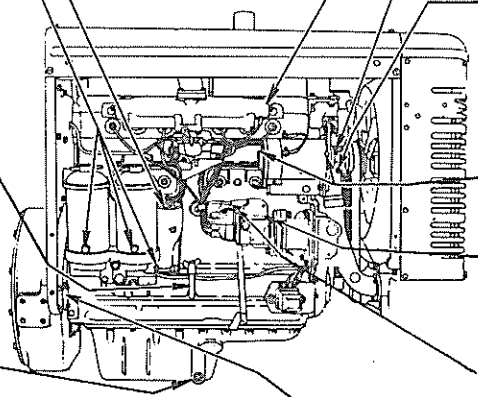
Lubricating oil filters . . . . . .
Drain the filters and replace the filter elements when crankcase oil is changed. (See page 65)

Crankcase oil level gauge 10
Readings on both sides of the gauge show the crankcase oil level when the engine is operating and when it is stopped. For an accurate check with the engine stopped, wait for the oil to drain into the crankcase oil pan. To use the gauge:
1. Unscrew the wing nut, remove the gauge and wipe it clean.
2. Insert 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.

Crankcase oil drain plug 240
Drain the oil while the engine is hot. It may be necessary to change the oil after shorter working periods under severe operating conditions such as extremely dusty conditions, low engine temperatures, intermittent operation, excessively heavy loads with high oil temperatures, or when diesel fuel with high sulphur content is used.



Lubrication Points on Right Side



Clutch pilot bearing . . . . . CL 60
Remove plate on flywheel housing. Turn engine until lubrication fitting is opposite opening. Apply 3 to 4 strokes of the lubricator.

Lubrication Points on Left Side

Always use clean containers. Keep lubricators clean. Wipe dirt from fittings before applying lubricators.

Hours — Lubricant — Point of Lubrication

Recommended Intervals of Time for Lubrication Service

10 hours of operation or daily service
60 hours of operation or weekly service
120 hours of operation or bi-weekly service
240 hours of operation or monthly service
480 hours of operation or bi-monthly service
960 hours of operation or seasonal service

Note—Intervals of time between lubrication services are based on average operating conditions. Under unusually severe conditions of operation, reduce the interval of time between services.

960 MG **Ignition cut-out switch**
Remove manifold end cover, apply a trace of grease to the contact points.

60 CL **Fan hub bearing**
Apply 1 or 2 strokes of the lubricator. **Do not overlubricate.** If lubricant comes out of the fan hub while lubricating, stop the application. Use of military specification grease MIL-G-10924GAA2 is suggested when extremely cold temperatures are anticipated.

60 CL **Water pump shaft**
Apply not more than 2 strokes of the lubricator. **Do not overlubricate.** Overlubrication will force lubricant into the cooling system, which may cause clogging. Use of military specification grease MIL-G-10924GAA2 is suggested when extremely cold temperatures are anticipated.

120 MO **Generator**
Apply 8 to 10 drops of oil to each of two oil cups.

60 MO **Magneto impulse coupling**
Oil liberally with grade of oil specified in "KEY" above (Also see pages 83 and 84 for complete magneto lubrication instructions.)

480 MO **Magneto distributor bearing**
Fill oil cup with grade of oil specified in "KEY" above (Also see pages 83 and 84 for complete magneto lubrication instructions.)

10 MO **Air cleaner**
Clean and refill the oil cup to the oil level bead with the grade of oil specified in "KEY" above. (Also see page 70)

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

73. LUBRICANT SPECIFICATIONS.

MOTOR OIL.

Motor oil (MO) (for use in crankcase, air cleaner, and injection pump) should be well refined petroleum oil free from water and sediment.

Heavy duty is the term used for motor oil possessing oxidation stabilizing, anti-corrosive and anti-sludging properties necessary to make it generally suitable for high speed diesel engines. This is additive type oil. The term heavy duty as used here does not pertain to the viscosity rating or "weight" of the oil.

Heavy duty crankcase oils provide the most satisfactory engine lubrication and should be used in International diesel engines with present day diesel fuels. The quality of the base oil and the amount and type of additives used in these oils determine their suitability for use in high speed diesel engines under severe operating conditions, and also determine the degree of their suitability for use with diesel fuels containing sulphur or other injurious products.

The requirements of diesel engine crankcase oils vary greatly with service severity and fuel composition. In order to give a better idea of the proper additive oil to be used in the engine, three types of service are defined. The type of oil required for each type of service is specified as follows:

a. Normal Service.

Diesel engine service is considered normal when operating temperatures are normal, fuel sulphur content does not exceed 0.4% and the engine operates at the specified horsepower rating for continuous operation, or is intermittently loaded to maximum horsepower.

Oil represented by the oil supplier as meeting all of the requirements of U.S. Military Specification MIL-L-2104A and/or British Ministry of Defence Specification DEF/2101A are a minimum requirement for this type of service.

b. Service More Severe Than Normal.

Operation as described for normal service plus any of the following conditions:

1. Fuel having 0.4% to 0.9% sulphur content.

2. Long stand-by periods.

3. Low atmospheric or engine coolant temperatures.

4. High atmospheric or engine coolant temperatures.

Oils generally known in the trade as "Supplement List No. 1" or "Sup. 1" lubricating oils are considered suitable for use in engines running under more severe conditions than normal. These oils are represented by the oil supplier as meeting conditions somewhat more severe than the conditions under which oils for normal service have represented.

c. Very Severe Service.

Conditions which describe most severe service are as follows:

1. Operation with fuel having sulphur content above 0.9%.

2. Unusually high or low atmospheric temperatures.

3. Continuous operation at maximum load or overload.

4. Torque converter type transmissions driven by diesel engines impose very severe conditions of operation which dictate the use of oils described below.

Oils which are known generally in the trade as "Supplement List No. 2" or "Sup. 2" represent the highest detergency level of heavy duty diesel engine oils and are considered suitable for use in engines running under severe conditions.

It has never been the policy of the International Harvester Company to publish approve lists of lubricants or to guaran-

tee oil performance in service. The responsibility for the quality of the lubricant, its performance under conditions of operation, and its compatibility with the diesel fuels used must remain with the supplier of the lubricant. High speed diesel fuels and lubricants should be procured from a reliable source. When in doubt consult your International Industrial Power distributor or dealer for information given in the latest Service Bulletin on crankcase lubricating oils.

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 flow 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: 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: 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 color.

74. LUBRICATING OIL FILTERS.

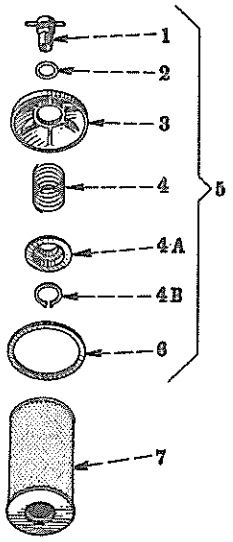
The life of your engine depends upon clean oil being circulated to all bearings. Minute particles of abrasive matter eventually accumulate in the crankcase of the engine, and lubricating oil undergoes changes which produce sludge, acids, gums, varnish, and other harmful by-products. The purpose of the 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. The full flow lubricating oil system of the UD-14A engine includes a "No-drain-back" feature which eliminates the necessity of pumping the oil into filters when starting the engine.

a. Oil Filter Element.

A radial fin type lubricating oil filter element is now standard equipment in the UD-14A diesel engines, replacing the umbrella type element formerly used.

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 67 and 68 on use of heavy duty oils.



b. Changing the Filter Elements.

1. Stop the engine.

2. Remove the crankcase drain plug and drain while the oil is still warm.

3. Remove the filter base drain plug and drain.

4. Remove the filter case drain plugs (1 for each case) and allow the cases to drain completely.

5. Clean off the filter case covers to prevent dirt from falling into the cases.

6. Unscrew and remove the case covers.

7. Remove the old elements.

8. Clean the inside of the filter cases with a rag dampened in kerosene.

9. Install the new filter elements.

10. Be sure all drain plugs are reinstalled.

11. Refill the crankcase and filters as follows:

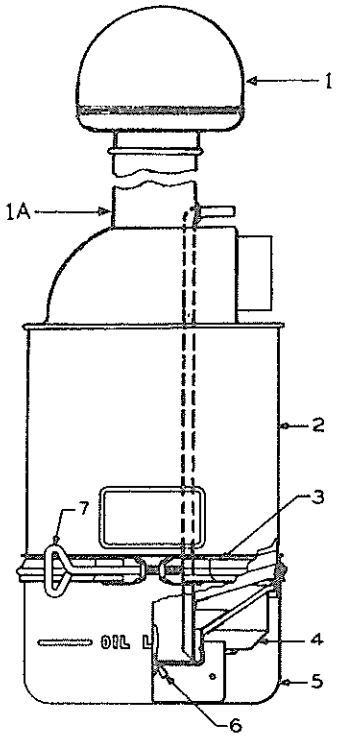
a. Fill the crankcase with 14 quarts of oil (grade specified in the "LUBRICATION GUIDE" page 66 for the prevailing temperature).

b. Fill the filter cases (one quart of oil for each filter case). Adding oil to each filter case speeds up lubrication to the bearings, oil pump drive gears, and other vital engine parts, thus eliminating the time required by the pump to fill the filter cases.

12. Install the case covers, making sure the surface of the rubber seal, seated in the cover groove, is clean. Tighten the covers hand tight (10-15 foot-pounds torque).

13. Start the engine and see that the oil pressure indicator is registering pressure.

NOTE: To avoid delays, always carry extra elements on hand for replacement at the proper time. Cleaning the old elements is not satisfactory.



75. 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 66.

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.

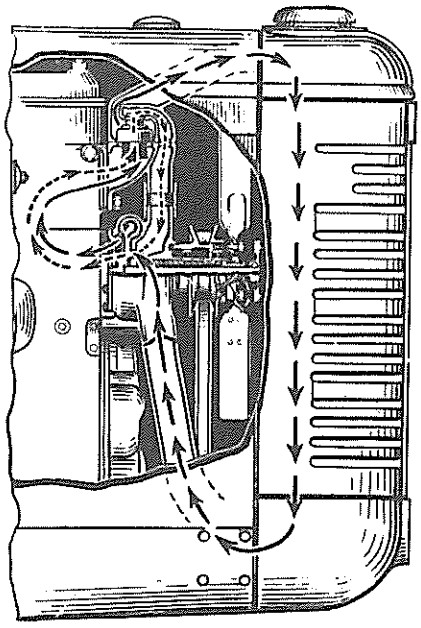
The screen in the air intake cap (1) prevents chaff and other coarse dirt from getting into the air cleaner. This screen should be kept clean and free from all chaff, oil, dust, or paint, as clogged holes in the screen will reduce the power of the engine by restricting the flow of air.

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.



76. 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.

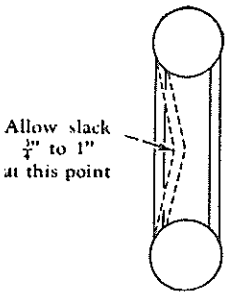
Filling the radiator with water to a level slightly below the bottom of the filler neck will allow for expansion of the coolant under normal operating conditions. Soft, or rain water is recommended as it does not contain alkali which forms scale and eventually clogs the passages.

If the power unit is to be operated in freezing temperatures, refer to "Cold Weather Operation", page 88, paragraph 101.f.

If the engine becomes overheated refer to "Operating Precautions", page 89, paragraph 102.

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

77. FAN BELT TENSION.

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.

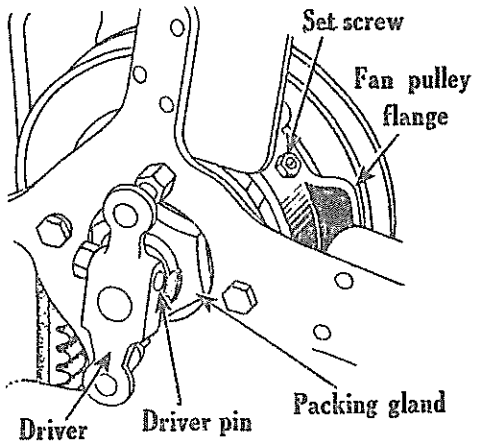
(5) Revolve the engine slowly and the belt will work off the pulley.

(6) Remove the tool used for revolving the engine.

(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 proper speed. Reverse the procedure for removing belt. The belt can be started on the lower pulley by hand and by slowly revolving the engine it will run into position.



78. REPLACING WATER PUMP PACKING.

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:

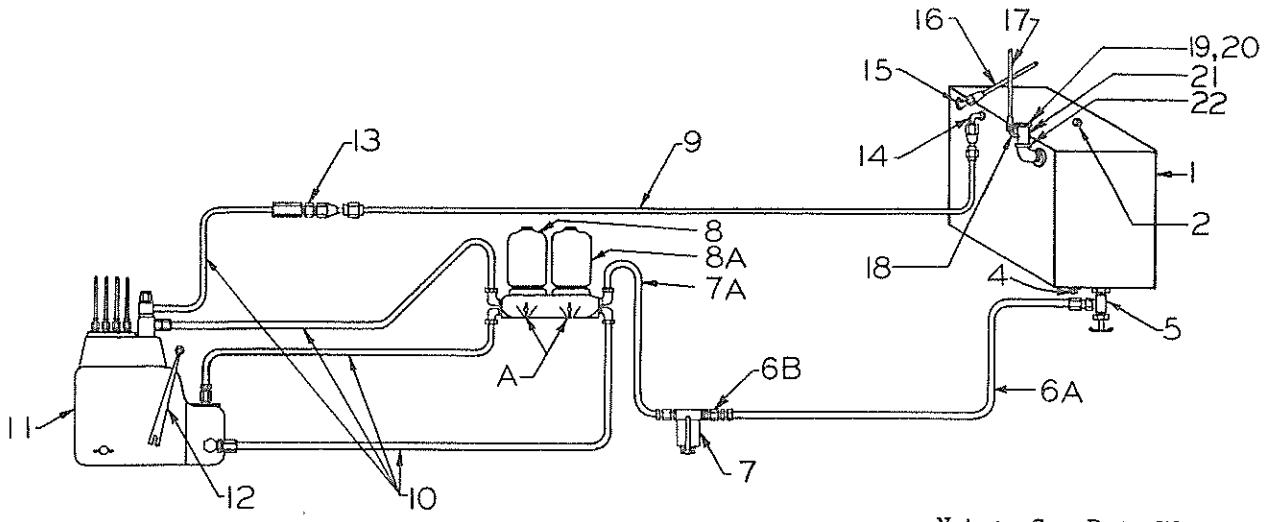
(1) Remove the driver pin.

(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.



Note: See Page 78 for Fuel Filters

79. IHC INJECTION PUMP AND FUEL SYSTEM.

The fuel flows from the tank (1) thru a water trap to the fuel filter (8A). 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 returned to main fuel tank 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 closely fitted moving parts, causing rapid wear and shortening normal life of 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.

80. FUEL OIL SPECIFICATIONS FOR IHC DIESEL ENGINES.

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)	0.4-0.5% 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 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 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 burner fuels, diesel fuels are usually made from 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 Diesel Fuel Specification D-975.

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 sub-zero 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 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 (1 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 for A.P.I. gravity fuels, of from 35 to 38. 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 these fuels
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	Kerosene type fuels
44	6.71	133,500	
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 specifications 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 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 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-0-2104A 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-0-2104A, 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.

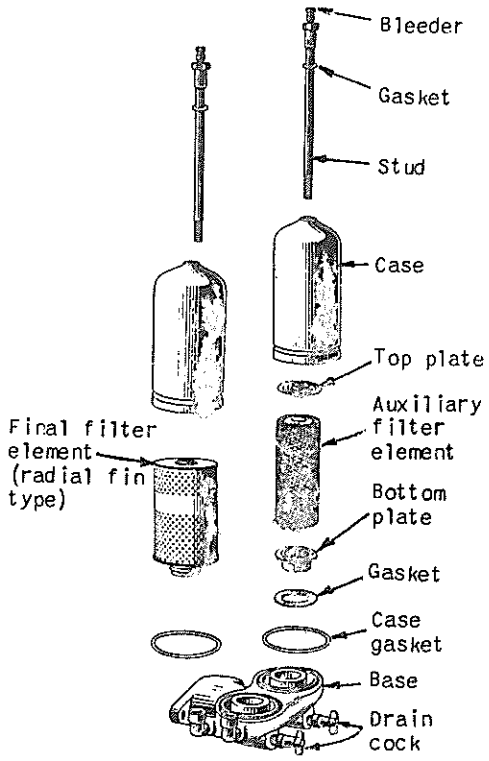
It is absolutely essential that the fuel be free of water, sediment and residue. It is important that the operator buy clean fuel and that he keeps it clean until it is in the engine. Discourage the use of funnels, cans and drums as it is difficult to keep them clean. Reduce the number of times the fuel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



Dual Fuel Filters

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 73, 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 into the base. Be sure the boss on the top plate properly enters the element and the spring holds the plate securely to the element.

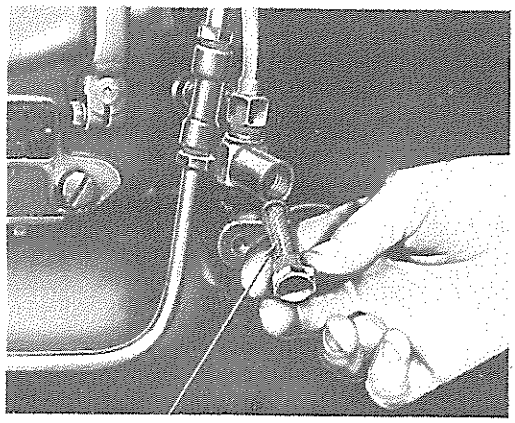
(10) Draw the case down tight by tightening the stud.

81. 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 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.



Primary pump filter

82. 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.

83. 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, 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.

84. INJECTION PUMP REMOVAL.

To remove the fuel injection pump:

(1) Keep all parts clean. Before disconnecting any fuel pipes from the pump, first thoroughly 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 injector 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.

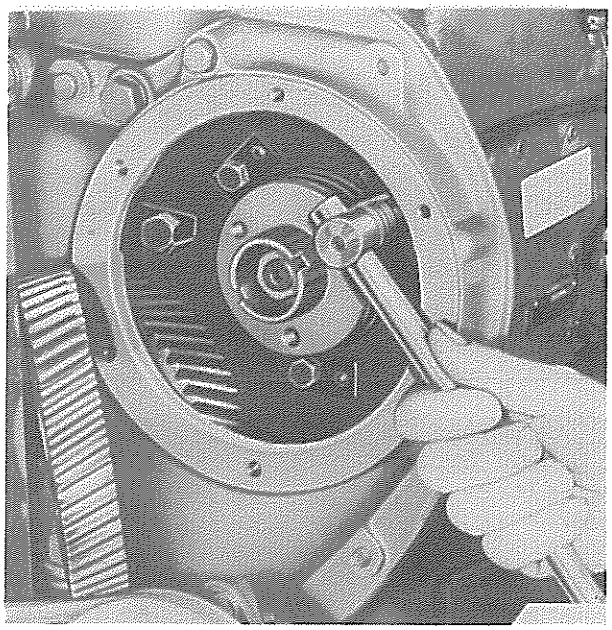
(7) Remove the cap screws which secure the pump gear cover, see page 80, to the crankcase front cover, then lift off the pump gear cover.

(8) Crank the engine so the chamfered tooth (D), see upper right, page 81, 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, see right illustration, which secure the timing indicator and pump gear to the gear hub, then lift off the timing indicator and the gear.

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



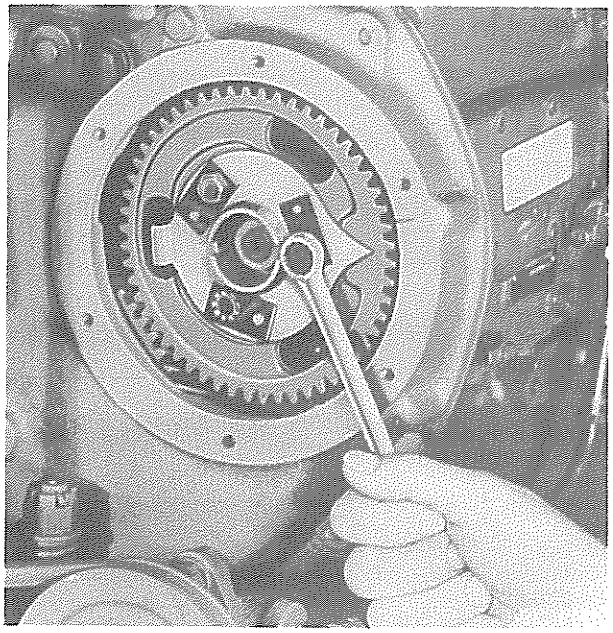
(11) Remove the two cap screws which secure the pump mounting flange to the crankcase front cover, then lift off the complete pump assembly, see upper left page 81.

85. FUEL INJECTION PUMP REPLACEMENT.

To replace the fuel injection pump:

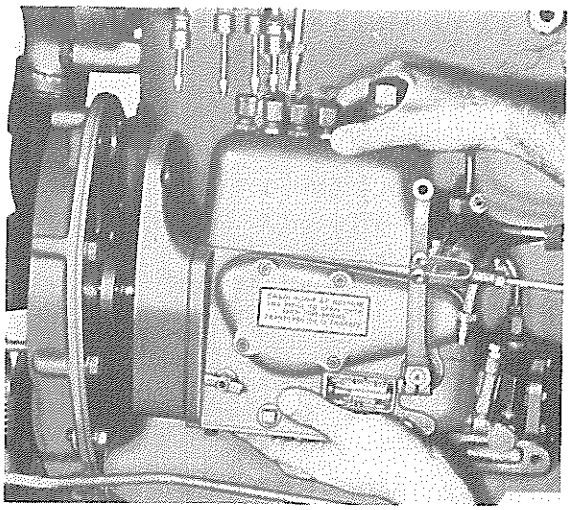
(1) If the timing has been disturbed while the injection pump has been removed, crank the engine until the No. 1 cylinder is at top dead center of the compression stroke. This position can be determined by removing the No. 1 spark plug and placing your thumb over the opening and cranking the engine slowly 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, see upper right page 81, 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.



(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, see upper right page 81. Under no conditions attempt to retime the engine by matching the "K" marks on the injection pump gear and the idler gear.



Removing the Complet 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) Revolve the engine slowly in order to align the 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.

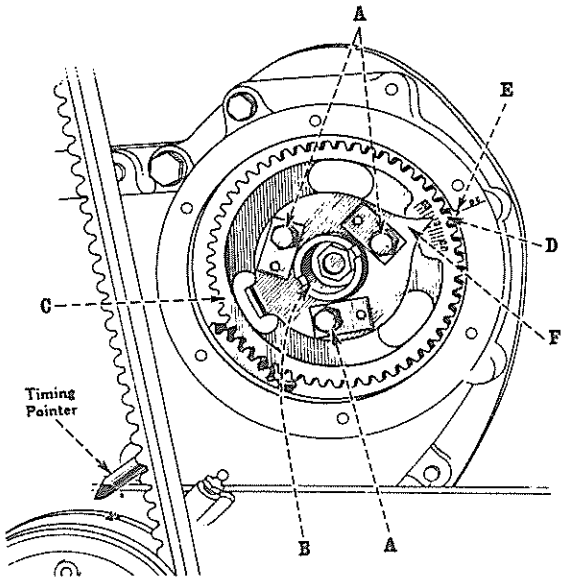
(9) Reconnect the fuel pipes. Be sure all connections are clean and tightened (one-eighth turn).

(10) Add lubricant as specified on page 66.

(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 82, paragraph 87.

(13) Convert to diesel cycle and note engine operation. If engine operates rough, check and adjust timing, paragraph 86.



Timing the Fuel Injection Pump

86. FUEL INJECTION PUMP TIMING. (See above)

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), see above, 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.

87. 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.

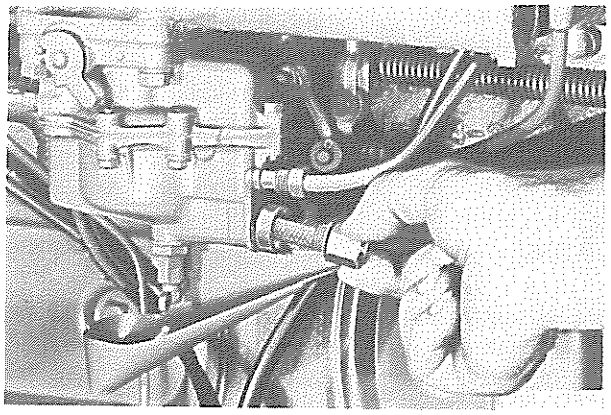
(1) Be sure the main tank is full of fuel.

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

(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.

88. 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.



89. CLEANING THE STRAINER.

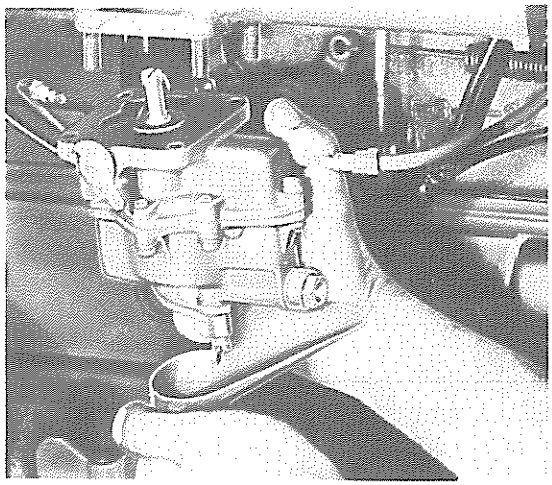
The float valve is protected against dirt and foreign matter by a strainer. The strainer screen should be removed occasionally and cleaned.

(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

90. 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.

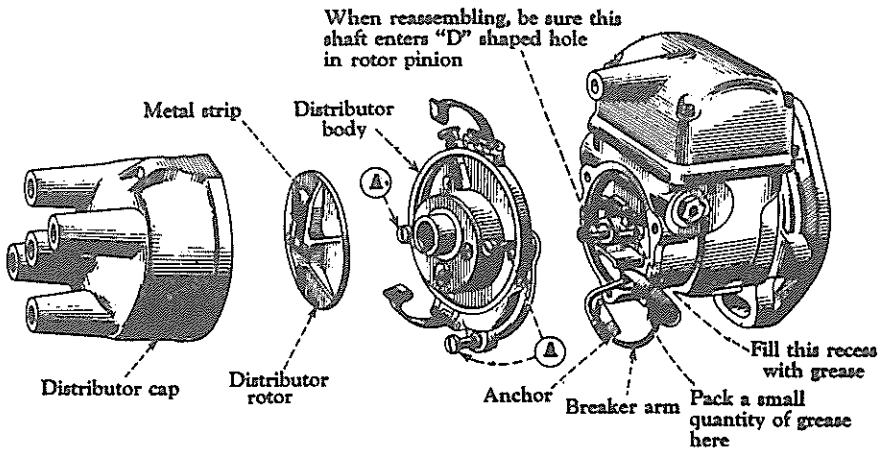
(1) Close the gasoline shut-off valve at the gasoline tank.

(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

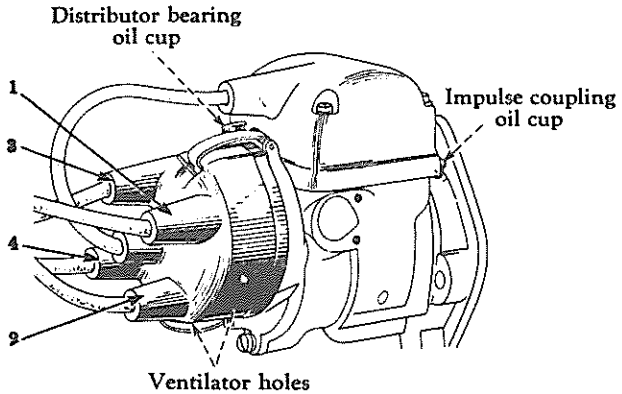
91. MAGNETO..

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 84 and 85. 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.

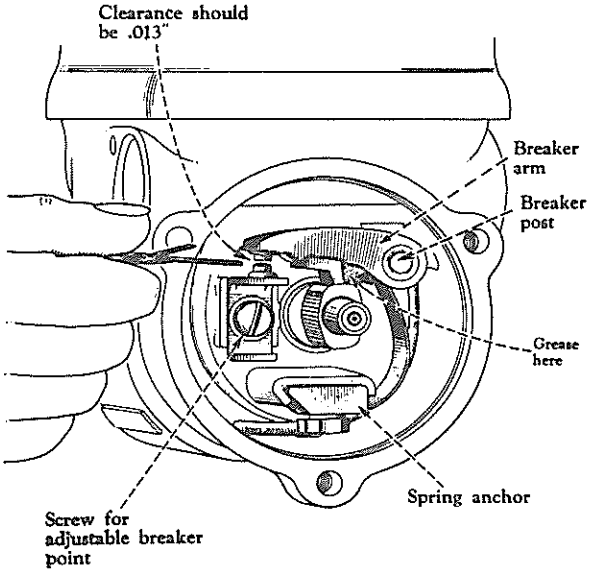
(2) After every two hundred and fifty hours of operation the breaker point chamber should be inspected to be sure it is clean. See that the points are in good condition and have proper clearance. If the chamber is clean, no attention is necessary other than checking the clearance of the points; but if 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.

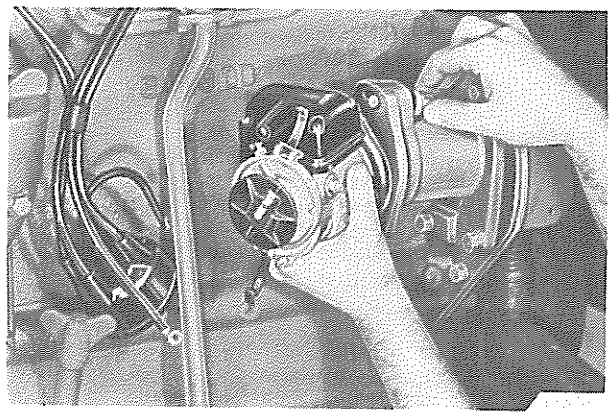
(8) Line up the distributor rotor key with the keyway in the spindle and press the rotor loosely on the spindle. Revolve the engine to the top dead center of the No. 1 compression stroke. The compression stroke can be determined by removing the No. 1 spark plug, placing your thumb over the opening, and revolving the engine until an outward pressure is felt. Continue to revolve the engine 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), upper illustration page 83. 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.

92. 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, thoroughly 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, lower illustration page 83, open at all times. The distributor rotor should also be kept clean.



Removing the Magneto

93. MAGNETO REMOVAL.

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.

94. INSTALLING AND TIMING THE MAGNETO.

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. Revolve 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 revolve the engine until an outward pressure is felt. Continue to revolve the engine 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.

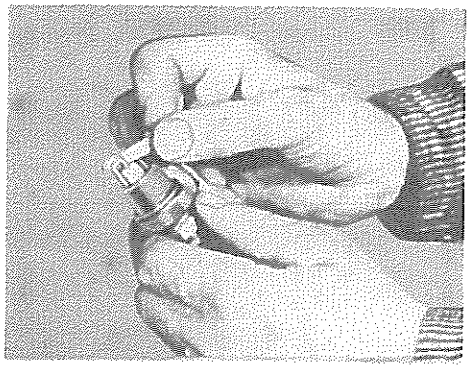
f. Insert the magneto mounting bolts loosely in the magneto flange, just enough to hold the magneto in place. Then revolve the engine one complete revolution to the next top dead center. Now push the upper part of the magneto toward the engine until the impulse coupling just trips.

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 86.)

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

i. To check the timing, revolve 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 Cap

95. SPARK PLUGS.

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 porcelain. Scratched porcelain allows carbon and dirt to accumulate faster.

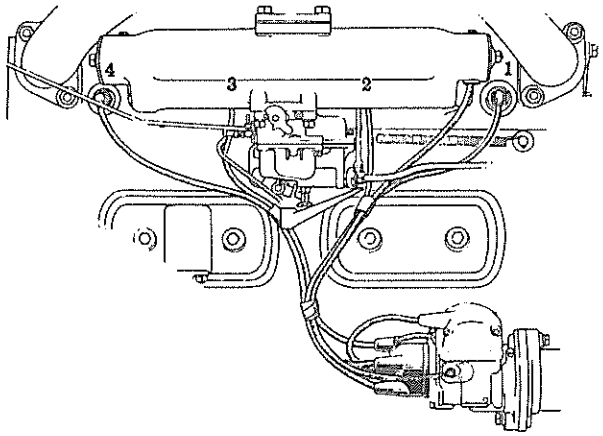
(2) Spark plugs should be removed after every two hundred and fifty hours of operation, or oftener if necessary, for cleaning and checking the gaps between the electrodes. A gap of .023" should be maintained.

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.



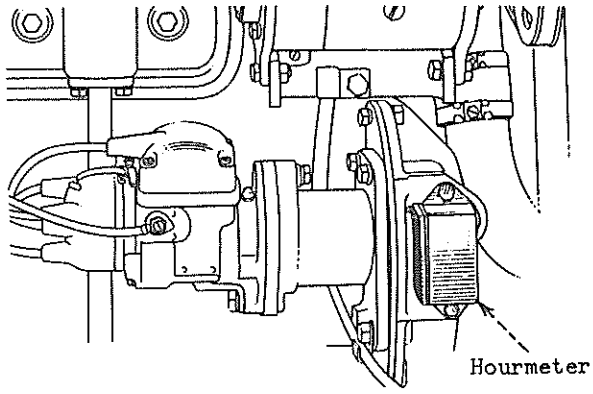
Spark Plug and Magneto Wiring Chart

96. SPARK PLUG CABLES.

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.



97. 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.

98. VALVE CLEARANCE ADJUSTMENT.

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.

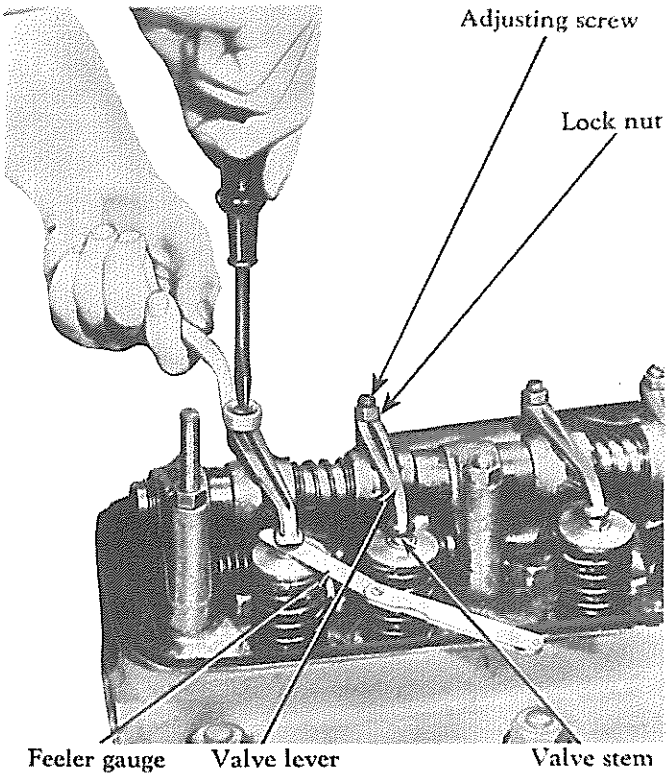
(1) Before checking the valve clearance, "cut-out" the magneto by pulling the "coil-to-distributor" cable from the magneto coil cover. This will prevent accidental starting.

(2) Set the compression release lever in the gasoline (starting) position. page 63, paragraph 63C.

(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 revolve 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 to revolve the engine 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.



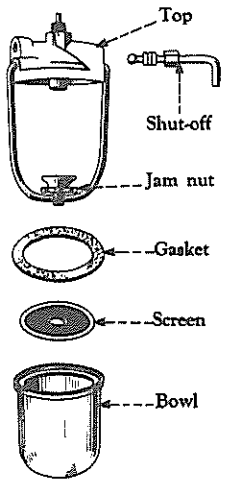
Adjusting Valve Clearance with Feeler Gauge

(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) Revolve 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) 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.

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



99. 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.

100. 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 66.

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.

101. 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 66.

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 85. Flush the impulse coupling end and drive chamber with kerosene, and replace.

e. Batteries.

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 71, 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 drain 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 determine how much protection against freezing the solution has.

(b) Never use honey, salt, kerosene 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.

102. 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 0.023".

i. Immediately after the engine starts, check the oil pressure indicator to see if it is registering the proper pressure, page 4A. 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 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 72.

k. For the most efficient operation, the heat indicator needle should be near 180o F.

l. Be sure to clean the air cleaner and to replace the lubricating oil filter element at regular intervals, as specified on page 70, paragraphs 75 c. and d.; and page 69, paragraph 74 b.; and in the lubrication chart on page 66.

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.

103. 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).

104. 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 66.)

c. Drain the lubricating oil from the diesel injection pump and governor, and refill with approved flushing oil, page 73.

d. Close valve (5), page 73, at the fuel supply tank.

(1) Disconnect the fuel supply tank line nearest to (6A).

(2) Disconnect the fuel supply lines (10) at the injection pump.

(3) Drain all fuel from tank (1). Store the drained oil.

e. Drain the fuel filters (8) and (8A) at points (A-A). 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) and (8A) when the fuel has been drained.

(1) Connect the fuel supply lines (10) at the injection pump.

g. Attach the valve end of tubing (6A) to a gallon can of clean approved flushing oil.

h. Close the air vent at the top of the fuel filters (8) and (8A) when the flushing oil appears.

i. Start and operate the engine on gasoline for five minutes; then stop it.

(1) Start up again and operate for one minute; then stop it.

(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 filters (8) and (8A). Reattach line (6A) 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.

105. 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-10W 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. Revolve 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 page 66.

e. Flush out the crankcase with diesel fuel, dry cleaning solvent, or kerosene, and fill with the grade of lubricating oil specified on page 66.

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 73.

h. Install the spark plugs.

i. Fill the cooling system and fuel tanks.

j. Fill the fuel filter as described under "Venting Air From Fuel System", page 82, paragraph 87.

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.

106. CHECKING MECHANICAL PROBLEMS

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

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. Remove injection pump.
	C. Injection pump plunger and bushing worn.	C. Remove injection pump.
	D. Surging at any idle speed.	D. Remove injection pump.
	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

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

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

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

107. PERIODIC INSPECTIONS.

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
Lubrication points	(See lubrication chart on page 66)

AFTER EVERY 60 HOURS OF OPERATION

Air cleaner	Remove and clean
Flexible rubber connection between air cleaner and air cleaner pipe	Inspect for loose fit or damage
Fan belts	Check tension; replace if necessary
Radiator fins	Clean spaces
Fuel transfer pump strainer	Remove screen and clean
Lubrication points	(See lubrication chart on page 66)

SPECIAL INSTRUCTIONS

Lubricating oil filters	Replace filter elements
Engine crankcase	Drain and change oil

AFTER EVERY 250 HOURS OF OPERATION

Gasoline strainer and sediment bowl	Take apart and clean
Spark plugs	Remove and clean; check gap
Magneto breaker points and chamber	Clean chamber and check gap
Magneto drive chamber and impulse coupling	Check and clean if necessary
Lubrication points	(See lubrication chart on page 66)

AFTER EVERY 400 HOURS OF OPERATION

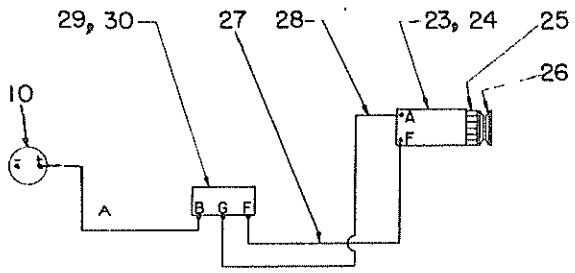
Carburetor gasoline strainer screen	Remove and clean
Cooling system	Clean
Engine valves	Check for clearance

AFTER EVERY 500 HOURS OF OPERATION

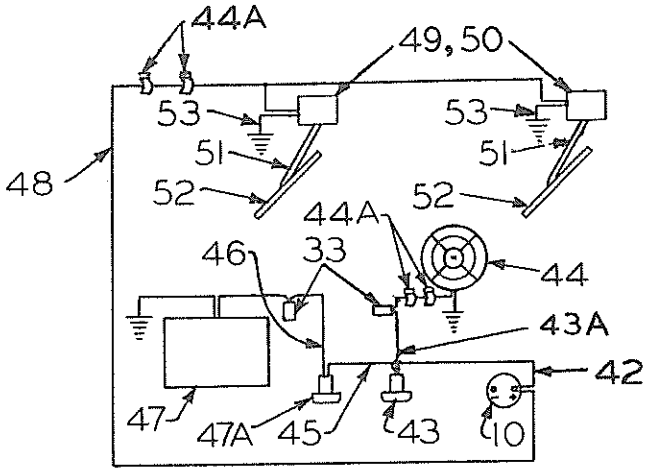
Lubrication points	(See lubrication chart on page 66)

PERIODICALLY

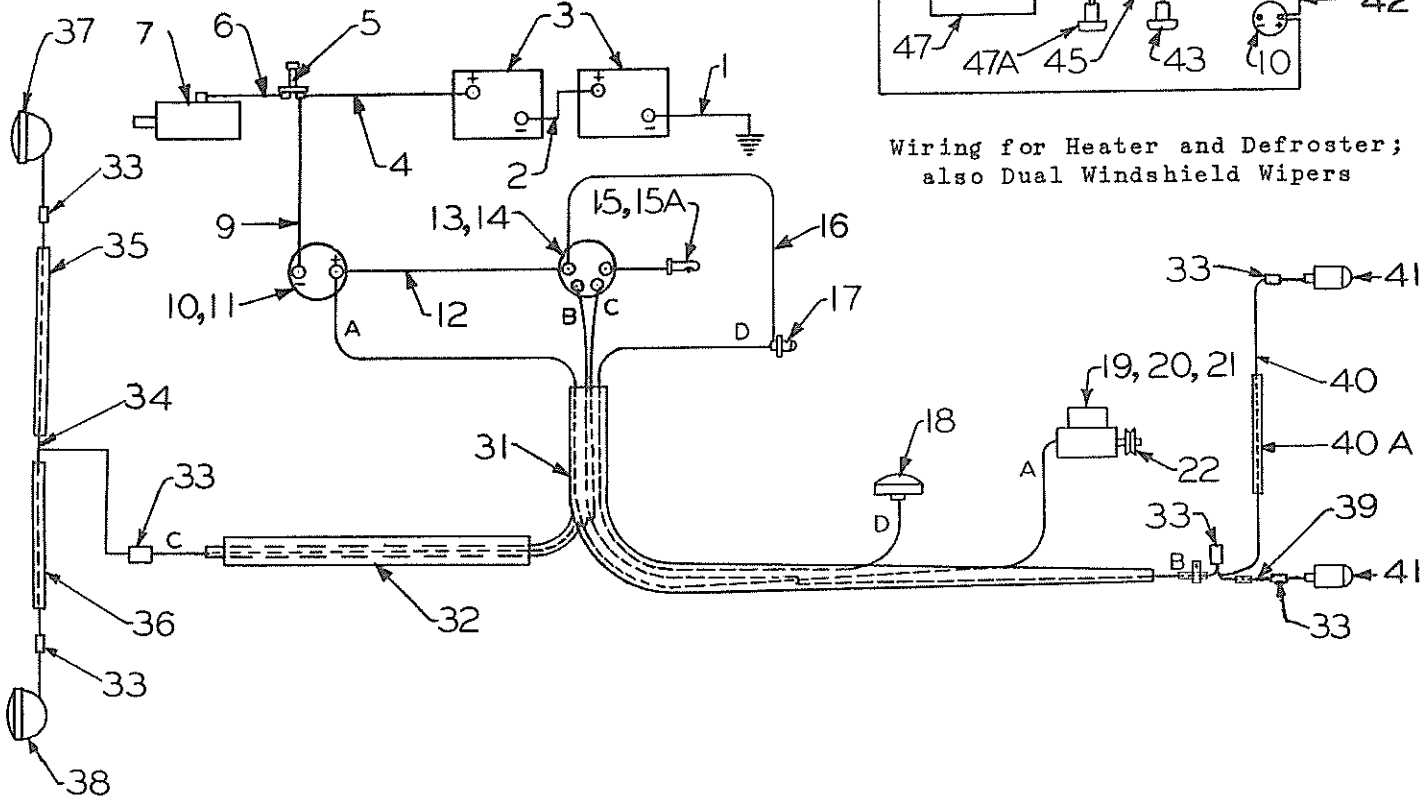
Fuel filters	Replace elements when necessary
Primary pump filter screen (in IHC injection pump)	Remove and clean
Magneto distributor cap	Remove and clean



Wiring for Extra Heavy Duty Generator

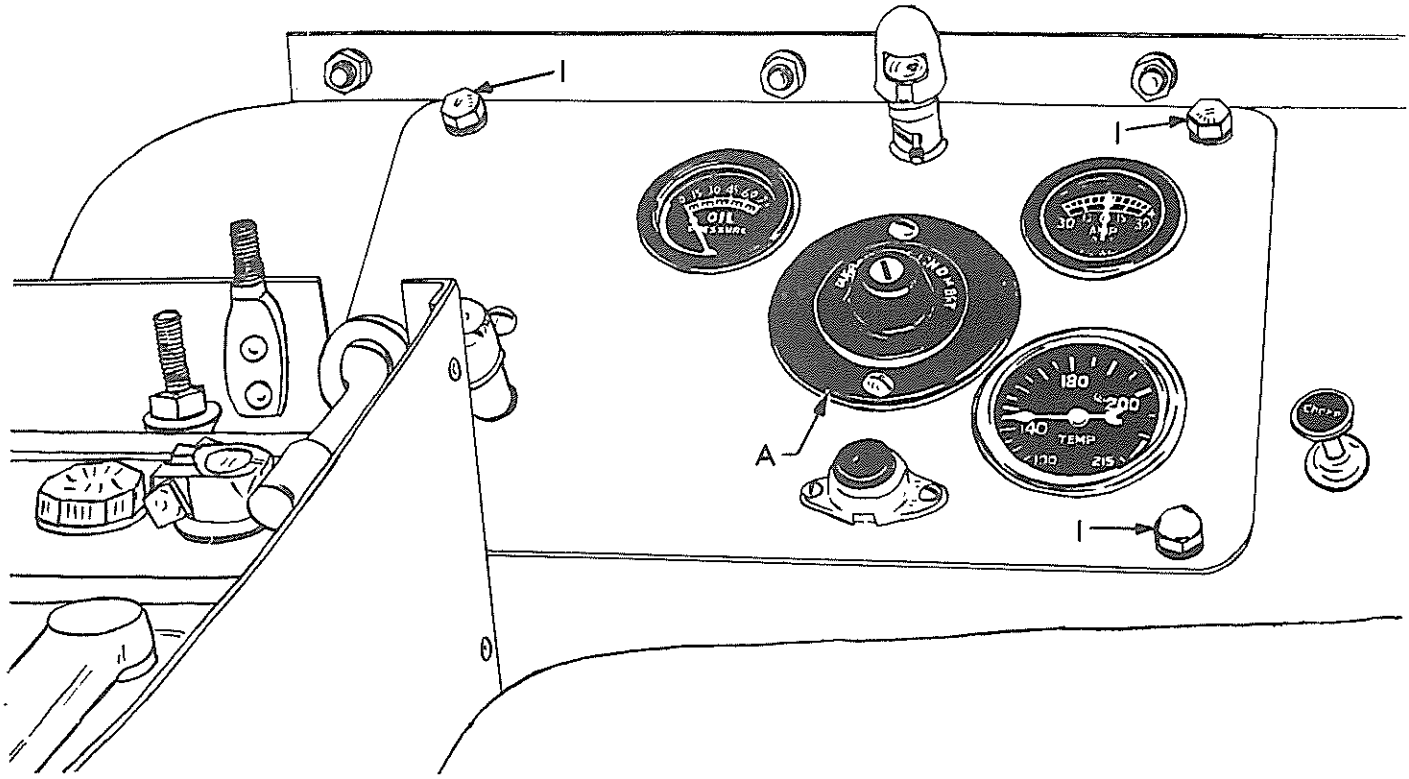


Wiring for Heater and Defroster; also Dual Windshield Wipers



108. WIRING DIAGRAM. (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	40A.	Loom
4.	Cable	23.	Generator (extra H.D.)	41.	Tail light
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 (regular H.D.)	38.	Headlight-left hand	53.	Wire



109. 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, or the panel on the outside cab wrapper sheet may be removed to gain access to the rear of dash panel.

110. 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 battery ground cable. Do not reconnect 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. 00 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. OO sandpaper over the commutator.

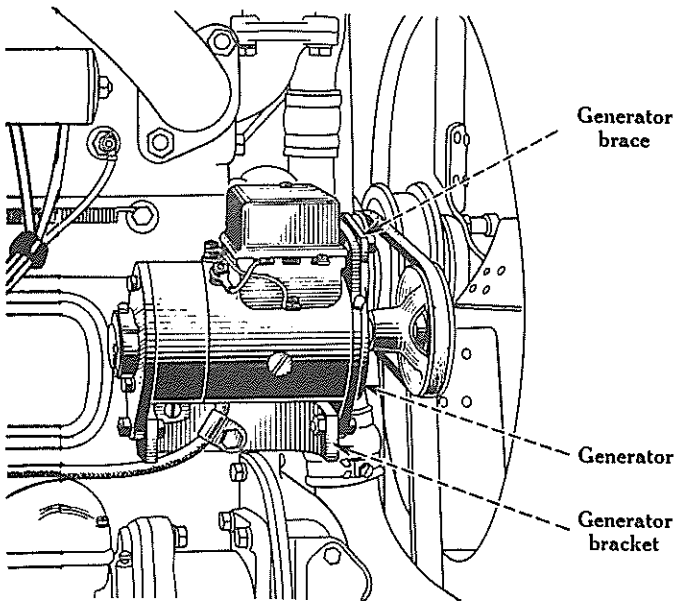
(3) When polishing the generator commutator remove the cover band and place the piece of No. OO sandpaper between a brush and the commutator while the armature is revolving.

111. 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.



Generator

a. Adjusting the Generator.
(See Illustrations, page 100)

(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.

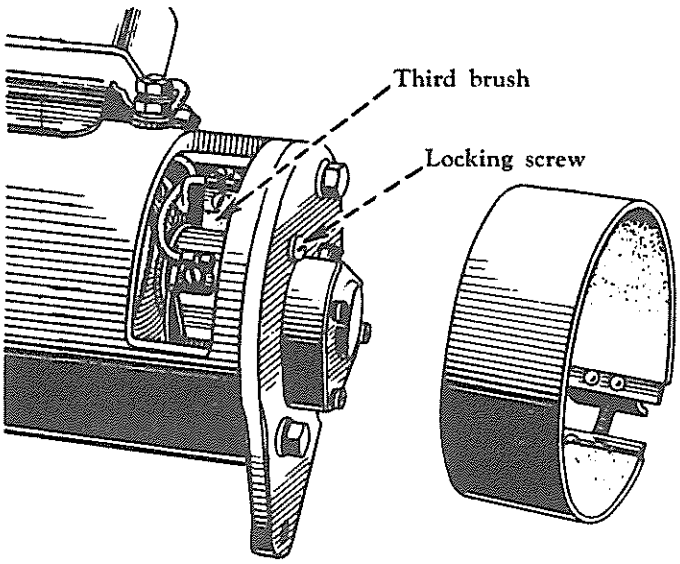
(c) The charging rate is changed by moving the third brush. This brush is the one mounted on the movable carrier.

(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.

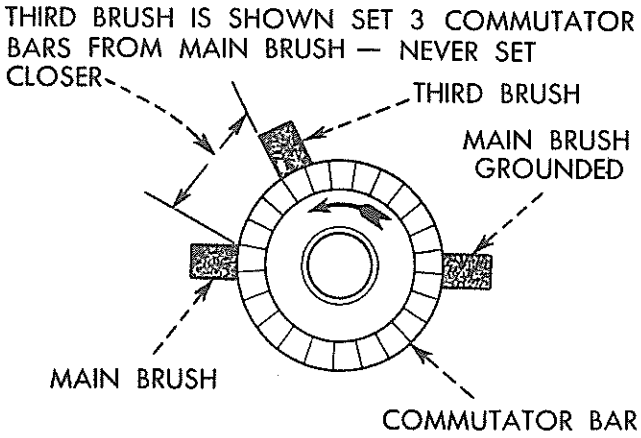
IMPORTANT: The third brush should never be set closer than three commutator bars from the main brush.

(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.



Generator Cover Band Removed Showing Brushes



Generator Third Brush Setting

112. 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.

113. 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 electrolyte 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).

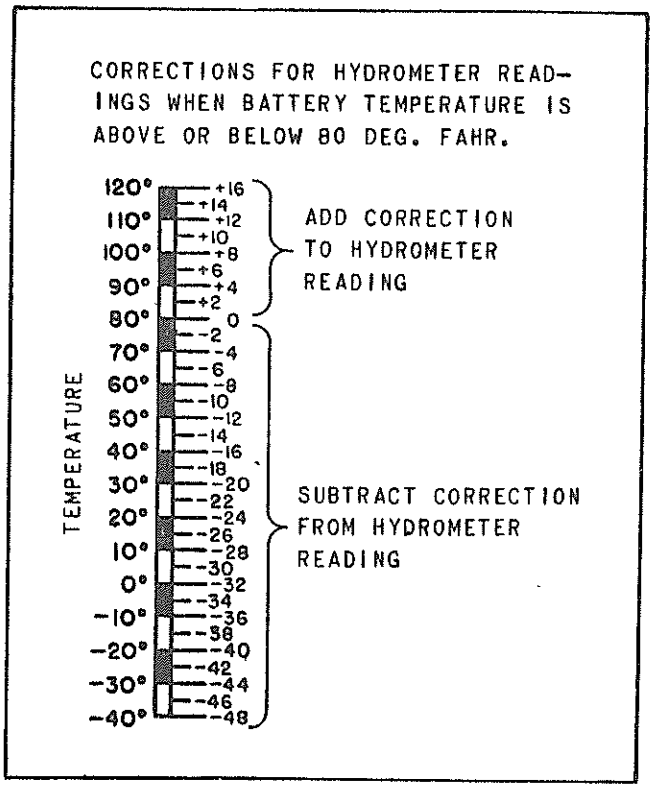
(c) If the specific gravity of the electrolyte is less than the required figure in the chart, the generator charging rate should be increased (see "Adjusting the Generator", page 99, paragraph (a), or the battery should be recharged with standard auxiliary battery recharger.

(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.

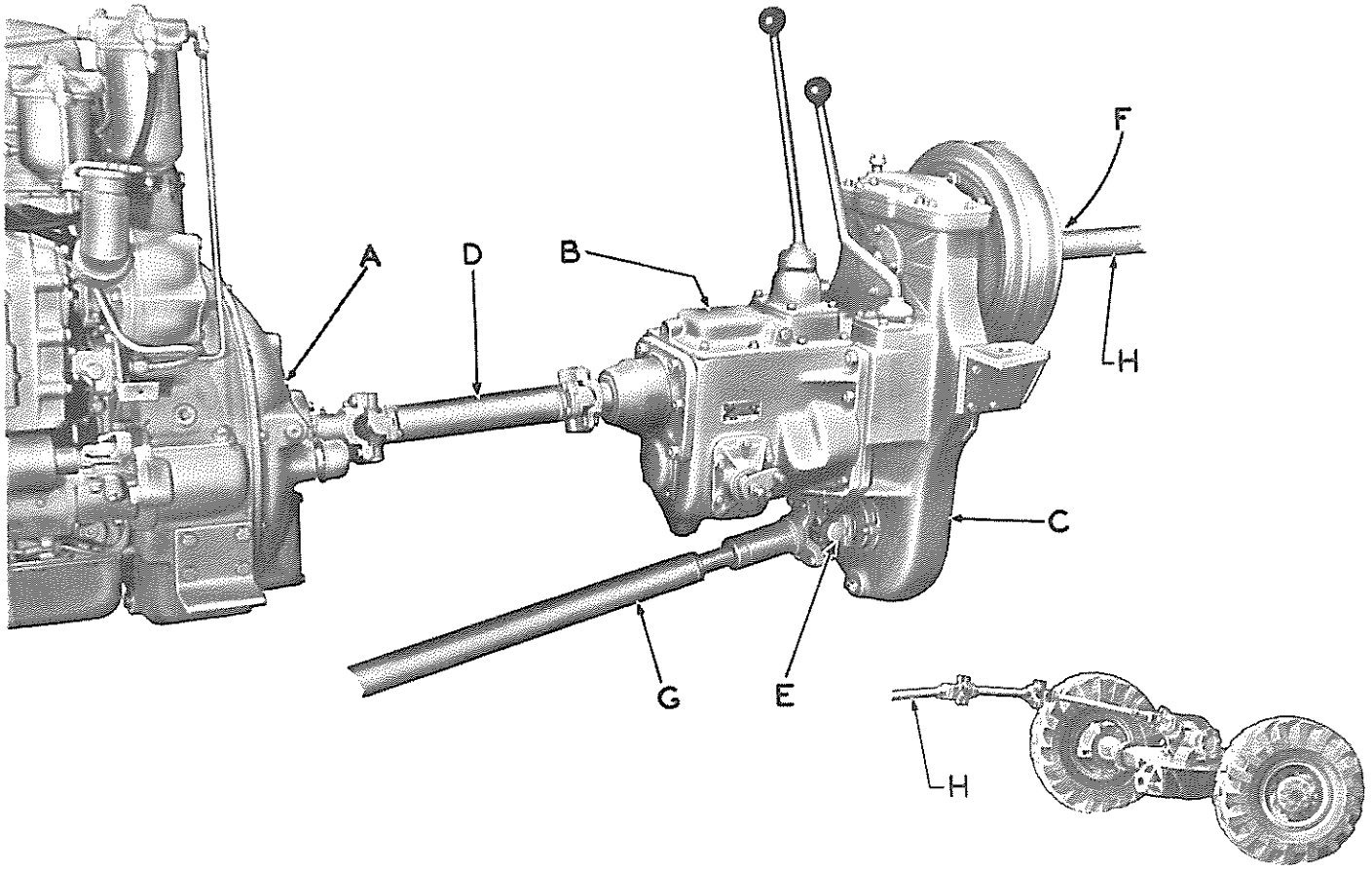
(e) Specific gravity readings should not be made immediately after water has been put into the battery. Take readings either before the water is added or after the battery has been on charge for some-time.

(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



135. POWER DISTRIBUTION - ENGINE TO WHEELS.

Every pound of the total weight of the machine is on a power driven wheel, and in this manner every ounce of engine power is transmitted to the front and rear axles.

The engine and clutch unit (A) is connected to the transmission (B) and transfer case (C) by means of a short propeller shaft (D).

The transfer case attached to the transmission extends above and below the centerline of the transmission and has two output shafts, the lower one (E) extending toward the rear, and the upper one (F) extending toward the front.

From the lower rearward shaft a propeller shaft (G) connects to the input pinion shaft of the rear axle. From the upper forward output shaft (F) of this power divider, as it might well be called, there is a propeller shaft (H) with several universal joints to carry the power down under the arched frame to the front axle.

Both front and rear axles have a double set of gears to further multiply the power on the axle shafts themselves, and eventually to the six driving wheels with tires.

136. FRONT AND REAR STEER.

The front steering angle is 25 degrees each way, and the rear steering angle is 15 degrees each way. Steering is done hydraulically by simply moving a valve handle requiring very slight fingertip effort. Motion is fast and no operator who has ever driven an AUSTIN-WESTERN power steer would go back to the old antiquated hand steering mechanism.

137. FRONT AXLE.

The front axle unit of the A-W power grader is of the double reduction type. The drive from the propeller shaft to the front axles is made first through a spiral pinion and bevel gear, and then through a pinion and spur gear fully enclosed, running in oil. It is equipped with dust proof oil seals and mounted on antifriction bearings throughout.

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 unnecessary 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.

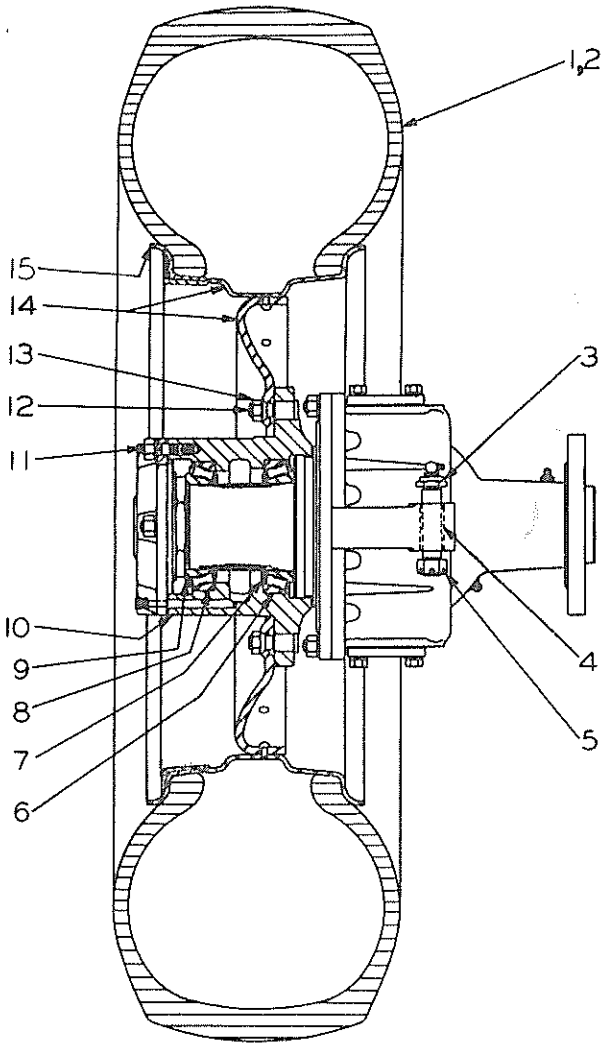
CAUTION: Do not use gasoline as it is dangerous because it may explode and cause a fire. Run machine slowly with the kerosene or fuel oil in gear case for several minutes both forward and reverse, and drain gear case. If you wish to get it absolutely clean, refill case a second time with clean kerosene or diesel fuel and repeat washing operation.

138. WHEEL REMOVAL AND REASSEMBLY

Both front wheels are attached in the same manner, so the following will apply to either right or left hand wheel.

(1) Remove all the nuts and lock washers from the drive flange studs (11) shown above.

(2) Remove the drive flange.

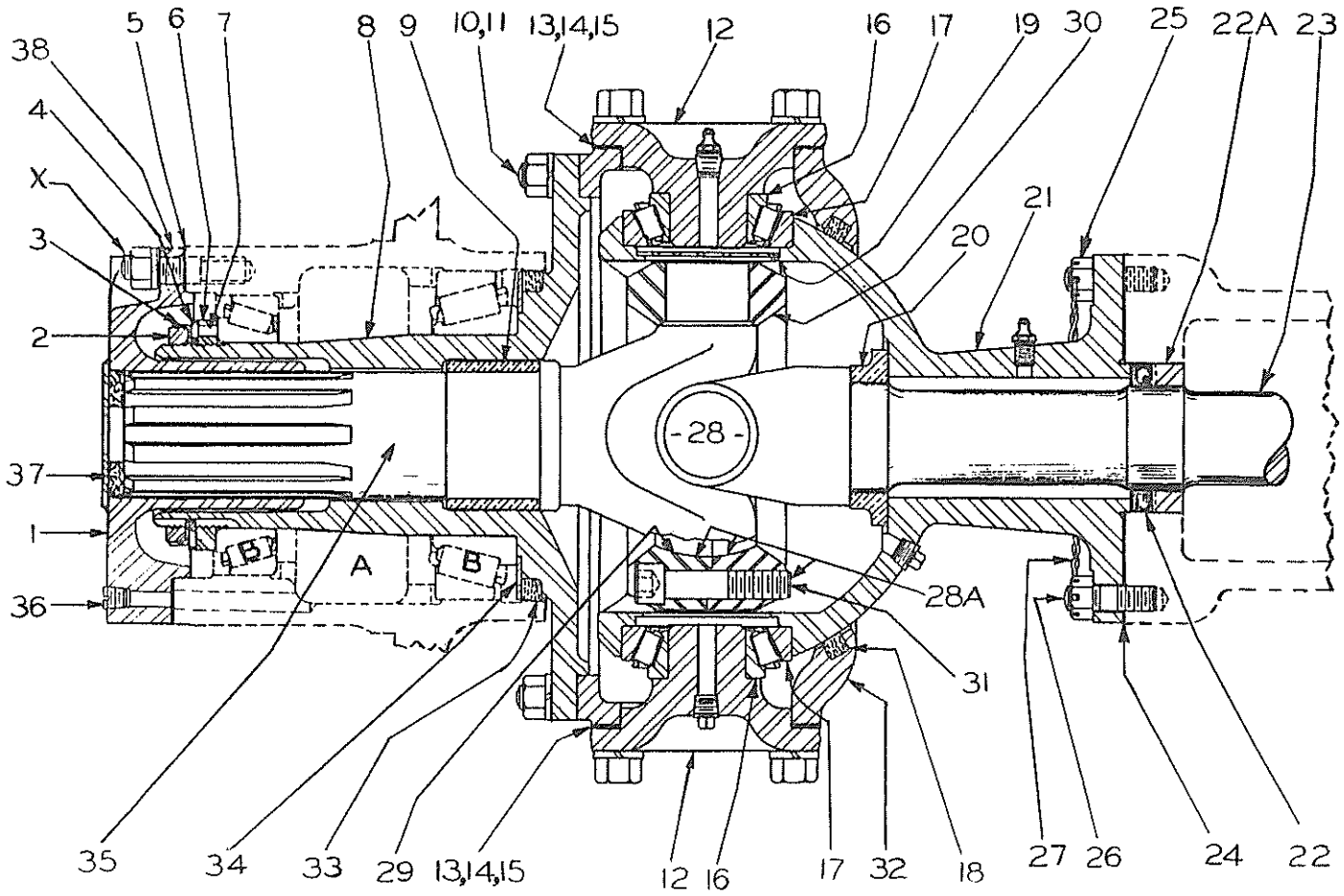


(3) If the drive flange sticks too tightly to be pulled off by hand, secure a couple of ½" hardened set screws to remove the flange. Lubricate the threads of hardened set screws well before inserting them in the threaded holes provided in the drive flange. Be sure to clean the threaded holes carefully and blow out all dirt present. The flange can then be forced off by screwing the set screws in through the flange against the wheel face.

(4) Unlock the bent over edge of lock washer (3), page 107, and remove the hub bearing lock nut (2).

(5) Remove the lock washer (3), the drilled washer (4), and the adjusting nut (with pin) (6).

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 to the ground and become dirty.

(7) If the hub bearing felt (33) is worn or damaged, replace it by prying off the inner bearing and removing the washer (34) and felt (33) shown above.

(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 (6) (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 prevent any load misalignment due to working strains.

(10) Replace the drilled washer (4). Be sure one of the holes aligns with the pin protruding from the adjusting nut (2). 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 (3). Replace and securely tighten the lock nut (2). Bend one edge of the lock washer (3) so as to firmly fix the lock nut (2).

(12) Replace the drive flange (1).

NOTE: Each drive flange (1) has a $\frac{1}{8}$" pipe plug (36) 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 (36) when the grader is being used at temperatures above 22° F.

(14) The purpose of the plug (36) in flange (1) is to make it possible (without removing the front wheels) to pump winterizing oil into compartment (A) when the temperature subsides to 22° F. and under (1/4th pint of SAE-10W pumped into each wheel port (36) will winterize the wheel bearing grease at location (B).)

(15) If an excess amount of pressure gear grease is pumped through opening (36) into compartment (A) during temperatures above 22° F., the excess lubricant will flow past the wheel felt (33). This excess lubricant should be kept off the tires.

(16) Replace lock washers and nuts on all studs.

(17) Check all nuts and retighten, if necessary, after operating grader about an hour, and again after a day's operation.

139. UNIVERSAL JOINT WITH AXLE SHAFT REMOVAL.

a. Follow the instructions in paragraph covering "Wheel Removal", page 106.

b. Remove all the nuts and lock washers from studs (10) and (11), page 107.

c. Loosen all the cap screws located in caps (12).

d. Remove the steering knuckle (8).

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 (22). There is another seal at inner end of axle shaft near the differential. 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. Wash all parts carefully with kerosene. Check and lubricate them carefully before reassembly.

140. AXLE UNIVERSAL JOINT DISASSEMBLY. (For Cleaning and Inspection Purposes Only)

a. Whenever the joint is removed from its housing for any purpose, it is a good idea to wash it and inspect it.

b. Clean and inspect all parts. If worn, chipped, or cracked, procure a new drive joint group, or parts, from your nearest parts depot.

141. WHEEL STEERING KNUCKLE DISASSEMBLY.

a. Follow the instructions covering "Universal Joint with Axle Shaft Removal", paragraph 139.

b. Remove the lock wires and nuts from the nine studs (26), page 107, in outer end of axle main housing.

c. Remove the tie rod fork bolts at (3), page 106.

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 (22), page 107, in end of trunnion socket, and replace it, if necessary. Be sure to oil it well before reassembly.

e. Remove the four cap screws from top pivot bearing cap (12) and remove the cap and shims (13), (14), and (15). 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 (12), following the same procedure used to remove the upper pivot bearing cap (12).

g. Slip the knuckle flange (32) off flanged (inner) end of trunnion socket (21).

h. The felt (18) 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.

142. WHEEL PIVOT BEARING ADJUSTMENT. ((16) and (17)). (With the Wheel Removed but Steering Knuckle Still on the Power Grader) *(See page 107)*

a. Remove the four cap screws from top pivot bearing cap (12) and remove the cap and shims (13), (14), and (15). 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 (12) so it can be put back in the original position.

b. Carefully wash out the bearing cup (17) 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 (12) with shims (13), (14), and (15). Keep these together for reassembly in original positions.

d. Wash the bearing cone, 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 (12).

g. If there is any vertical 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 of same thickness, to both top and bottom bearing caps.

Continue this adjustment until the play is just out of bearings when screws are tight, then remove a thin shim (.005") 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 (12) must be left loose until the axle and knuckle drive joint group have been put in place and knuckle (8) has been securely tightened in place by the twelve nuts on studs (10) and (11), page 107. Otherwise, knuckle flange (32) will distort and the pre-loading effect will be destroyed.

143. FRONT WHEEL TOE-IN ADJUSTMENT. *(See page 110)*

a. The A-W power grader is equipped with a tie rod adjusting nut (8) (which has both right and left hand threads). Turn the adjusting nut so that front toe-in is 0". Then retighten the two clamp bolts. Measurements to be made at the side wall of tires as close to center line of axle as possible.

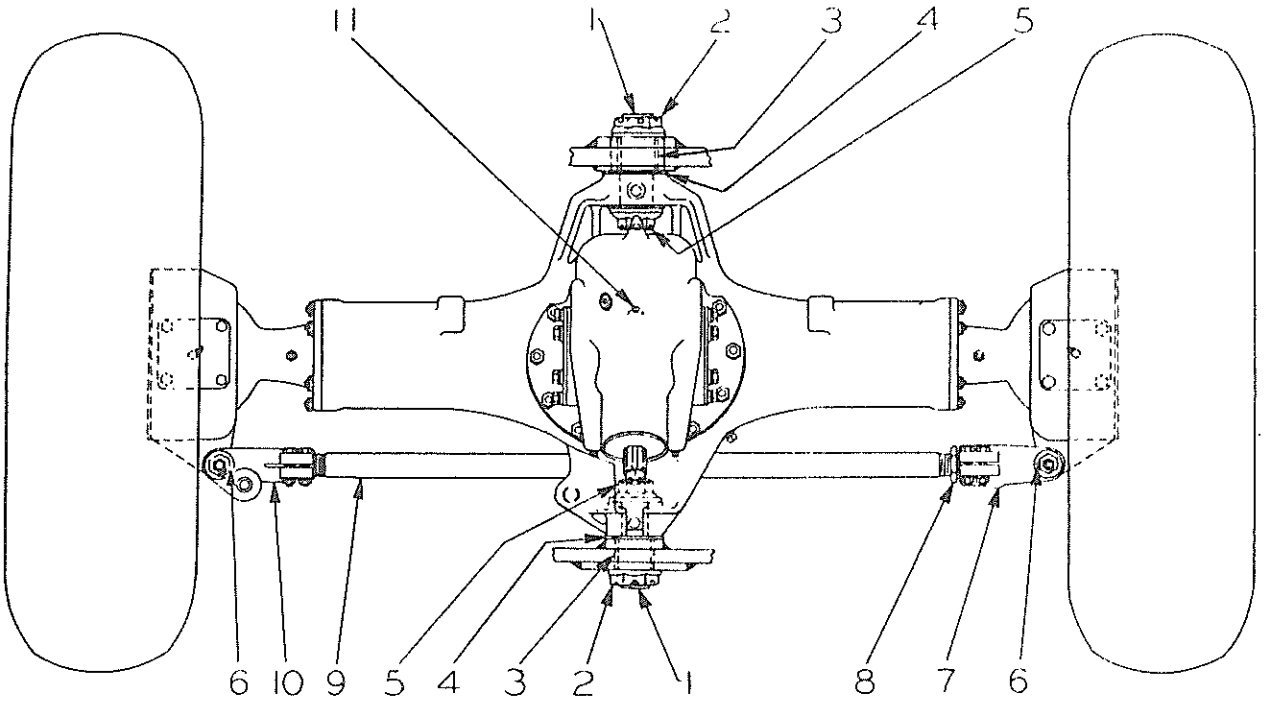
b. No toe-out should be tolerated. Failure to comply with the above will cause excessive tire tread wear.

144. REMOVAL OF FRONT AXLE ASSEMBLY FROM FRAME. *(See page 110)*

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 (5) from pivot pins (1).

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 (1).

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.

145. FRONT AXLE GEAR CARRIER REMOVAL. *(See page 113)*

a. Remove axle from frame. (See page 109, paragraph 144.) Remove bottom drain plug to drain oil from axle.

b. Block up under axle housing to hold it when wheels are removed.

c. Remove the lock wires and all the nuts from studs (26), page 107, on both sides. Remove fork bolts at (3), page 106.

d. Slide out, about 8", both the right and left wheel, with trunnion socket and axle still attached.

If the oil seals (22), page 107, are damaged or worn, be sure to replace them before reassembling.

e. Remove all the nuts from studs (40), page 113. Remove the tapered dowel bushing (46) from one of the studs.

f. Lift the gear carrier out of main axle housing.

146. HYDRAULIC BOOSTER STEERING - WHEEL CONTROL. (Special Order) (Field Installation)

a. Preliminary Check on Grader.

(1) Check wheel alignment (no toe-in or out permissible.)

(2) Check steering ram adjustment so both wheels turn same to right or left.

(3) Be sure to check the clamp bolts on ram rod end and tie rods, making sure they are tight.

b. Assembly Instructions.

(1) Install steering wheel, shafts, and Ross steering gear unit.

(2) Turn hand wheel (A), page 112A, all the way to the right and to the left.

The hand wheel should turn freely, but if not, look for binding in support bearings (B), pages 112 and 112A.

(3) Count the revolutions of hand wheel to determine center position.

With hand wheel set at half the total revolutions, assemble steering arm (C), page 112, at axle as close to dimension (H) as possible.

(4) Assemble booster valve, flow control regulator, hoses and tubing according to piping diagram shown on page 112D.

(5) Square head pipe plug is to be removed from top of gear carrier and replaced by socket head plug (H), page 112, to eliminate possible damage to hoses.

(6) With booster valve in neutral and front wheels straight, assemble steering valve rod (K), page 112.

Next assemble linkage (C), by turning shaft (L) until dimension (M) is 27/32".

c. Steering Arm (C) Adjustment.

(1) With set screws (J), page 112, out, steer wheels the maximum distance to right. Then screw in set screw against stop.

Turn wheel slightly to left and give set screw two extra full turns and lock into place.

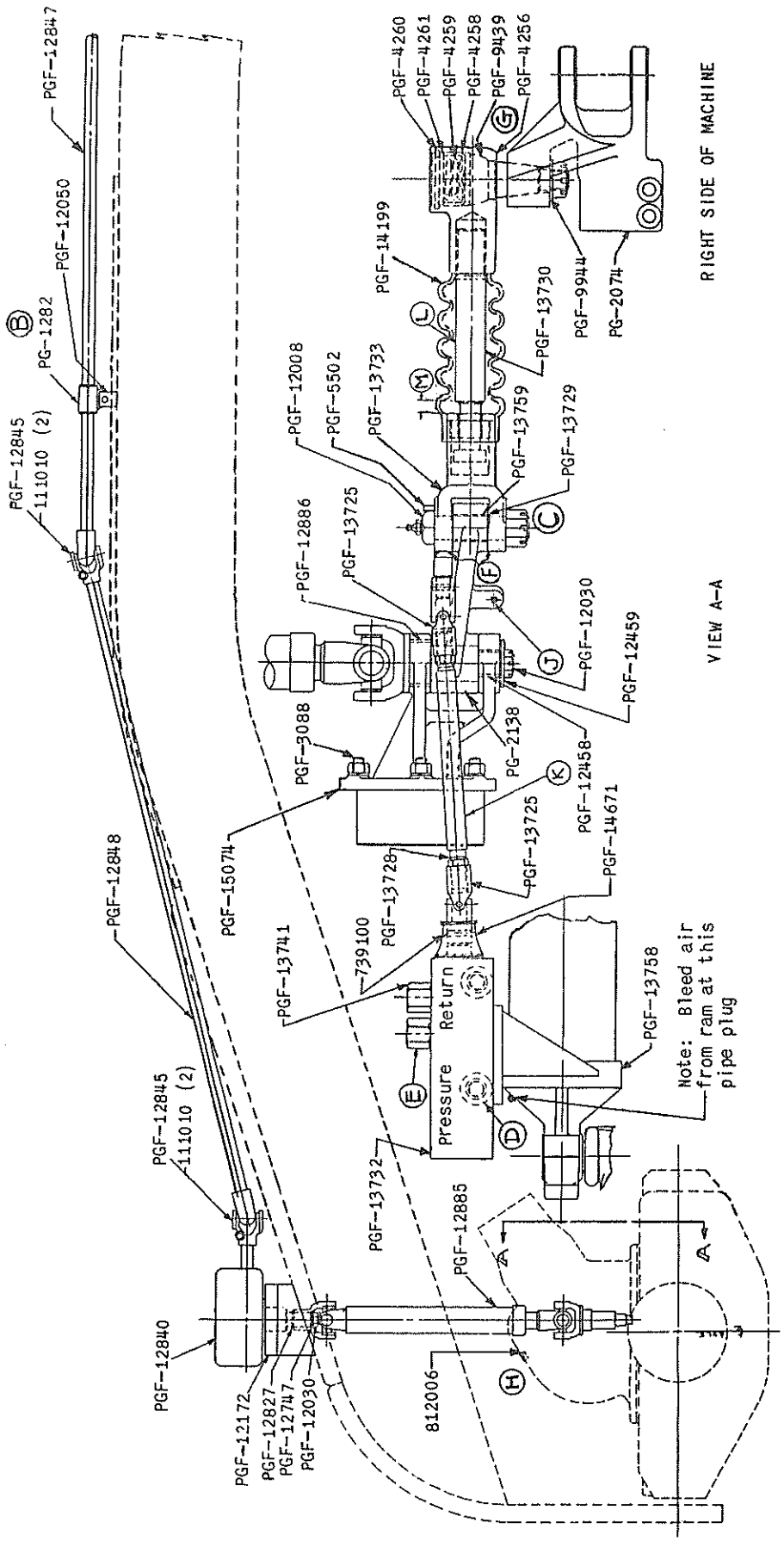
Follow the same procedure for steering to left.

(2) Shims (F), page 112, are provided for steering arm (C) to permit alignment with manual steering linkage (G).

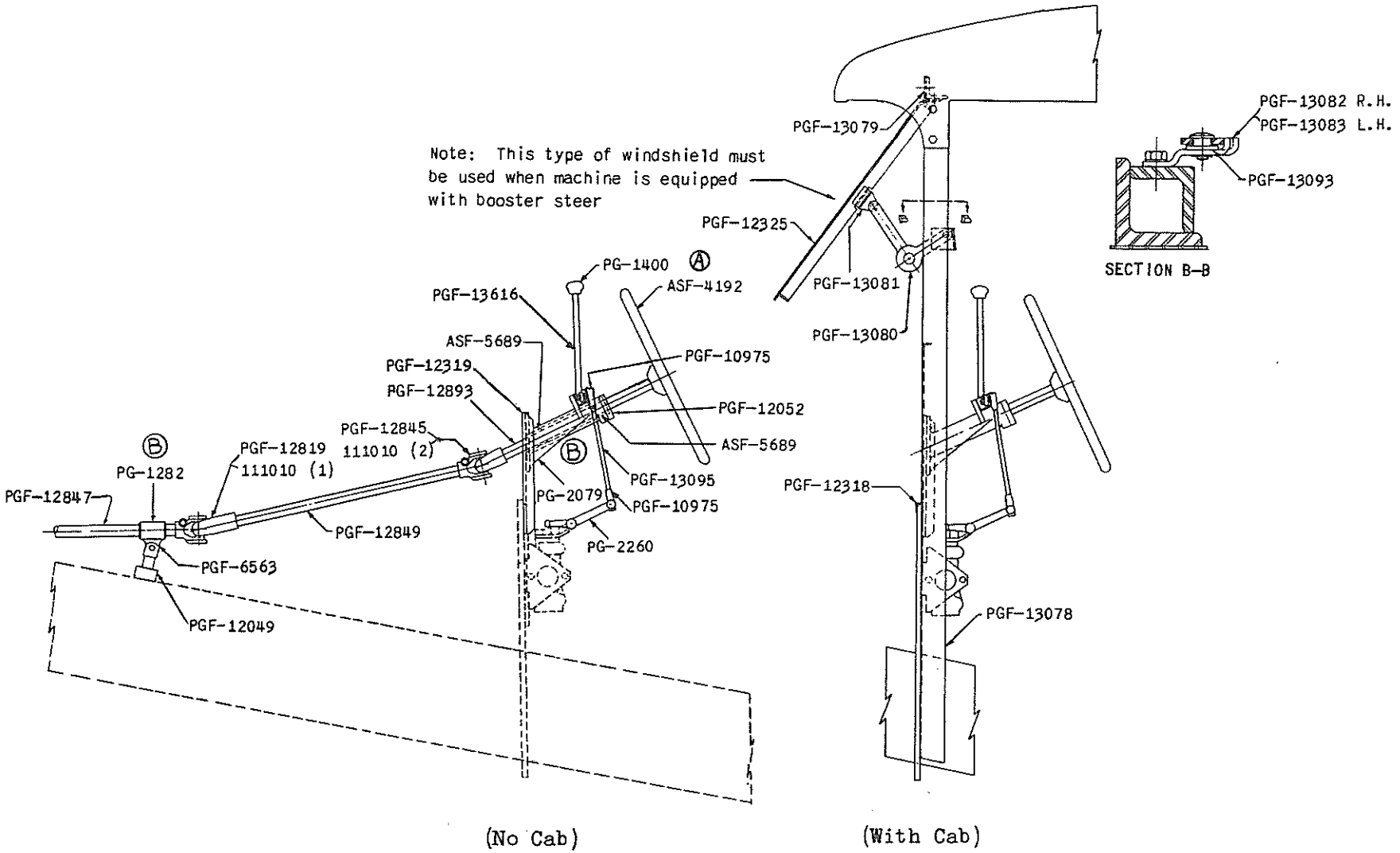
d. Lubrication.

(1) Lubricate each grease fitting with general-purpose pressure gun grease ("Lithium" type preferred); two strokes of lubricator every 50 hours of operation.

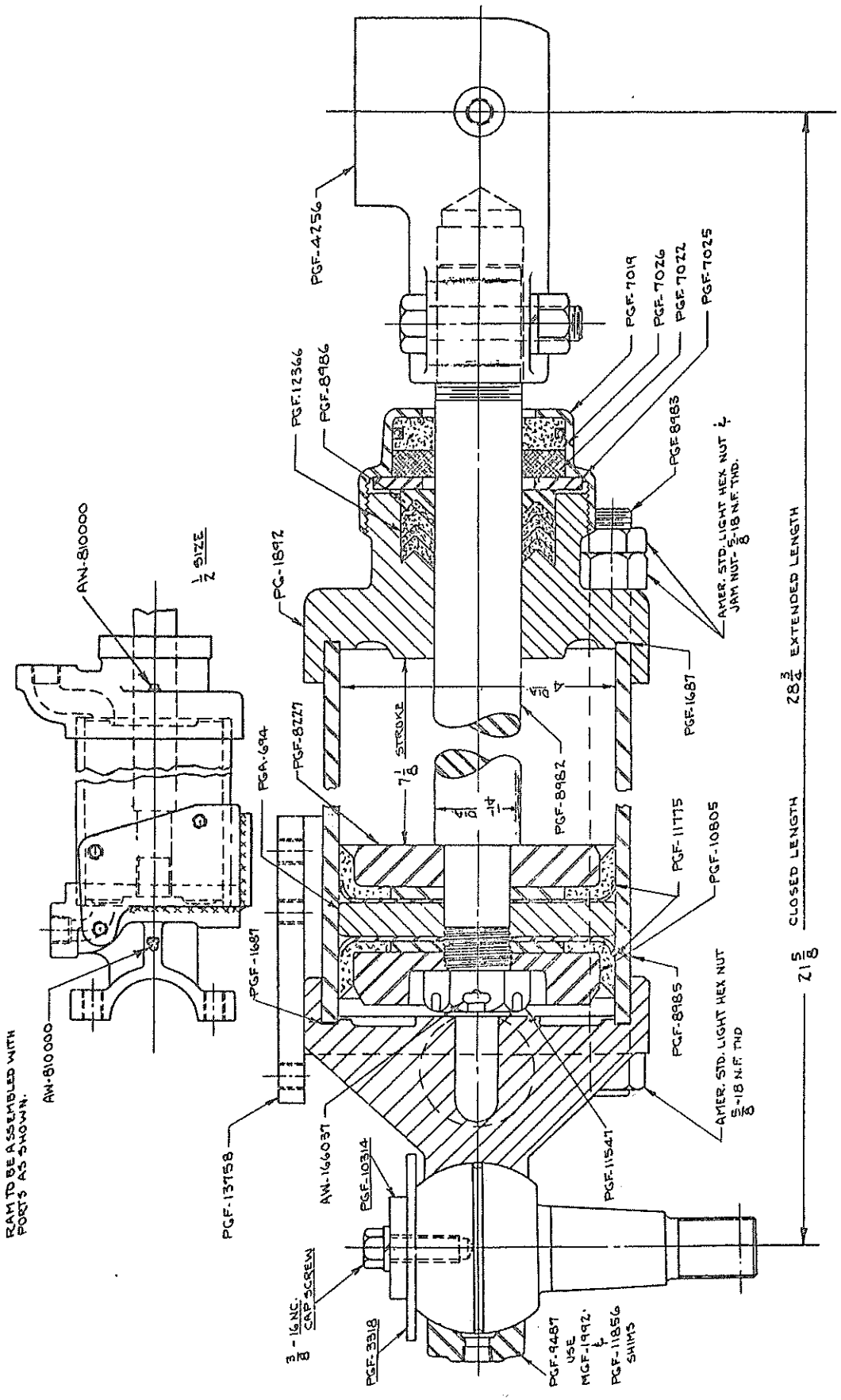
(2) Add SAE-140 oil (for year around use) to Ross steering gear unit.



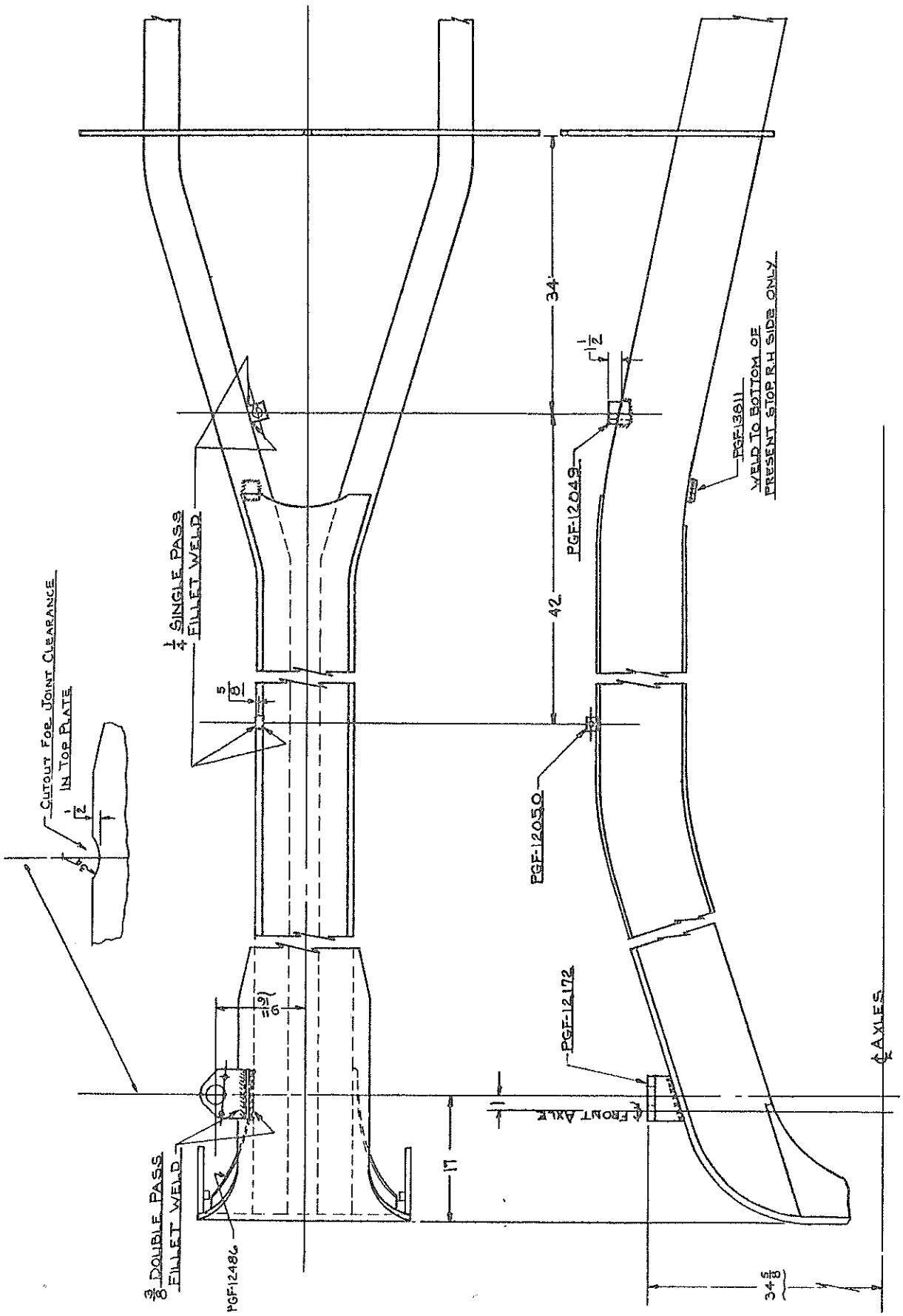
Linkage for Booster Steering



Steering Wheel and Valve Linkage for Booster Steering

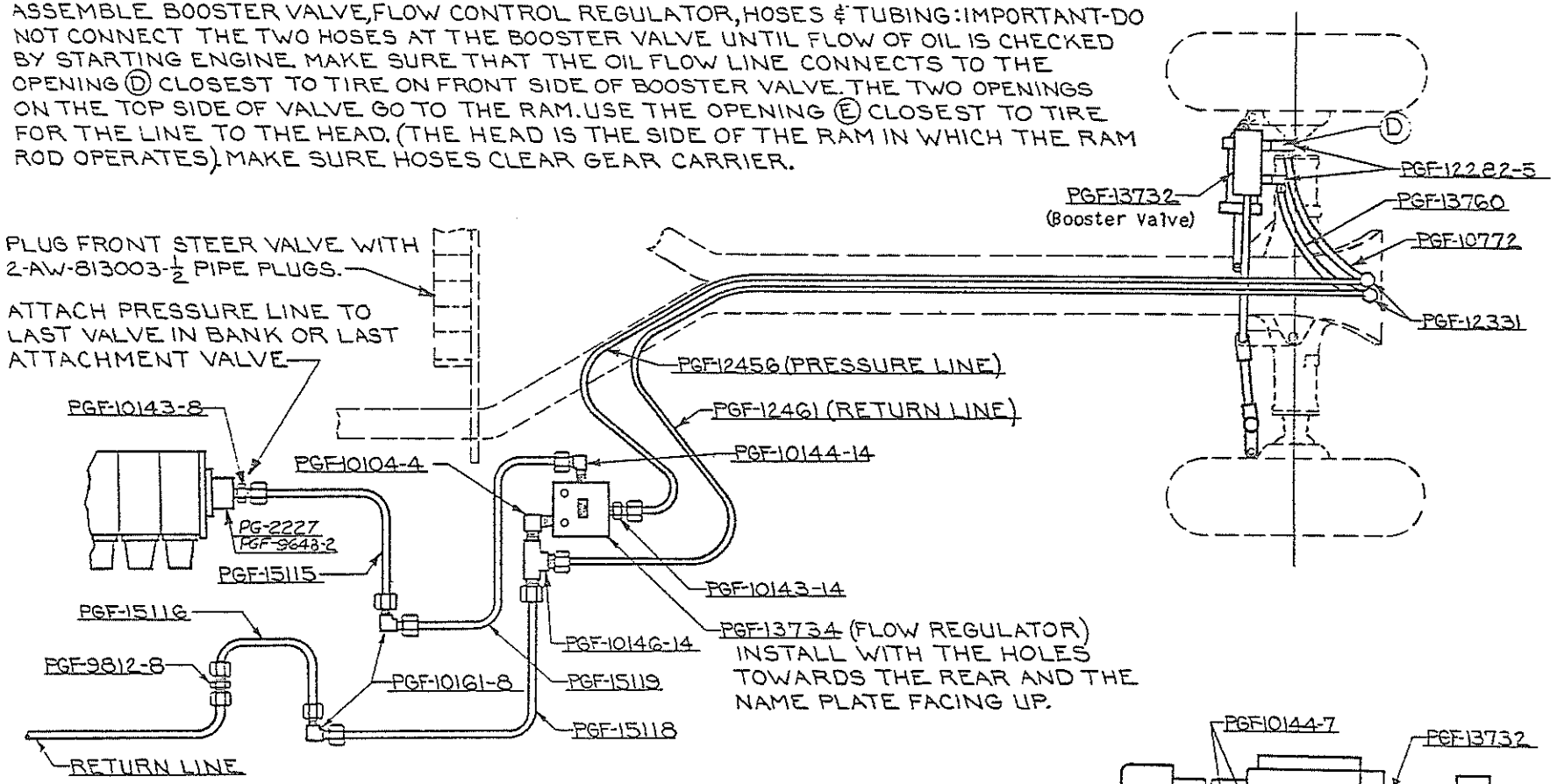


Ram for Booster Steering

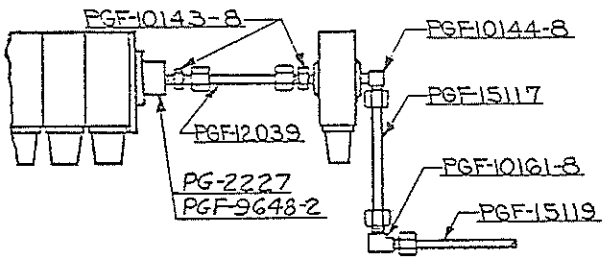


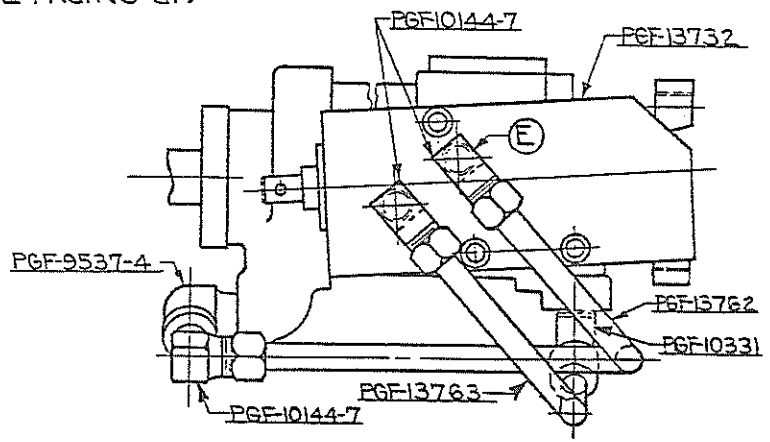
Supports for Booster Steering

ASSEMBLE BOOSTER VALVE, FLOW CONTROL REGULATOR, HOSES & TUBING: IMPORTANT-DO NOT CONNECT THE TWO HOSES AT THE BOOSTER VALVE UNTIL FLOW OF OIL IS CHECKED BY STARTING ENGINE. MAKE SURE THAT THE OIL FLOW LINE CONNECTS TO THE OPENING Ⓓ CLOSEST TO TIRE ON FRONT SIDE OF BOOSTER VALVE. THE TWO OPENINGS ON THE TOP SIDE OF VALVE GO TO THE RAM. USE THE OPENING Ⓔ CLOSEST TO TIRE FOR THE LINE TO THE HEAD. (THE HEAD IS THE SIDE OF THE RAM IN WHICH THE RAM ROD OPERATES). MAKE SURE HOSES CLEAR GEAR CARRIER.



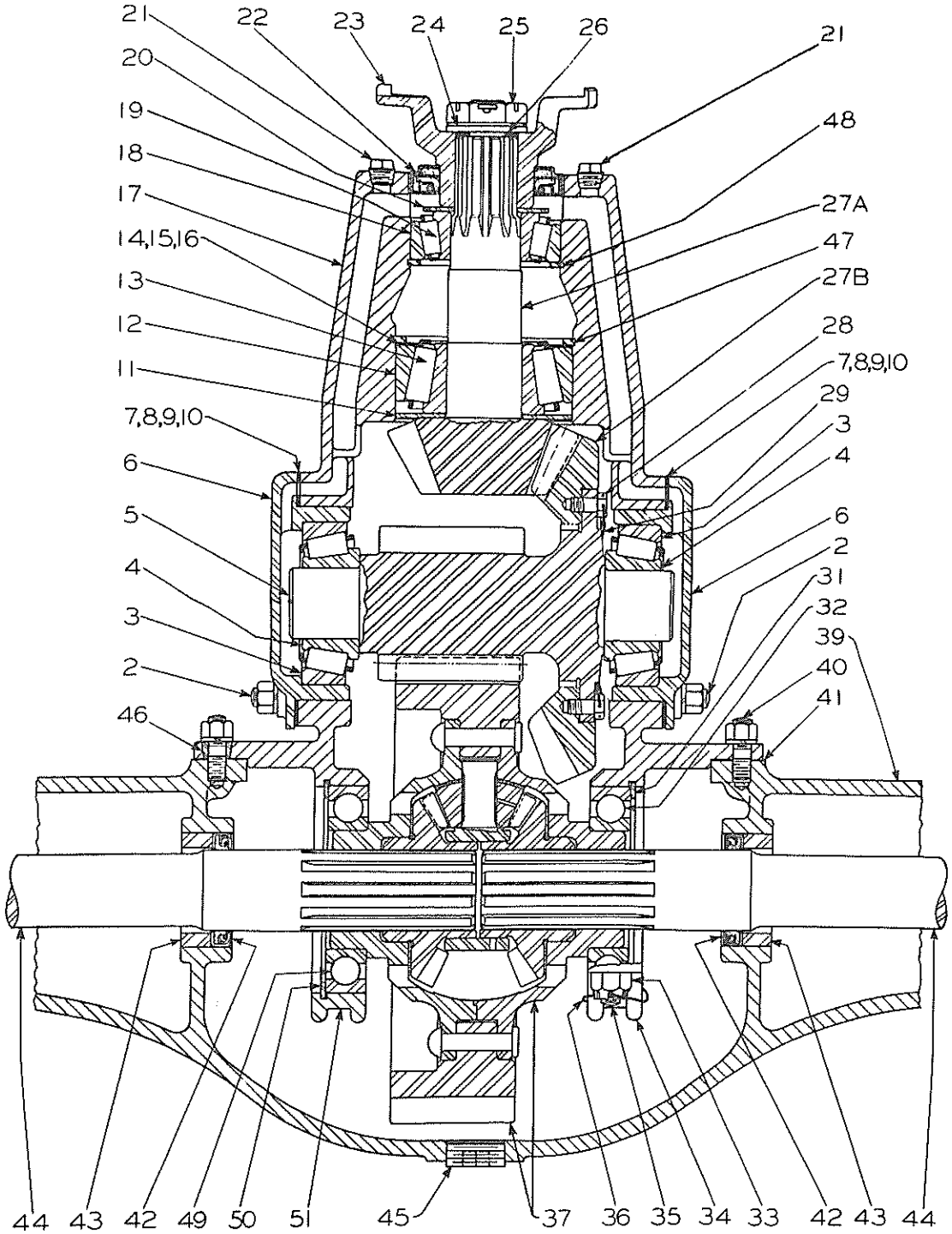
PIPING WITH ATTACHMENT VALVE





TOP VIEW OF VALVE AT STEER RAM

Piping for Booster Steering



147. FRONT AXLE GEAR CARRIER DISASSEMBLY. (After Removing the Assembly from Axle Housing)

a. Remove the lock wires and nuts on the four studs (35).

b. Remove the bearing caps (51) and (34). (If they are not already marked, mark them so they can be put back in exactly the same position in reassembly.)

c. Lift out the bull gear and differential group (37).

d. If ball bearings (32) and (49) on differential hub are worn, replace them with new ones.

e. If you desire to remove the one piece bull pinion and bevel gear hub (5), proceed as follows:

(1) Remove nuts and washers from studs (2).

(2) Remove the left bearing cap (6). Save the gasket (7) and all shims (8), (9) and (10). Wire these to the cap so they will be replaced in original position.

(3) Remove the right bearing cap (6), saving the gasket (7) and shims (8), (9) and (10). Wire them to the cap to prevent mix-up.

(4) Remove the bearing cone and roller assembly (4) from ring gear end of shaft (5). If bearing cone (4) cannot readily be driven from shaft, pour hot oil over bearing only, to expand it for easier removal. (When reassembling, polish both ends of shaft (5) using emery cloth so bearings will drive on and off easier.)

NOTE: Keep the shaft (5) cold.

(5) Remove the shaft (5) after removing the cap screws (28) holding the bevel gear (27B).

(6) If inspection shows chipping or flat spots on either bearing, replace both the cone and cup of that bearing.

(7) Clean and check all parts carefully before reassembly.

f. If you desire to remove the bevel pinion (27A) proceed as follows:

(1) Remove the cotter and nut (25).

(2) Remove washer (24) and universal joint fitting yoke (23).

(3) Place a bronze drift on threaded end of pinion shaft, and drive it back through bearing (19). Be careful to save all the shims (14), (15) and (16), also washer (20).

(4) Check oil seal (22) and replace it with new one if necessary.

(5) If inspection shows any flat spots or chipping on bearings (12), (13), (18), or (19), replace both the bearing cone and the cup of damaged bearing.

148. FRONT AXLE GEAR CARRIER REASSEMBLY. (See page 113)

a. After all usuable parts have been carefully cleaned, proceed as follows:

(1) Assemble cup (12) with shims (14), (15) and (16), also cup (18), into the carrier casting (17).

(2) Place washer (11) and cone (13) on shaft (27A) as shown.

Next insert shaft (27A) into location.

Install cone (19), washer (20), seal (22), yoke (23), gasket (26), washer (24), and finally nut (25).

(3) Tighten nut (25) sufficiently to remove all end clearance at bearings (13) and (19). Do not over-tighten nut (25) because the bearings (13) and (19) will be adjusted too tightly endwise.

Shaft (27A) should turn freely, except for the friction applied by the seal (22) around the yoke (23).

(4) If you install too many shims (14), (15), or (16), the teeth of pinion (27A) will extend too far into the ring gear teeth near arrow (27B).

The teeth of both pinion (27A) and gear (27B) should be approximately flush with one another at the back side, or near arrow point (27B).

If you do not install a sufficient quantity of shims (14), (15), or (16), then the teeth of pinion (27A) will be outward from the teeth of gear (27B).

See pages 116 and 117 for proper tooth contact.

(5) When installing a new bevel gear (27B), or a new pinion and gear hub (5), be sure to temporarily assemble the two together before putting them into the gear carrier. By doing this you will be sure they fit together properly.

The bevel gear is held firmly in place by cap screws (28) through the backing flange. 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 (5).

Insert gear hub (5) (with gear (27B) slipped over end) into top of the gear carrier housing.

Align the bevel gear with flange and slip the gear into place tightly against the flange, as shown on page 113.

Be careful not to damage the gear teeth.

Insert and tighten the screws (28). Install lock wire (29).

If necessary (not recommended) heat the bearing cones (4) in hot oil (not over 300°F.) and tap them into place against the gear hub shoulders. (Always replace worn bearings.) Both ends of shaft (5) can be polished down by means of emery cloth in order that the bearing cones (4) can be more easily removed.

Align the oil holes and replace both of the bearing caps (6), together with the gasket (7) and the shims (8), (9) and (10), but first make sure the bearing cup (3) is in good condition. If otherwise, replace it and bearing cone.

Check the position of gasket (7) and shims (8), (9) and (10), and the bearing caps (6).

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.

If end play exists in the one piece pinion and gear hub (after the caps (6) are tightened), it can be eliminated by removing shims (8), (9), or (10), as required.

See pages 116 and 117 for diagrams on proper tooth contact. Be sure the pinion and gear hub has only a slight drag when both caps (6) are tight.

If pinion (27B) needs to be adjusted for proper mesh with bevel gear, add or remove shims (14), (15), or (16) as required.

See pages 116 and 117 for diagrams on proper tooth contact.

(6) Place the large spur gear and differential group (37) in position after installing the two hub bearings (32) and (49).

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.

Replace the bearing caps (34) and (51) and tighten the nuts on studs (35) and wire them to prevent their loosening.

(7) Install a new gasket (41).

Lower the now completely assembled gear carrier down into front axle housing (39).

Put the tapered dowel bushing (46) in proper place and tighten this stud nut first; then tighten the rest of the nuts on studs (40).

(8) Carefully push the axles and wheels back into axle housing and replace and tighten the slotted nuts (25), page 107.

Install wires through stud ends to keep nuts from loosening.

(9) Check the toe-in adjustment. See page 109, paragraph 143., "Front Wheel Toe -In Adjustment."

(10) Fill axle housing with recommended oil. (See lubrication charts, pages 5 and 6.)

Pour about a pint of this oil into either hole located at front side of the pinion compartment near fitting yokes. These two holes have a 1/2" square head pipe plug (21), page 113, in them. This oil prevents the bearings (13) and (19) from insufficient lubrication when first starting newly assembled axle.

149. *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:

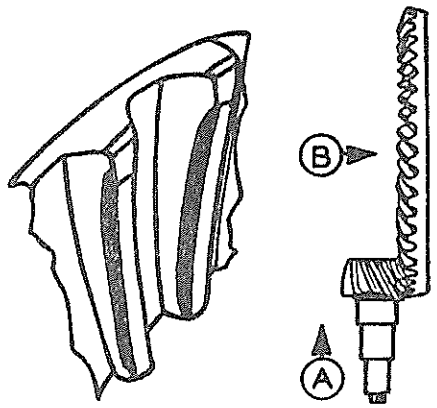
First: The *factory adjustment* of bevel drive gear and pinion sets is as correct as special equipment and years of experience in building thousands of axles can make it, and *should not be disturbed except when absolutely necessary.* For example, should it be necessary to dismantle and reassemble the 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.

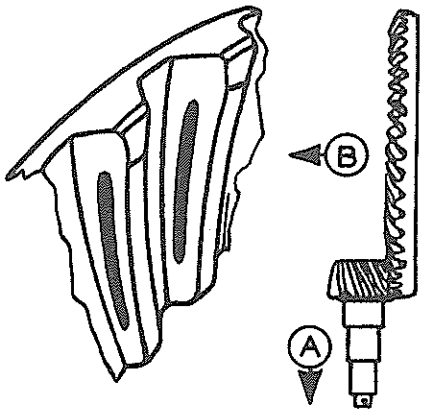
Second: Always bear in mind that gears and pinions are matched at the factory, and as far as possible should remain matched in service. *Well matched sets operate quietly.*

b. Checking Tooth Contact.

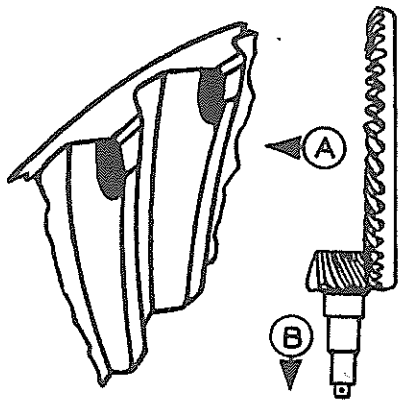
This is accomplished by means of oiled red lead applied lightly, or sparingly, to the drive side of the bevel gear teeth. When the pinion is rotated the red lead is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape and location of the contacts. Sharper contact impressions 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.



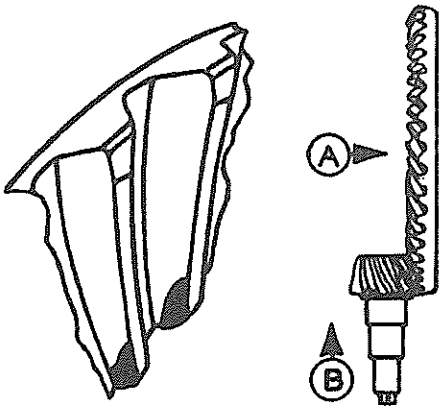
(1) The above diagram shows a HIGH NARROW CONTACT, which is undesirable and will result in noisy operation, galling, and overloading of the teeth. To obtain correct contact, remove shims to move the pinion (A) in toward the toe of the gear teeth (toward the center of the axle) to lower contact area to 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.



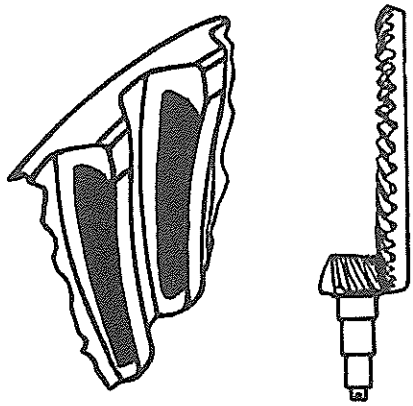
(2) The above diagram shows a LOW NARROW CONTACT, which will result in galling, grooving of teeth, and noise. To secure correct contact, add shims to move pinion (A) out from gear (away from center of axle) a sufficient amount to move the contact area to the proper location. To obtain correct backlash (.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 lenghtwise 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.

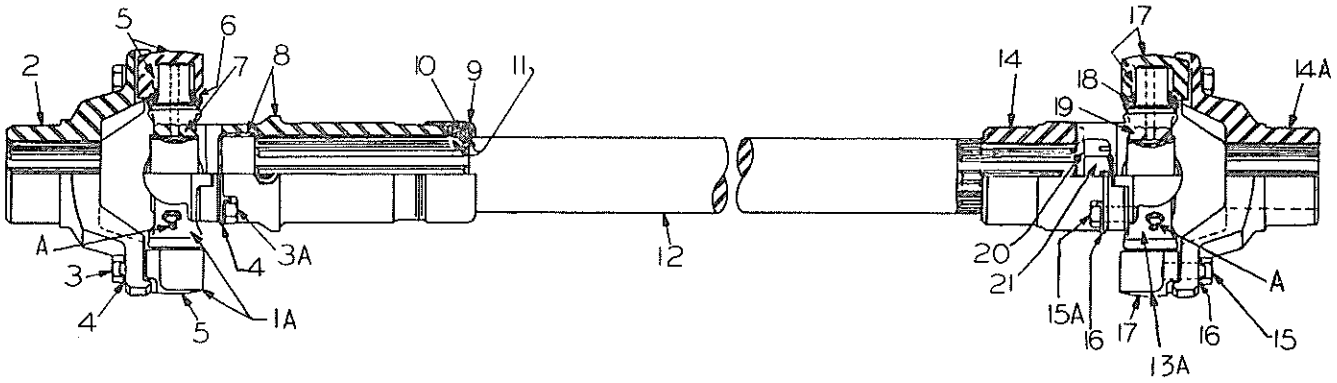
150. PROPELLER SHAFTS.

a. Lubrication.

The needle bearings are packed with lubricant at time of assembly. Grease fittings at (A), shown below, are provided in each bearing group.

The joints should be dismantled, cleaned, and inspected every 5000 hours of operation. Worn parts should be replaced at that time.

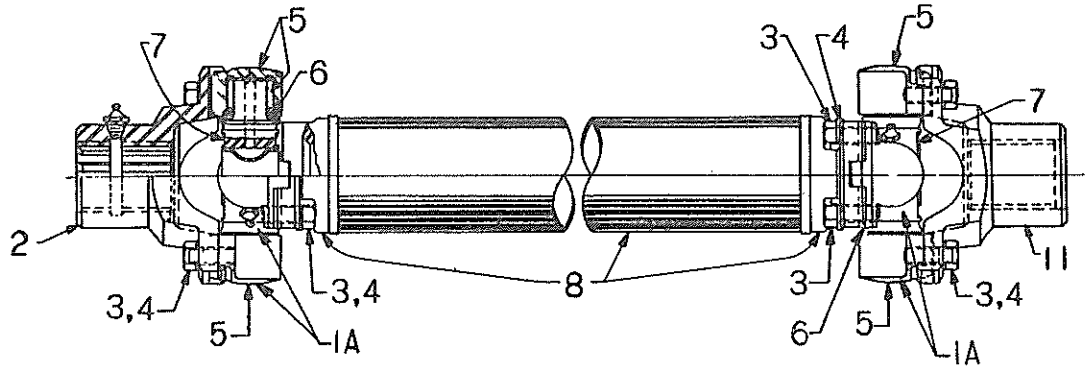
The needle bearings should be repacked with lubricant before assembly. (See lubrication chart, page 6.)



Front Section of Front Propeller Shaft

b. Front Section of Front Propeller Shaft.

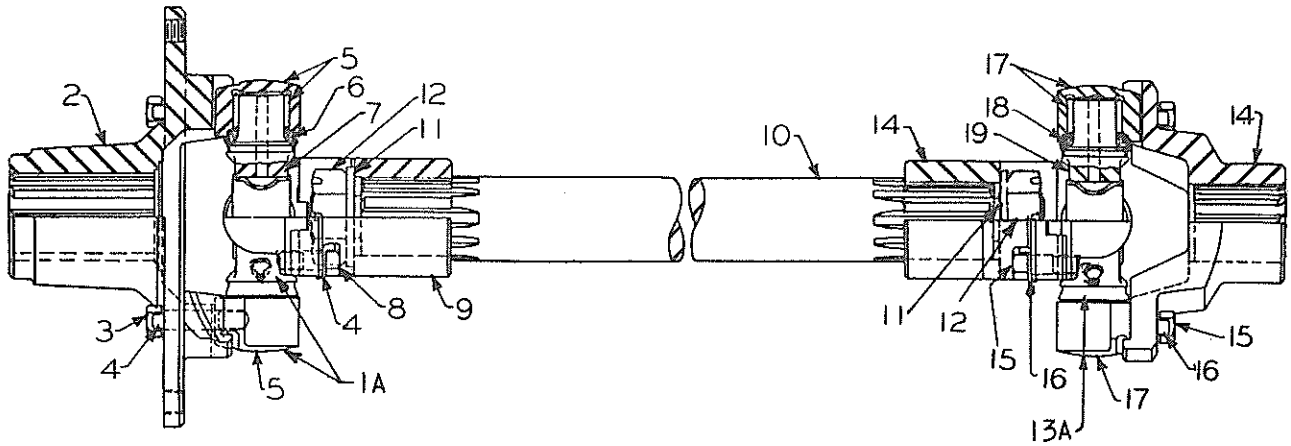
The slip yoke (8) must be installed at the rear end (away from the front axle). When assembling slip yoke (8) to shaft (12) be sure to time the yokes (8) and (14) turned up.



Clutch to Transmission Propeller Shaft

c. Clutch to Transmission Propeller Shaft.

When making repairs to the main clutch group, the tube group (8) may be removed after first removing the eight cap screws (3).



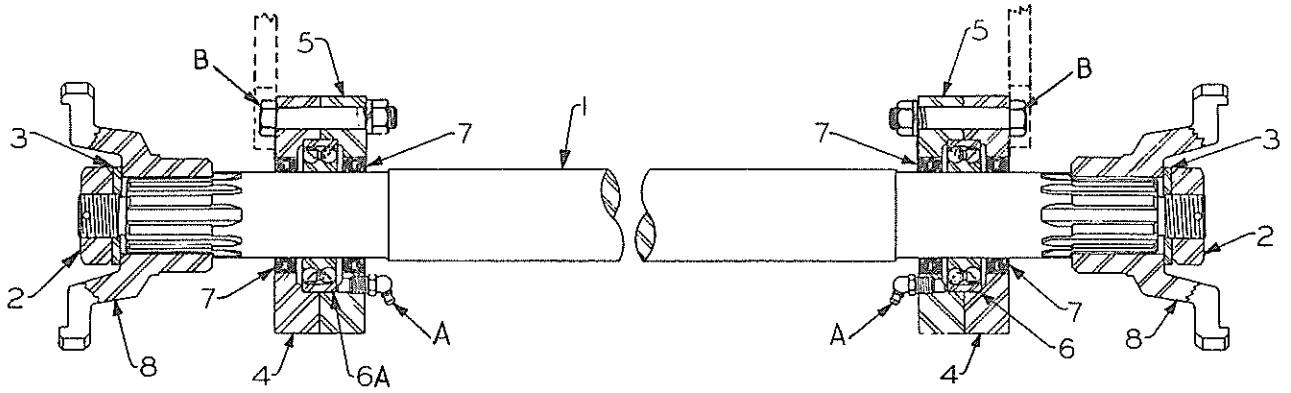
Transfer Case End

Rear Section of Front Propeller Shaft

d. Rear Section of Front Propeller Shaft.

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 cap screws (8) to the side, also the fitting yoke (14), located at the right end of shaft (10), is shown correctly timed to the splined shaft (10). This procedure indicates the proper timing of these yokes to the propeller shaft "U" joints.



Center Section of Front Propeller Shaft

e. 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 6.

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.

151. 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.

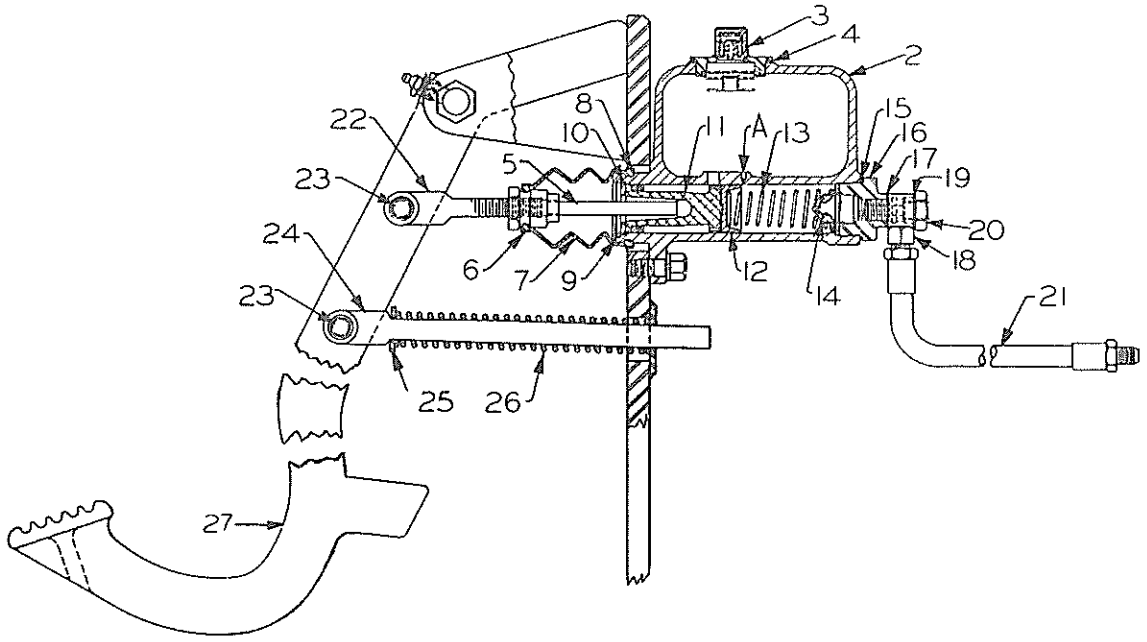
The foot pedal should be adjusted so that there is approximately 1" of free movement at the tread portion of the pedal before the pressure stroke begins. Should the master cylinder link be adjusted so that there is no backlash in the foot pedal, the master cylinder piston and cup may not return sufficiently to uncover the master cylinder compensating port (see (A) below), 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, either by bleeding, or allowing the fluid to cool.

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 Adjustment.

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), page 121. 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 page 121)

(1) Jack up rear wheels and one front wheel clear of the floor.

(2) Remove the four 3/8" pipe plugs (54) from brake drum (46). (See page 124.)

(3) Release brake. Revolve wheels, causing brake to rotate until arrow that is cast into the brake drum (46), page 124, 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), page 121, enough to permit turning the anchor pin with a screw driver (inserted through adjusting hole in 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.

152. HAND BRAKE.

The hand brake lever and interconnecting cable actuates lever (25). See below.

Periodic mechanical adjustments are not required to the hand brake mechanism.

Lubricate daily the hand lever pins and internal cable, using SAE-10W oil.

153. HYDRAULIC FOOT BRAKE MASTER CYLINDER.

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), page 119, clean on master cylinder to prevent air vent being plugged with dirt.

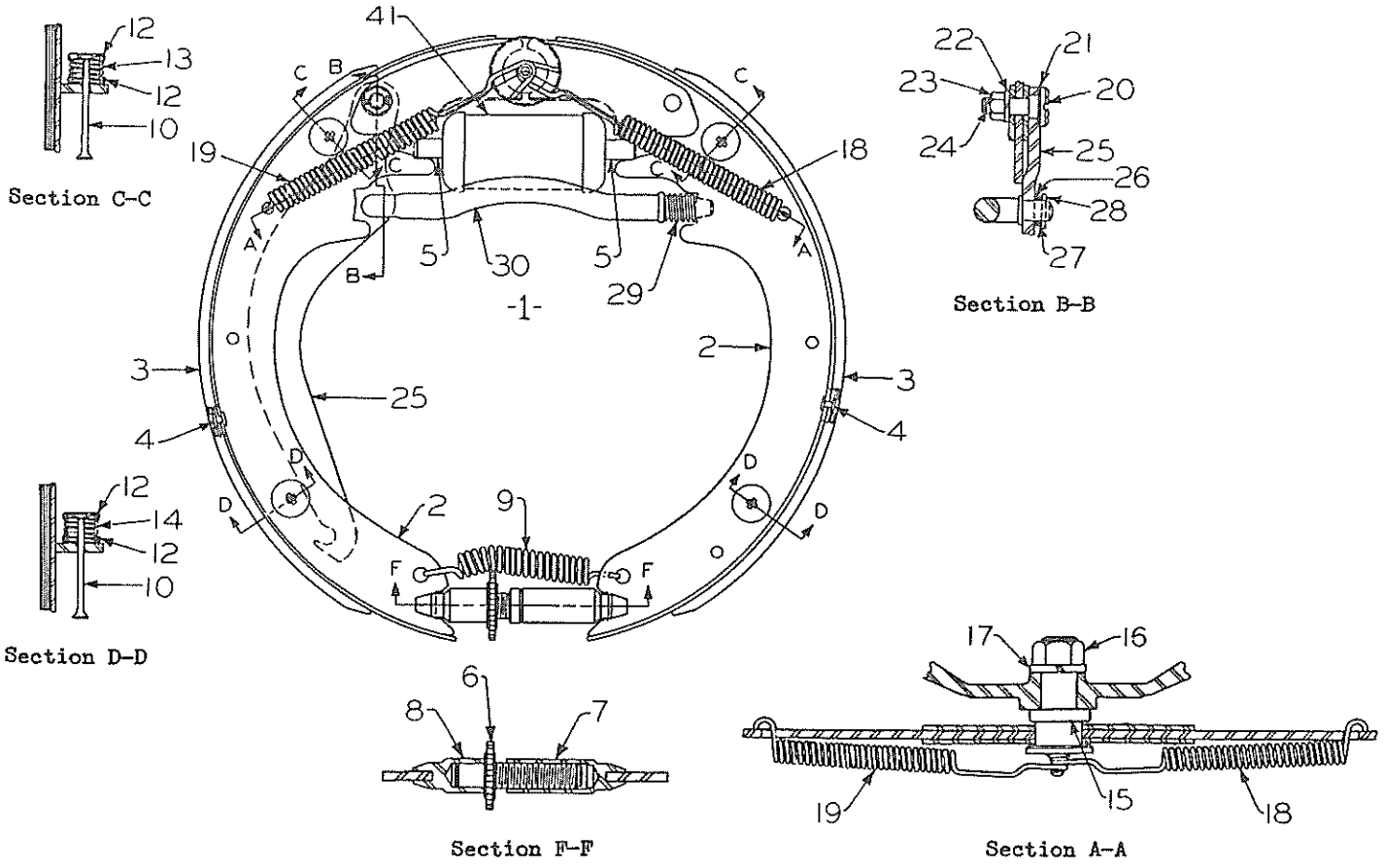
Use only genuine Lockheed or Delco brake fluids. Substitutes may do considerable damage to the hydraulic system.

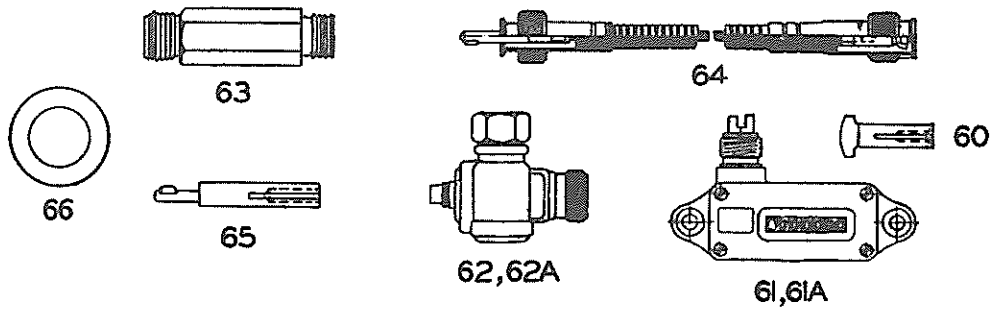
CAUTION: Be sure to keep the reservoir half full of brake fluid when bleeding the brake system. Should the reservoir be drained during the bleeding operations, air will again enter the system and rebleeding will be necessary.

153A. AUXILIARY BRAKE. (Special Order) (Original Equipment Only)

The auxiliary brake used on A-W graders is installed on a flange which is part of the rear gear carrier. The brake assembly is of the same basic type used for the primary brake. Hydraulic lines for the two brakes are in parallel and are actuated at the same time with one brake pedal. There is no emergency brake unit on the auxiliary brake.

All instructions pertaining to adjustment and maintenance (page 119) apply to the auxiliary brake and must be performed at any time the primary brake is adjusted.

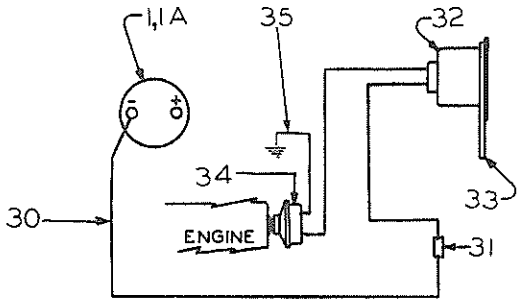




153B. ODOMETER. (Special Order)

The odometer attachment is not standard equipment on A-W graders but it is highly recommended as an aid to proper maintenance and care. The use of an odometer will greatly facilitate maintenance of complete machine records.

The odometer is simply installed by removing cap (32), page 124, and screwing adapter and washer (63 and 66 above) with drive tip (60) and shaft extension (65) inserted, into the tapped hole in the transfer case.



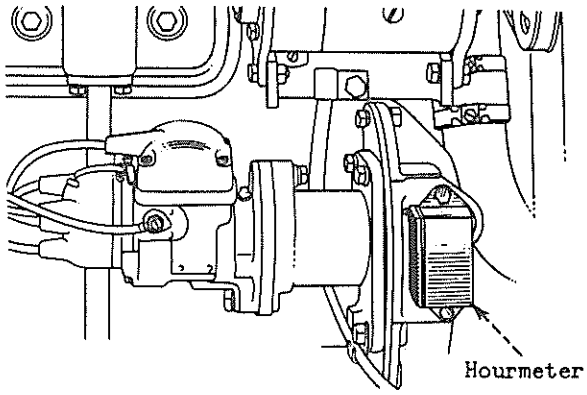
Wiring for Hourmeter
(for GM 71 Series Engine)

153C. HOURMETER ATTACHMENT.
(Special Order)

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.

The front wall of the grader cab has a hole provided through which the adapter is installed.

The odometer head is mounted on the left side of the front cab wall and a correct right angle joint (each tire size requires a different angle joint) along with a flexible shaft complete the unit.



The International UD-14A engine can be equipped with a mechanical unit (shown above) either as original equipment or in the field.

The General Motors 71 series engines use an electrical unit (shown at left). The meter unit (32) is mounted in a hole provided in the voltage regulator bracket (see "A", page 2A) and the sending unit (34) at left is inserted into oil gallery at "B" (page 2A) after removing the pipe plug. The electric wiring is as shown at left.

With "homemade" brackets this unit can also be used on a UD-14A engine.

154. 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 operator's seat, battery box, and dash. Two hydraulic lines (61) and (62), pages 147, must be disconnected at the hydraulic valve bank.

Certain equipment, such as a cable hoist of not less than 1/2 ton capacity, and the necessary wood blocking, 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 127; (50) and (11), page 124. The center section of front propeller shaft, page 118A, may now be removed, after removing the bearing housing to frame bolts (B), page 118A.

NOTE: Shaft (1), may have to be shifted forward slightly within the bore of bearing (6).

(2) Remove shift lever group with cover, after removing the nuts at (26), page 126. Also remove the two sheet metal covers near the top of the transmission.

(3) Remove pin (7). Then remove rod group, after removing the cotter pin near (9), page 132.

(4) Remove brake cable at hand lever.

(5) Remove hydraulic brake hose at master cylinder and (20), page 119.

(6) Remove socket (89), with shift lever (77), page 125. Also remove guard under the transfer case.

(7) Remove the two bolts (94) and (102), page 125.

(8) Place suitable blocking under transmission.

(9) Use one cable hoist and attach lifting end over the front two studs (26), page 126. (Balance of hydraulic piping need not be removed.)

(10) Transmission and transfer case may now be shifted forward about four inches, and carefully lowered to the ground by means of the hoist.

(Remove blocking progressively as transmission and transfer case is being lowered to the ground.)

Reassembly is the reversal of the above procedure.

155. TRANSFER CASE DISASSEMBLY.
(See page 124)

To remove the transfer case from the transmission, it is necessary to first follow the procedure outlined in paragraph 154.

The 2-speed transfer case is attached to the machined rear face of the transmission in the power division gear case and contains six gears. This case pilots over the outer race of the end bearings at the top transmission shaft.

Eight large studs (16) and (26A) 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 (37) and oil guards (38), page 124.

(2) Remove nut (52) on upper drive shaft (51), also universal joint brake flange (50). Remove the nuts from the studs (35) and (53). Bearing cap (34) may now be pulled out, after which the shaft (51) 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 (45), shims (41), with Timken bearing and cup, will come out with the shaft. Keep the shims wired to plate (45) while in dismantled state.

The upper gear (39) may now be lifted upward and out of the case, together with the rear Timken cone (4).

(3) Remove the nuts from studs at bearing support (67). Next pull out the bearing housing (67). The snap ring (57) should now be removed. The gear (31) may now be pulled off shaft (24), together with the ball bearings (58), roller bearing (58A) and thick spacer (59), and thin spacer (60).

(4) The two lock screws (81), with lock wires (82), page 125, may be removed, permitting the removal of shifter shafts (83) and (91). Also remove two springs (85) and two balls (84). Slip the shifter (30), page 124, off the shaft. (Lift out forks (80) and (90), page 125, when dismantling. Insert these forks into slot in shifters when reassembling.) Then expand the snap ring (29), page 124, and slip it, with gear (28), off the shaft.

(5) The transfer case (1) may now be removed from the transmission case, after all nuts have been removed from the studs (16).

(6) Remove cap (71), with shims (72), (73) and (75). Keep the shims wired to cap (71).

(7) Next remove the nut (13) and yoke (11) from shaft (12). 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 (4) at right side will come out with the shaft.

(8) Remove shaft group (22). The gear (2) and other cone may now be lifted up and out of the case.

156. TRANSFER CASE REASSEMBLY.

a. For reassembling, reverse the above procedure.

b. Before reassembling shaft (12), clean, inspect, and replace (if necessary) all parts, such as seals, gaskets, Timken and ball bearings, and spacers (7), (21), (48), (59) and (60), page 124.

c. Clean the complete transfer case and parts carefully, inside and out.

d. Place Timken cone (4) (taper outward) over the stub end of the shaft, and pass the yoke end of shaft (12) through the right lower hole in the case: then through parts as follows: gear (2), Timken cone (4), with taper outward. Tighten cap (8) solidly to the case (1), after being sure Timken cup (5) is in place. Assemble spacer (7) and tighten solidly the yoke (11), using washer and gasket with nut (13).

e. Next install cup (5) with taper inward, then a new gasket (72), together with shims (73), (74), (75), as required and cap (71). Shaft (12) should not have any end clearance. Lubricate both Timken bearings (4) with SAE-30 oil.

f. When a new gasket (26) 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 (58), nearest to cap (61).

We strongly recommend the use of a dial indicator attached to the right end of shaft (24) and indicating in the bore of the transfer case at the point where the outer roller bearing (58A) 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 (26) should always be installed.)

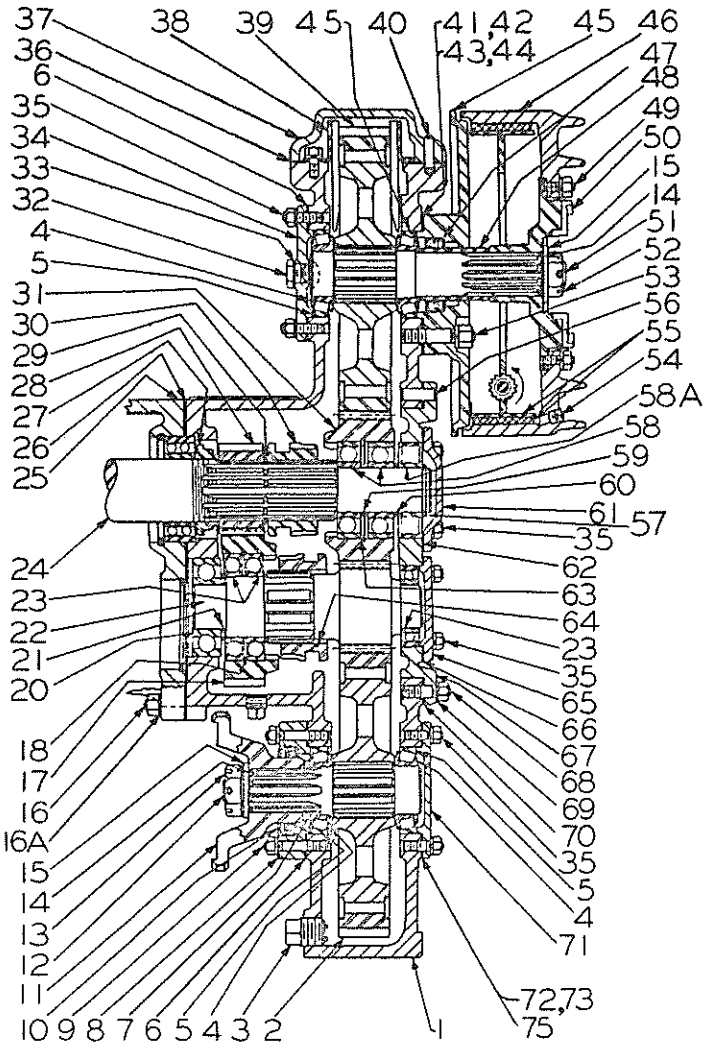
NOTE: Nut (27) must be on the shaft with the small diameter toward the right.

g. Slip gear (28) over shaft (24). Be sure the snap ring (29) is locked in the shaft groove. The shifter fork slot in shifter (30) should be nearest to gear (28). (Insert the fork (90), page 125, into the shifter slot before moving the shifter onto the spline of shaft (24).)

Assemble the shift clutch (64) on the countershaft (22), with the fork groove toward arrow (64). Install snap ring (18) into the bore of idler gear (17), also the two bearings (23). Then lubricate both bearings with SAE-30 oil and lightly drive the gear with bearings over the shaft (22). Next slip the spacer (21) and drive the lubricated single row ball bearing (20) over the shaft. Then install the assembled shaft (22) into the transfer case bore. Lightly drive the lubricated bearing (23) onto the stub end of shaft (22).

h. Reinstall shift fork (80), page 125, together with shifter shafts (83) and (91), locking the two set screws (81) by means of lock wires (82), as shown. Replace the balls (84), springs (85), tube (86), and bracket (80).

Install the rear ball bearing (58), page 124, and the snap ring (63) in gear (31), and slip it over shaft (24). Next slip the following parts on the shaft in order shown: namely, spacer (59), bearing (58), spacer (60), bearing (58A), then securely locate the snap ring (57). Lubricate the ball bearings and roller bearing (58A).



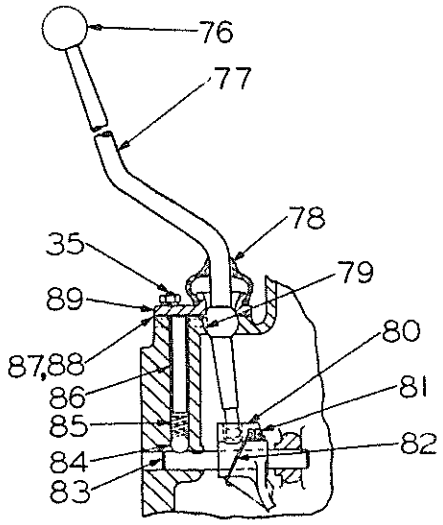
Transfer Case
(Section A-A)

NOTE: The location and end clearance of all gears, bearings, and spacers are controlled by the snap rings as follows: (29), (63), (57) and (18).

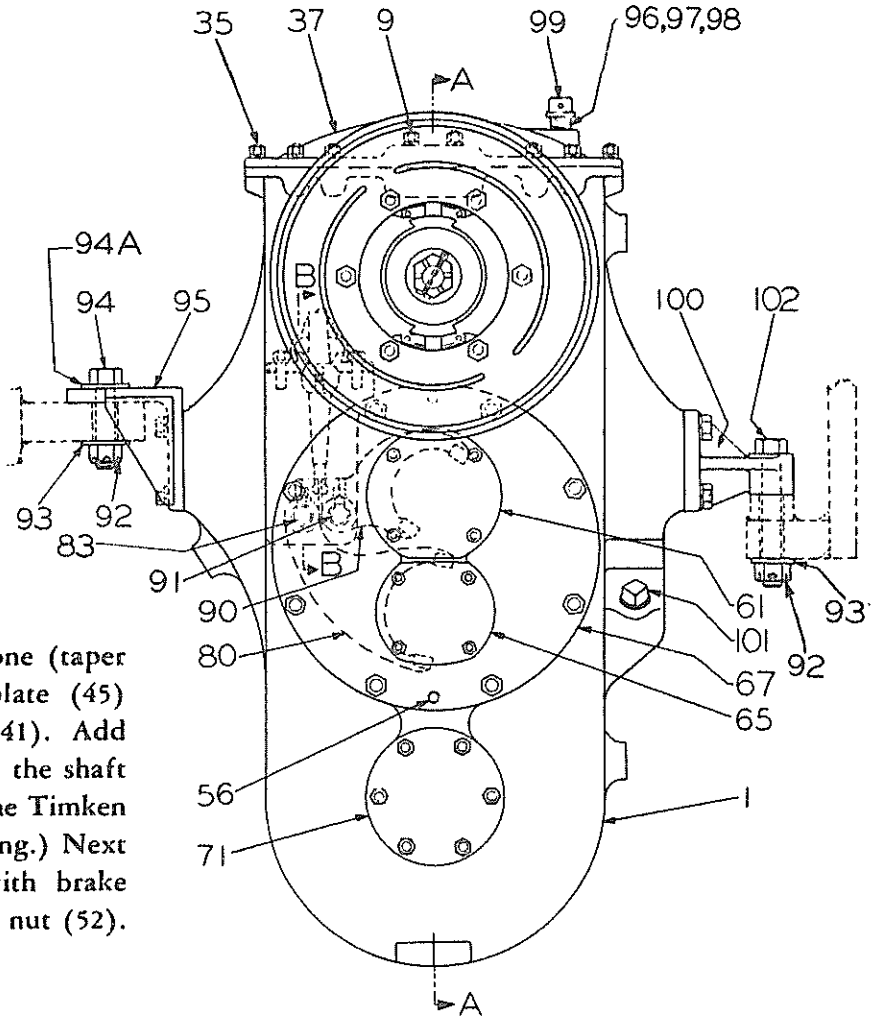
All snap rings should be concentric and the circular tension should solidly lock the rings in the snap ring grooves.

Next install bearing support (67), caps (61) and (65), by means of studs and lock washers and nuts provided. When shifters (30) and (64) are in neutral position, the gears (31), (22), (2) and (39) should rotate freely, except for friction developed by the seals (10) and (47).

i. Lower the gear (39) into position, after installing the left cone (4) (taper outward) with cup (5), together with cap (34) and gasket (6).



Section B-B



Transfer Case

Next insert shaft (51) and right cone (taper outward), with cup (5). Then brake plate (45) (seal lip turned inward) with all shims (41). Add or remove shims as required in order that the shaft (51) will not have any end clearance. (The Timken bearings should not be preloaded or binding.) Next install spacer (48) and flange (50), with brake drum (46). Securely tighten and cotter the nut (52).

j. Install the oil collectors (38).

k. Reinstall cover (37), this page. Cap (99) has a drilled vent for ventilation purposes. Tube (96) extends downward into the transfer case about $2\frac{1}{2}$". Its lower end is cut on a 45° bias and the long side of the tube should be turned toward gear (39), page 124.

Never attempt to dismantle or make repairs to the transfer case without thoroughly studying the cross section diagram shown on page 124.

157. TRANSMISSION SHIFT COVER.

(See page 126)

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.

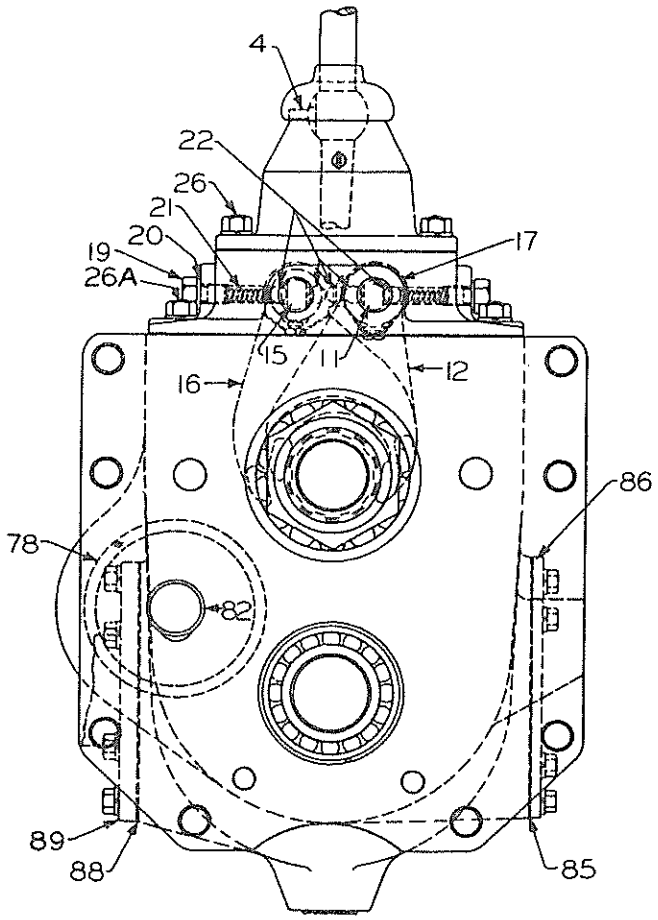
d. Remove the two cap screws (19) with washers (20). The two outer springs (21) and balls (22) will now come out.

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), page 127.



158. TRANSMISSION DISASSEMBLY.

In order to disassemble any part of the transmission, follow the instructions under "Transmission and Transfer Case Removal", paragraph 154, which will permit the transfer case and transmission to be removed from the grader.

Now remove transfer case from transmission by following the instructions given under "Transfer Case Disassembly", paragraph 155. You may now disassemble the transmission (as shown on page 127) as follows:

a. Move both shifters (38) and (49) into mesh. Remove cotter and loosen nut (27).

b. 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).)

c. 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).

d. Oil pocket (A) delivers oil through 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.

e. Oil flows through bearing (30), after which it flows through bearing (36) and back into the transmission case.

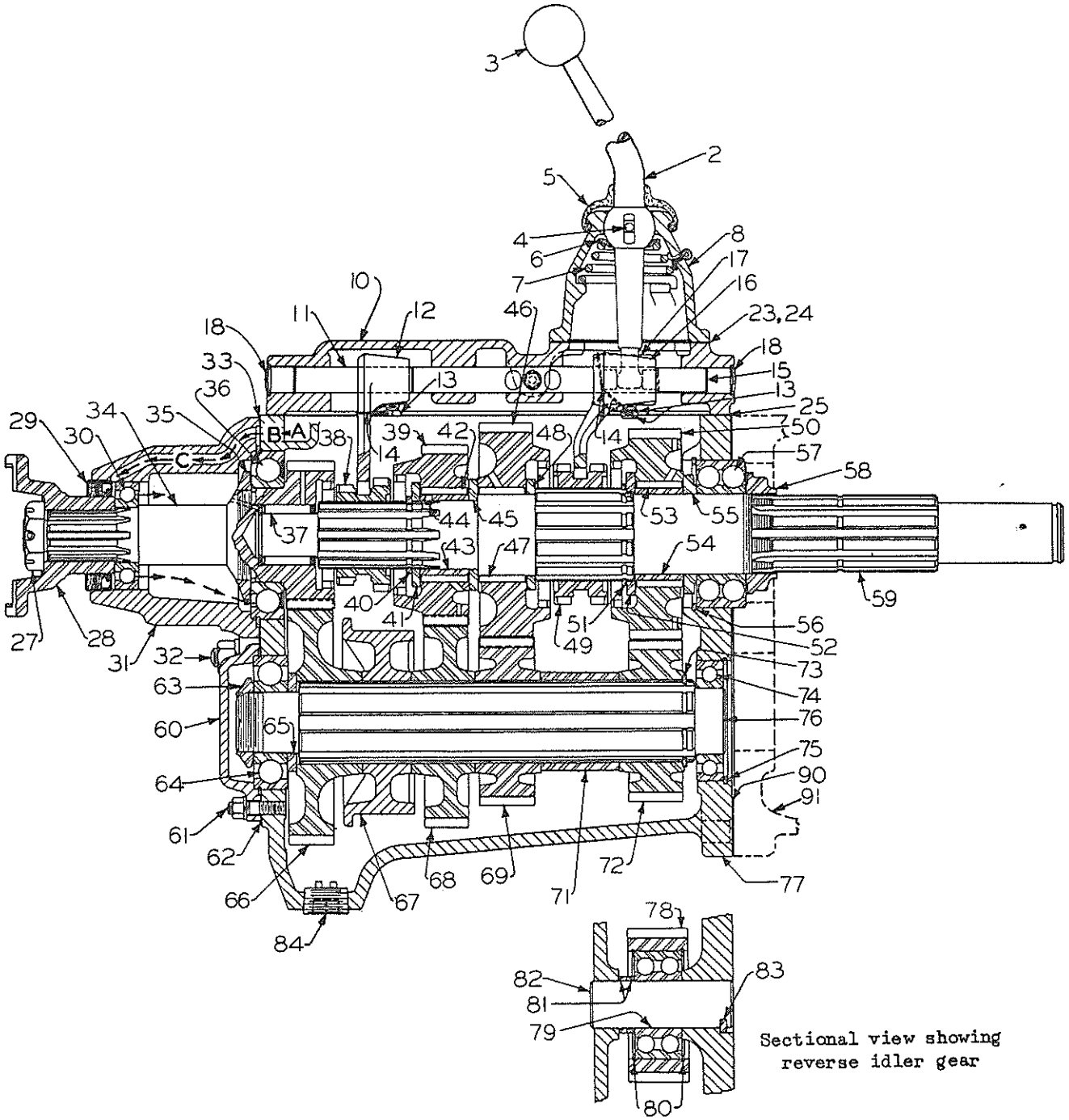
f. Slip the low and reverse shifter gear (49) to the left, and pry the snap ring (51) out of its groove. Slip both of these to left as far as they will go. Screw off the nut (58). Drive the main shaft (59) to the right until bearing (57) may be pulled off the shaft.

g. 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.

h. 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).

i. Expand and slip the snap ring (40) off the shaft. Next slip the following parts off the shaft; washer (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.



Sectional view showing reverse idler gear

j. 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.

k. 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.

l. All countershaft gears may now be removed from the case for cleaning and inspection.

m. The reverse idler gear (78) and reverse gear parts may be removed, after removing shaft (82), with key (83).

159. 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 on page 127.

c. Install a new adjusting nut (63), page 127, on the clutch end of the countershaft.

d. Reassembly is the reverse of the above procedure.

160. TIRE PUMP. (Special Order) (Part No. PGF-13961, model 127-12V)

a. Specifications ("All-Purpose" Compressor).

AIRSEAL: Specially processed heavy neoprene, reinforced with nylon, takes the place of ordinary piston rings.

LUBRICATION: Grease-packed sealed ball bearings. No other lubrication required.

PISTON: High tensile strength aluminum.

OIL-FREE AIR: Absolutely oil-free air at all times. No oil filters or collectors needed in the air line.

RELIEF VALVE: None needed due to patented design, which is the reason why no "All-purpose" compressor can ever explode.

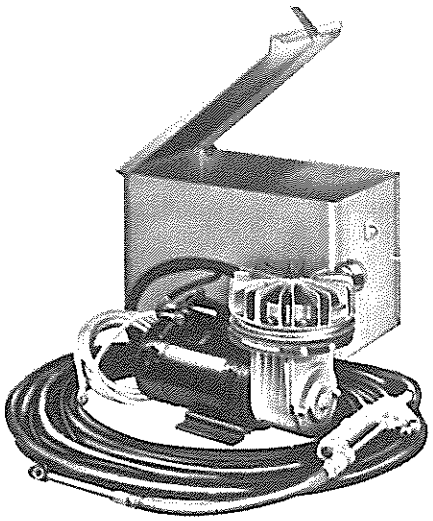
b. Operating Instructions.

The compressor supplies air only on demand by firmly squeezing the lever on the tire chuck. Releasing this lever will automatically register the tire pressure on the gage. To deflate the tire, depress the handle to an intermediate position.

Conserve battery power by running the grader engine at a fast idling speed to permit the generator to charge the battery while the compressor is in use.

c. Service Instructions.

If the compressor runs but delivers only a small amount of air, trouble may be due to a broken valve or air seal, or a clogged air filter. Keep filter clean at all times.



"All-Purpose" Air Compressor

To examine valves or air seal - Remove bolts around top of finned head. Remove screws which hold retainer plate and air seal to top of piston. Inlet Valve (Part No. D-10158) is on underside of Compression Plate. Outlet Valve (Part No. D-10775) is on top. These valves may be changed by removing the two screws which fasten them to the Compression Plate.

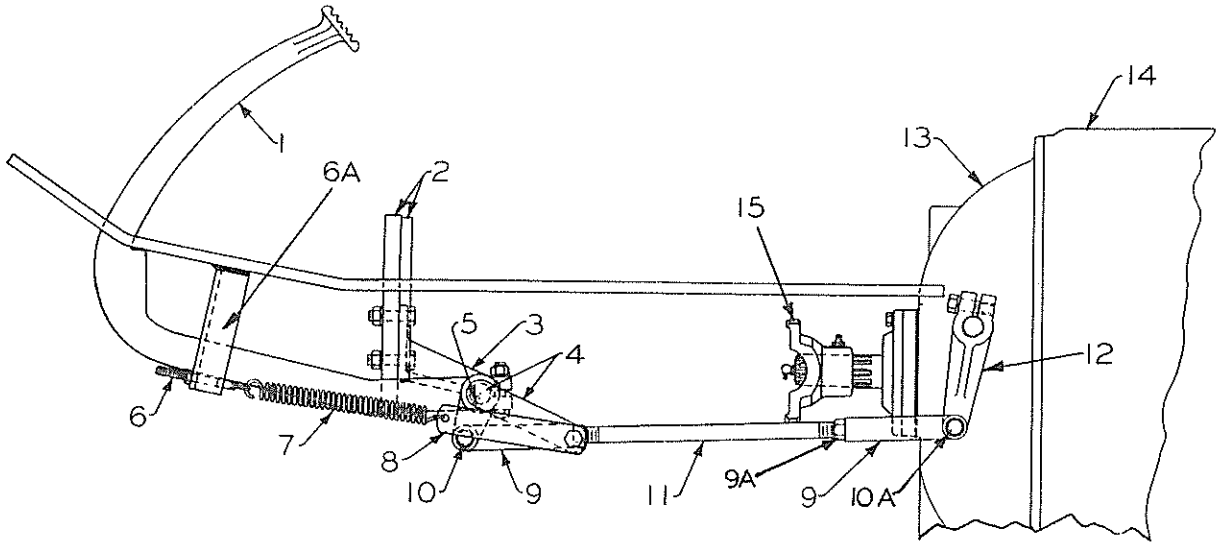
CAUTION: Always use new head gasket. Be sure all screws and bolts are tightened securely to prevent air leaks.

d. Guarantee.

The Johnson Service Company of Milwaukee, Wisconsin, guarantees its Air Compressors, unconditionally, for a period of 90 days. All units are thoroughly tested and inspected. However, any part or parts proving defective within one year of date of purchase will be replaced without charge.

This guarantee applies to defective material or workmanship. Ordinary wear, accident, mis-use or misapplication are expressly excepted. All repairs and parts under this guarantee are F.O.B., Johnson Service Company, Milwaukee, Wisconsin. No local service or repair charges will be allowed unless permission is granted by the Johnson Service Company of Milwaukee, Wisconsin.

NOTE: The Electric Motor is manufactured by the Electric Auto-Lite Company of Toledo, Ohio. Service and parts can be obtained from any Auto-Lite dealer.



161. MAIN CLUTCH ADJUSTMENT.

a. General.

(1) First inspect the clutch pedal linkage. (See above drawing.)

(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 lever (12) is located on the shaft so 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, with the pedal (1) 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 (8), page 131, and the clutch fingers, to permit the clutch to operate satisfactorily, unless abused.

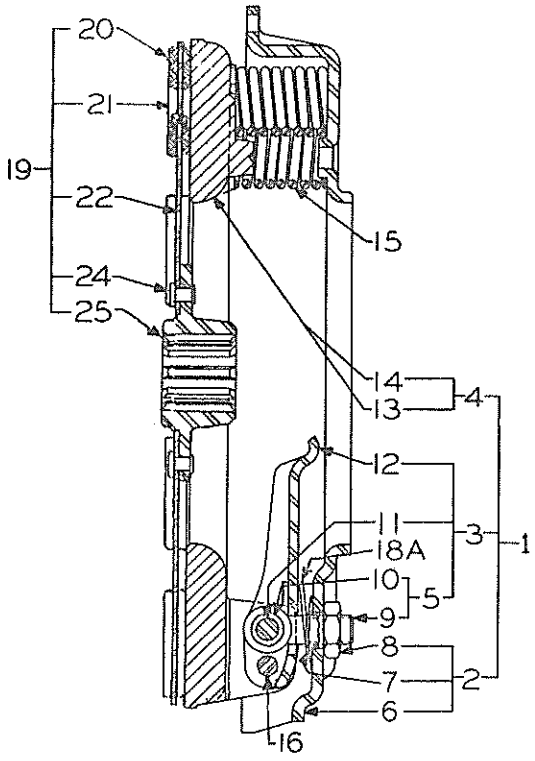
b. Clutch Adjustment.

(1) To adjust clutch, first loosen lock nut (9A), (see above drawing), remove pin (10A), screw forked yoke onto the rod (11) about two turns, and reinstall pin (10A). Do not reinstall the cotter pin through 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 from 2" to 3". If it is adjusted as shown, 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.

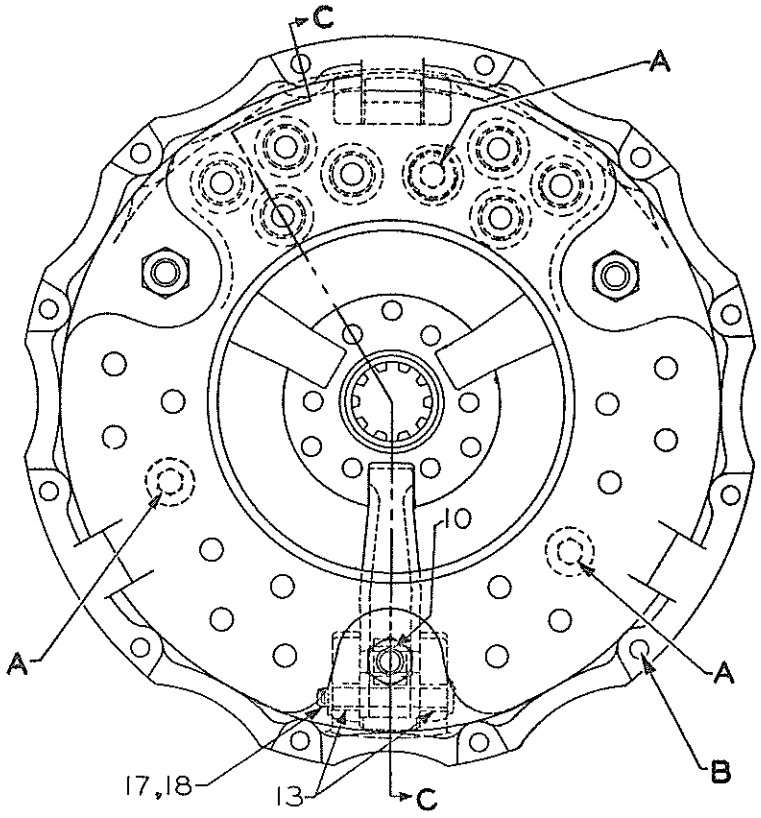
(3) To ascertain if the clutch is disengaging properly, stop the engine, have someone depress the clutch pedal to within 3" of floorboard. Then try to turn the propeller shaft yoke (15) with your hands. If it turns freely you can consider the clutch linkage is adjusted correctly and that the clutch is properly disengaging.

NOTE: When the clutch pedal is fully depressed to the floorboard, you cannot turn the yoke (15) easily, because the transmission clutch brake is applied. *Raising the clutch pedal about 3" will release the transmission clutch brake.* (See page 132 for clutch brake.)



Section C-C

15" Clutch (Sectional View)
(for UD-14A, GM-4080 or GM4-71 Engine)



15" Clutch (Rear View)

c. Clutch Adjustment Warning.

Do not disturb the factory setting of the three nuts (8), (shown above), 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), page 129). Never make any adjustment of the three nuts (8).

d. Clutch Abuse.

Abuse consists of slipping the clutch such as trying to move the grader 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.

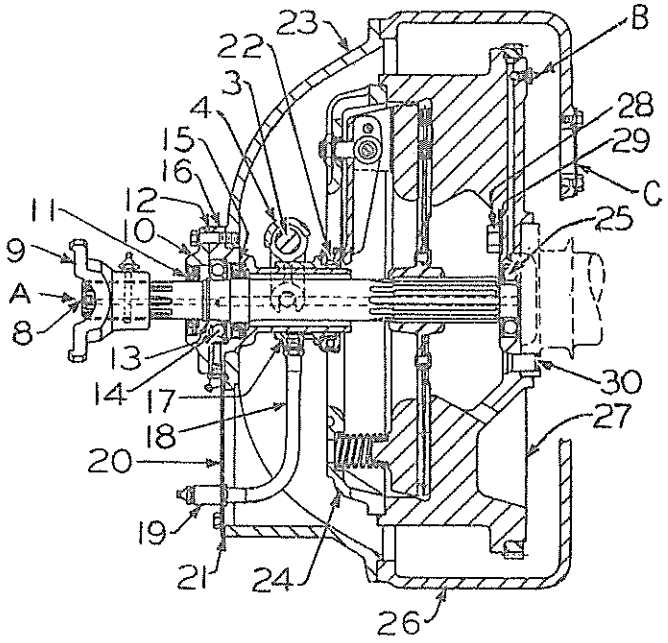
Riding the clutch pedal with your foot, or over-lubrication of the clutch release and pilot bearings, constitute other forms of abuse.

e. Clutch Lubrication.

(1) Clutch throw-out bearing (22), page 131, is lubricated through the exposed high pressure fitting (19), extending through 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) The UD-14A clutch pilot bearing (25) is lubricated through hole in bell housing at (B), while the GM clutch pilot bearing (25) is lubricated through a grease fitting screwed into the rifle drilled hole (A) of the clutch shaft (8). Rotate shaft until lubrication fitting (B) is visible. Consult lubrication chart, page 6, 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.



Clutch Compartment

f. Clutch Removal.

(1) General:

The clutch may be easily removed from the A-W 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, are all that is required. One man can do the job easily.

(2) To Remove Clutch: (See above)

(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), page 129.

(c) Remove the inspection door (20) (see above). 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) Use 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), page 130. These screws will compress the twenty-four clutch springs (15), and keep the clutch group assembled during clutch removal.

(g) The cap screws at (B), page 130, may now be removed, after which the clutch drive member group may be lifted out of the bell housing.

g. Clutch Installation.

(1) General:

If a new driven disc is needed, the outside diameter of the disc should run true with the splined hole at hub (25), page 130. To check this, proceed as follows:

(a) The driven member with shaft (8), and parts (23), (16), (10) and (14) (see above), may be temporarily assembled to the bell housing. The clutch group (24) should not be assembled to the flywheel at this time. The hub 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), page 130. The dial indicator may be read thru cover opening (20) (see above).

(c) When the shaft (8) is rotated by hand, the outside face of the buttons 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), (above) if worn. Assemble the bearing seal away from the crankshaft flange. Before assembly use a grease gun to fill the rifle drilled holes at point (B) on UD-14A and at (A) on GMC-71 series. Pack the bearing with lubricant.

(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).

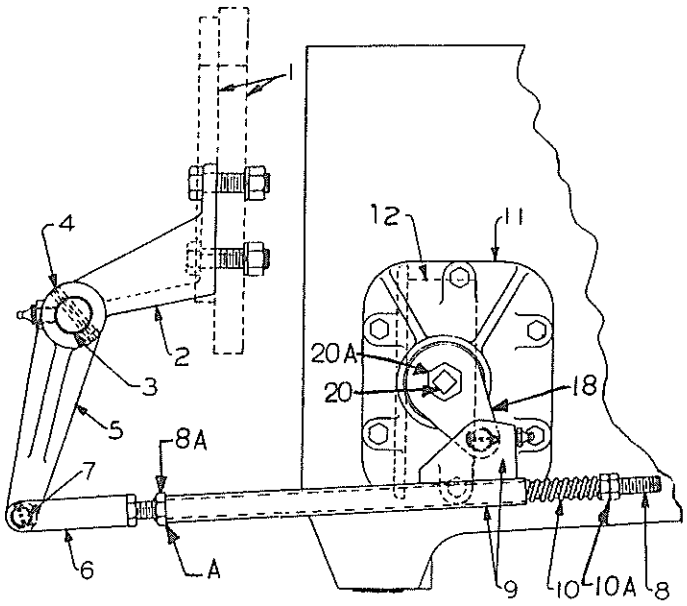
(e) Install and tighten the bell housing (23) to the housing.

(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), page 130. Reinstall parts (18), (19) and (20), page 131, and the propeller shaft.

(h) Lubricate all bearings (14), (22) and (25).

(i) Re-adjust clutch linkage, page 129, paragraph b.



162. CLUTCH BRAKE. (See Above)

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, together with external linkage, is interconnected to the clutch foot pedal (1), page 129. When the foot pedal is pressed to the floorboard, the linkage moves lever (18), (below) 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 footpedal 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), (below) and interconnecting linkage are shown in released brake position.

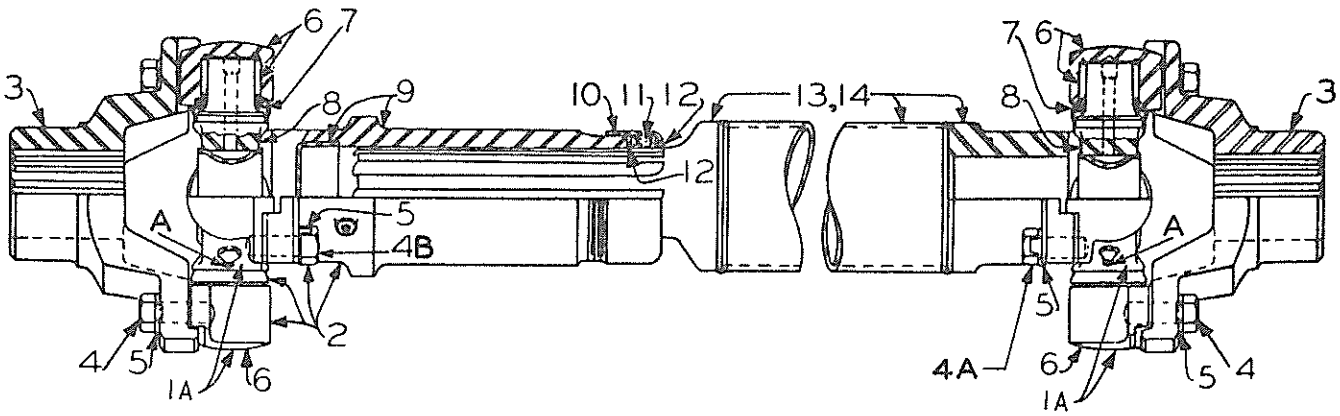
(1) First adjust the main clutch, page 129, paragraph b.

(2) With clutch pedal in fully raised position (engine stopped), the overall length of spring (10), (below) should be adjusted to about 1-3/4". Then lock the two nuts (10A) together as shown.

(3) Run engine at wide open throttle. Then have an assistant depress and hold the foot pedal to the floorboard.

(4) Loosen lock nut (20A), (see illustration at left) 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 129, paragraph 6, before the above adjustments are made.



Rear Axle End

163. *REAR AXLE PROPELLER SHAFT.* *(See above.)*

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.

164. *REAR AXLE.*

The rear axle unit of the A-W power grader is of the double reduction type. The drive from the propeller shaft to the rear axles is made first through a spiral pinion and spur gear, fully enclosed, running in oil. It is equipped with dust-proof oil seals and mounted on anti-friction bearings throughout.

The filler and oil level is the 1" pipe threaded hole with square head pipe plug. It is located on the center line of axle on front side of housing, a few inches below the flange. Keep this filled with oil as recommended in the lubrication instructions, page 8.

In making repairs to parts located at either end of the main axle housing (52), page 137, including replacing of the drive shafts, it is unnecessary to remove the main axle housing from the rear end of power grader frame.

165. *REMOVAL OF REAR AXLE AND TANDEM ASSEMBLY FROM FRAME.*

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, backwards and forward for 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.

(1) Place machine on level place.

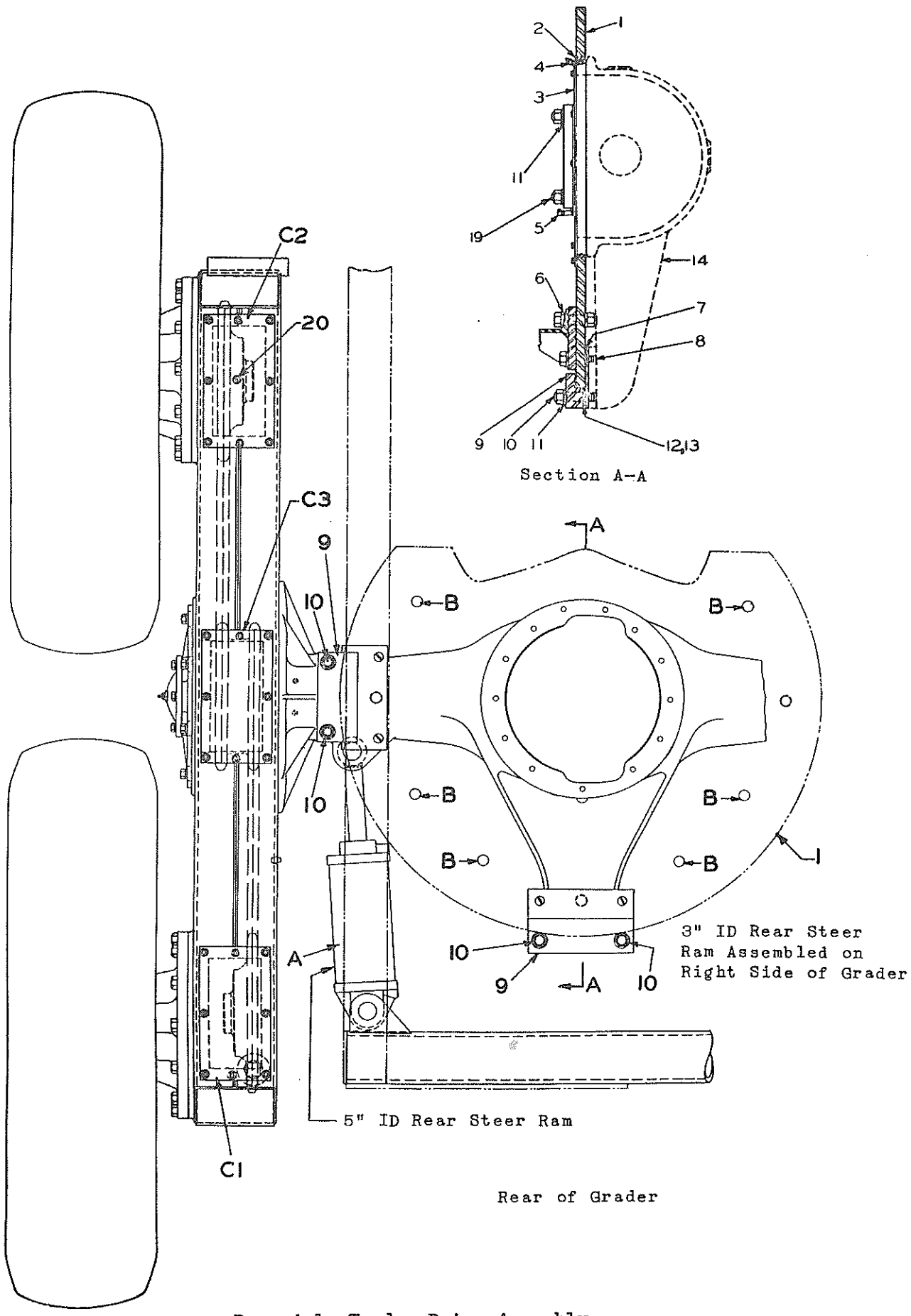
(2) Revolve moldboard until it is square across. Lock circle latch. Place blocking under each end of the moldboard, about a foot from the ends.

(3) Block both front wheels securely to prevent possibility of machine rolling forward or backward.

(4) Remove the six cap screws (B), shown on page 134, which attach the support plate (1) to the main frame itself.

(5) Remove the four cap screws at yoke (28), page 137.

(6) Remove pin with keeper and disconnect the rear steering rams from the rear axle housing.



Rear Axle Tandem Drive Assembly

(7) Start the engine and operate (push forward) blade lift ram levers (3) and (8), page 9. Operating these levers slowly and intermittently will raise the rear end of the main frame sufficiently to permit the rear axle, with wheels and tires, to roll away from the frame. (Place a jack under the rear bumper plate as a safety measure to stabilize and hold up the rear end of the grader frame.)

(8) The support plate (1), shown on page 134, may be removed from the axle housing, after removing the six nuts from studs (10). The three guides (9) should be marked in order that they will later be reinstalled in the same position.

The shims (12) and (13) should be wired to each guide during the dismantling operation.

The support plate bushing (2) should be inspected and replaced if damaged or worn. Spread lubricant by hand to the lower side near the guides (9).

If steering rams are removed from unit, make certain during reassembly to install large cylinder on left side and small cylinder on right side.

166. REAR WHEEL DRIVE CHAIN ADJUSTMENT.

To test the chain tension, remove the inspection covers (C1) and (C2), page 134.

Jack up the housing at the left rear wheel and turn the top of the wheel toward the front of the grader and hold it there. With a short bar through hole, test the upper chain tightness. You should be able to lift the chain about 1/2 inch.

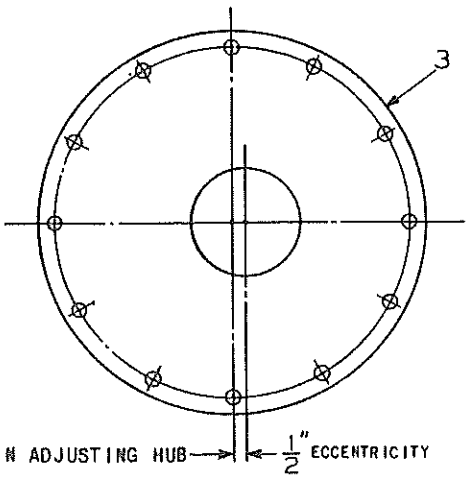
If there is more than 3/4" slack, the chain tension should be re-adjusted as follows:

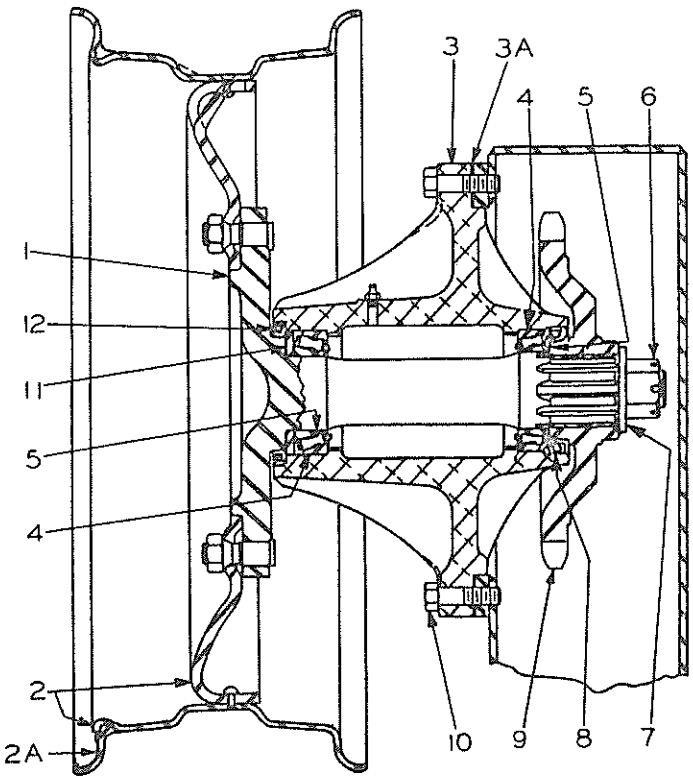
Remove all cap screws (10), page 135. To tighten the chain rotate the eccentric spindle hub (3) in correct direction. Install the cap screws (10).

NOTE: It will be best to remove the wheel (2) from axle flange (1) before making this adjustment, in order to see the gasket (3A) and get the cap screw holes in the proper location.

Since all four rear wheels are driven by an enclosed roller chain, each wheel axle group has an eccentric hub (3), by means of which the chain tension can be adjusted as required. Each wheel, therefore will have to be raised and chain adjustment procedure followed as directed, except the front tandem wheels have to be held rearward at the top of the tire when testing the chain tension.

The two Timken bearings (4) and (5) at right and left side of axle (1), should have no end clearance. Carefully adjust nut (6) to accomplish this adjustment; then insert a strong cotter pin into place to lock the nut (6).



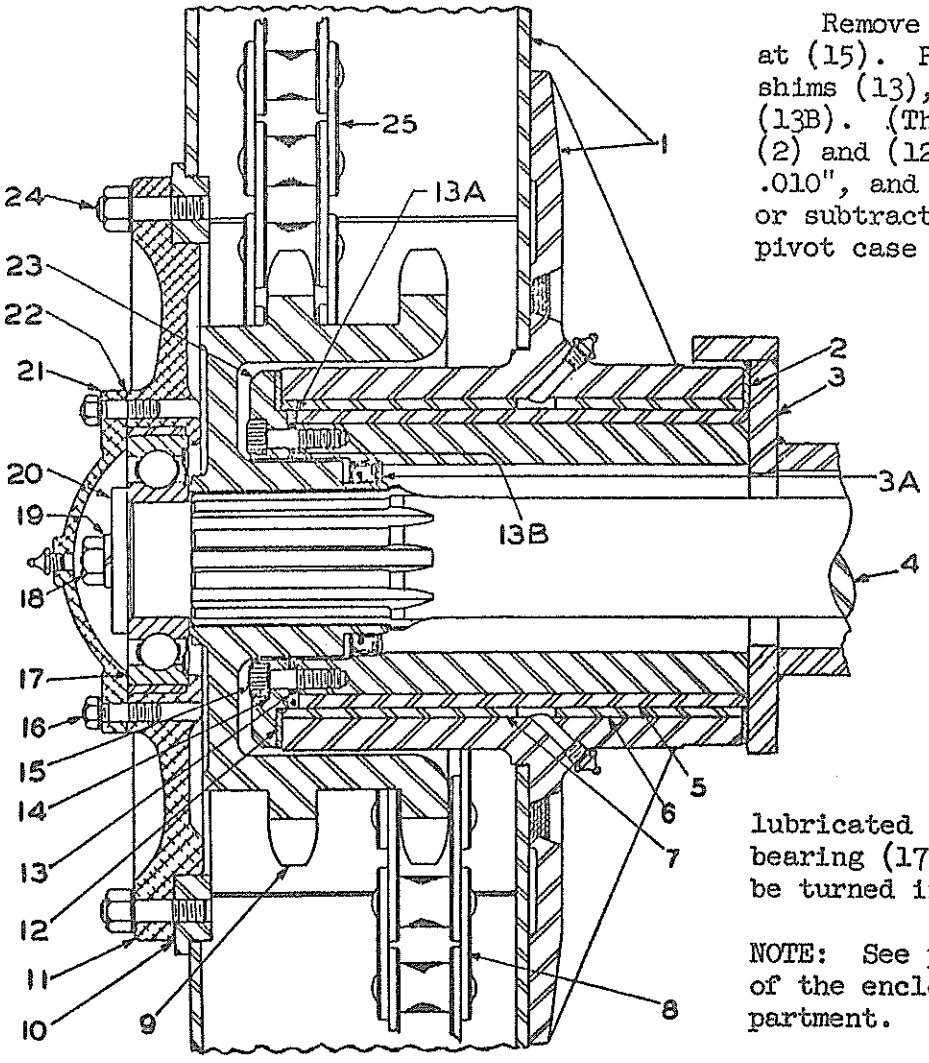


167. REAR AXLE PIVOT CASE. (See Below)

a. General.

Power from the rear axle is transmitted from drive axle (4) (shown below) to drive sprocket (9). Chain (25) drives the front tandem wheel, while chain (8) drives the left rear wheel. Inspection cover (C3), page 134, may be removed to expose the sprocket (9) together with chains (25) and (8). Inspection covers (C1) and (C2) may also be removed as required. Chains (25) and (8) (shown below) have a master link, from which two cotter pins may be removed, together with link itself, after which both chains can be removed from the pivot case.

The illustration below show the left hand pivot case, but the right hand pivot case is assembled similarly, and the instructions in the above and following paragraphs will apply to it also.



b. Drive Axle Removal.

Disconnect both drive chains (25) and (8) at a point near sprocket (9).

Remove cover (21) after removing nuts (with lock washers) at (16). Remove cap screw (18) and washers (19) and (20). Remove bearing support (11) after removing nuts, with lock washers, at (24). The sprocket (9) with shaft (4) may now be drawn out of the axle housing bore (3). Inspect bearing (17) before reassembly. If seal (3A) is worn or damaged, it should be replaced, making sure it is assembled with the lip turned outward.

c. Pivot Case From Axle Housing Removal.

To remove pivot case from axle housing (3), proceed as outlined in paragraph b., above. Then place a supporting jack under the center of axle housing (3).

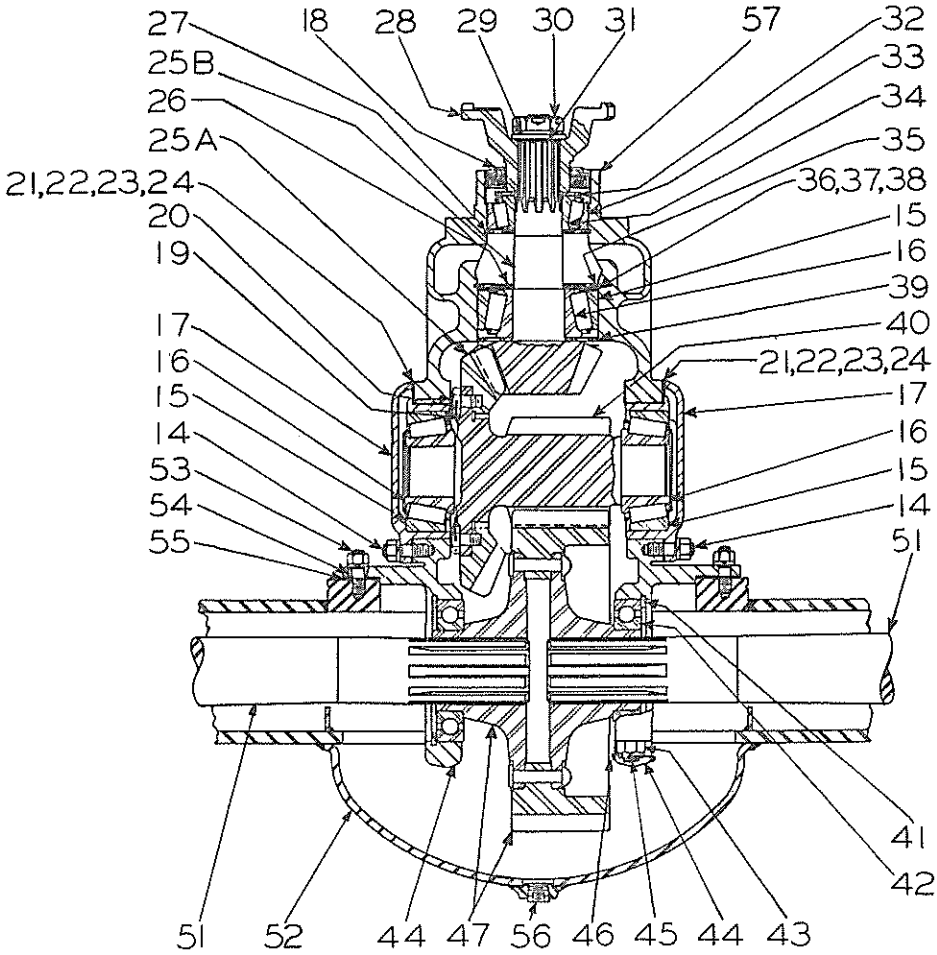
Remove all screws with lock washers at (15). Remove thrust plate (23) with shims (13), "O" ring (13A), and spacer (13B). (The end clearance between plates (2) and (12) should be spproximately .010", and this is accomplished by adding or subtracting shims (13).) Pull the pivot case (1) off of axle housing (3).

Inspect, and if scored or worn, replace bushing (6), short (inner), and long (outer) bushing (7). These bushings should be pressed in until they are flush at the outside.

d. Reassembly.

Reassembly is the reverse of the above. Be sure that all bearing surfaces are well lubricated at time of assembly. The annular bearing (17) has a sealed side which must be turned inward.

NOTE: See pages 4 and 6 for lubrication of the enclosed chain or pivot case compartment.



168. REAR AXLE GEAR CARRIER. (Viewed from rear of machine toward front)

Gear and hub group (47) consists of solid drive on the rear axle of this machine, instead of a differential (37) used on the front axle as shown on page 113. The ring gear (25A), shown above, locates on the left side of the housing.

169. REAR AXLE GEAR CARRIER REMOVAL.

a. Block up both ends of the axle housing, then remove both axle shafts (4), page 136, by following instructions found in paragraph 167, (a) and (b).

b. Remove the nuts from studs (53), also the one tapered bushing (54).

c. Lift out the gear carrier assembly as a group.

d. In reassembly, reverse the above procedure and use a new gasket (55). After starting all the nuts on studs (53), tighten first the one with the tapered dowel bushing (54) on it. Replace seals (3A), page 136.

170. REAR AXLE GEAR CARRIER DISASSEMBLY AND REASSEMBLY.

a. Remove the nuts on studs (45), caps (44), and washers (41).

NOTE: The written text 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 147, pages 113 and 114.

(2) Paragraph 148, pages 114 and 115, except sub-paragraph (8) and (9).

(3) Paragraph 149, pages 116 and 117.

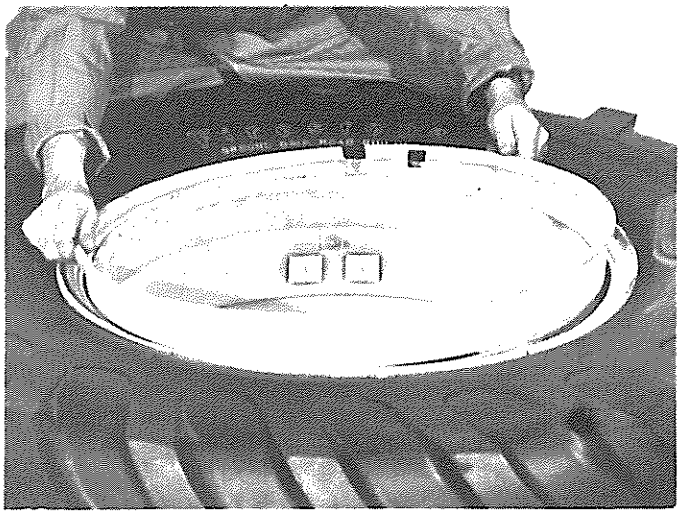
Always replace worn bearings with new ones. Always keep worn but useable Timken cups and cones mated or wired together during disassembly.

171. *TIRES.*

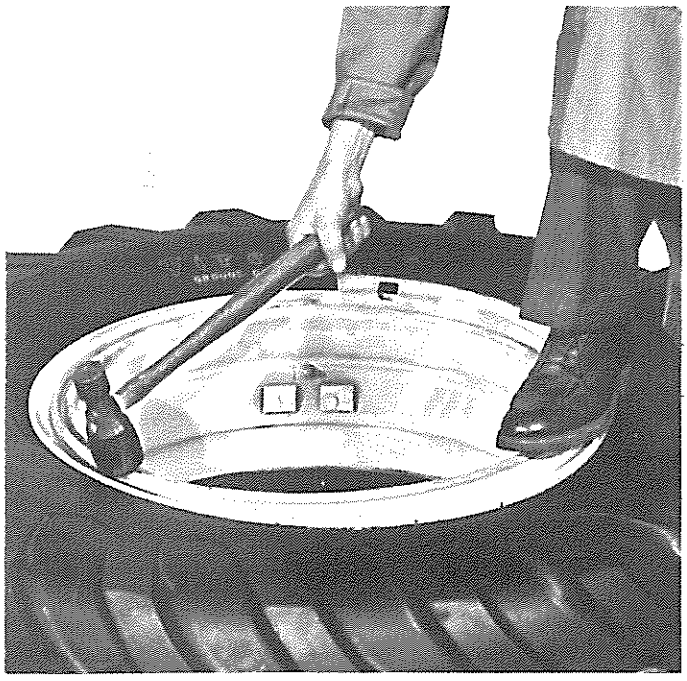
a. Mounting Procedure.

Assemble parts in position as shown below. Note rim base is placed on wood blocks to provide clearance for tires. Rim nut is removed from valve and valve is properly placed to fit offset valve hole in rim.

Lower tire onto rim base and apply rim nut to valve. Place the continuous side flange in position and then insert tapered toe of locking ring between side flange and tire bead as shown below.



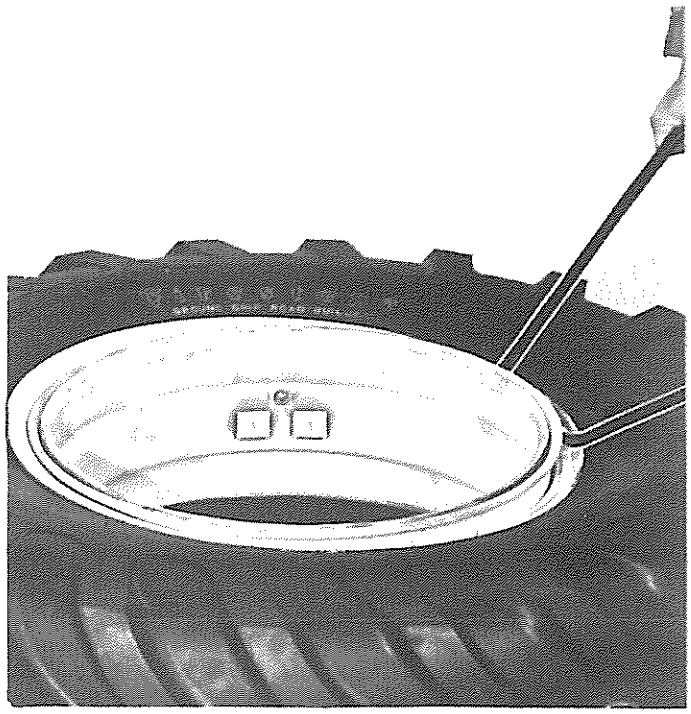
Engage one end of the locking ring in the rim gutter and working progressively around the rim, hammer the ring in place, using a soft metal hammer as shown below.



Carefully examine the assembly to make certain the locking ring is in place, then inflate to recommended pressure (see page 141) to seat the tire beads. Completely deflate to permit proper positioning of tube and again reinflate to recommended pressure for service.

b. Demounting Procedure.

Completely deflate tire by removing valve core or using deflator cap. Use tire tools to free tire bead from the bead seat on removable flange side as shown below.



Insert tapered end of tire tool in notch located at split in locking ring to pry the ring out of the rim gutter at this point as shown below.

Use tire tools to progressively remove the locking ring, then remove the side flange ring as shown below.

Turn tire over and free tire bead on fixed flange side. Remove rim nut from valve and then force tire off the rim base.

CAUTION: When mounting a new tire, be sure that it has a 5^{o} tapered bead seat and the same number of plys as the tires fitted to the other wheels. Undue tire wear may otherwise occur.

172. TIRE INFLATION.

TIRE SIZE (5° Tapered Bead Seat)	13.00 x 24; 10 or 12 Ply		14.00 x 24; 10 Ply	
	*Front Tire Inflation	*Rear Tire Inflation	*Front Tire Inflation	*Rear Tire Inflation
With or without Scarifier.....	30	25	30	25
With Bulldozer.....	40	25	40	25
With Snow Plow and Wing.....	40	25	40	25

*Variation of 2 lbs. permissible. When mounting a new tire (with flap), be sure that it has a 5° tapered bead seat and the same number of plys as the tires fitted to the other wheels. Undue tire wear may otherwise occur.

When operating A-W graders at excessive side tilt, approaching a 2 to 1 slope (see slope chart on page 13) the tire inflation in all tires may be increased 10 lbs. over the pressures shown above. This increase in tire pressure when operating at or near a 2 to 1 slope will stabilize the tires and prevent them from rolling slightly sidewise on the rims. Damage to the tire sidewalls will be reduced, when the additional tire pressure is raised by about 10 lbs.

When the construction slope work approaches a 3 to 1 slope, the tire pressure in all tires should be lowered to values as shown in the pressure chart shown at the top of this page.

The tire pressures shown in the above chart are ideal for maximum tire flotation and general construction.

NOTE: Tandem graders - those without the "A-W Front Wheel Drive", at best can only be effectively used in 3 to 1 slope construction work.

173. WATER WEIGHTS FOR FRONT AND REAR TIRES. (Not recommended or required)

174. TIRE CHAINS.

Tire chains may be used on all wheels in snow removal.

Tire chains are not recommended for use on 14.00 x 24 tires.

Tire chains must have cross chains every other side link. Never use tire chains having cross chains every two or three side links or more.

174A. WHEELS.

The standard wheel used on this A-W grader has a 10 inch, 5° tapered bead seat, rolled steel rim.

If replacement of wheels is necessary, always use an A-W wheel. (See Repair Parts Catalog.)

175. HYDRAULIC SYSTEM.

a. General.

The hydraulic system on A-W power graders 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 thoroughly, 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 22° F. For temperatures below 22° 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 paraffin or asphalt base oil will be acceptable.

c. Reservoir.
(See page 147)

(1) Reservoir (83) is fitted with a drain plug and a flange (87) at the bottom. When changing oil this flange may be removed and the entire inside of the reservoir may be cleaned and swabbed out.

(2) Draining and cleaning the pump strainer (93) 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 (93), pages 147 and 148, is located in the suction supply line between the reservoir (83) and the hydraulic pump (104).

(2) To clean the strainer, unbolt the 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 "O" ring (94) (between tank and (head). 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), page 147, 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 (93), or to the quality of oil used. The proper setting of the hydraulic relief valve is 1500 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.

176. *HYDRAULIC PIPE FITTINGS, HOSE AND PIPING.*

a. Hydraulic Pipe Fittings.

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).

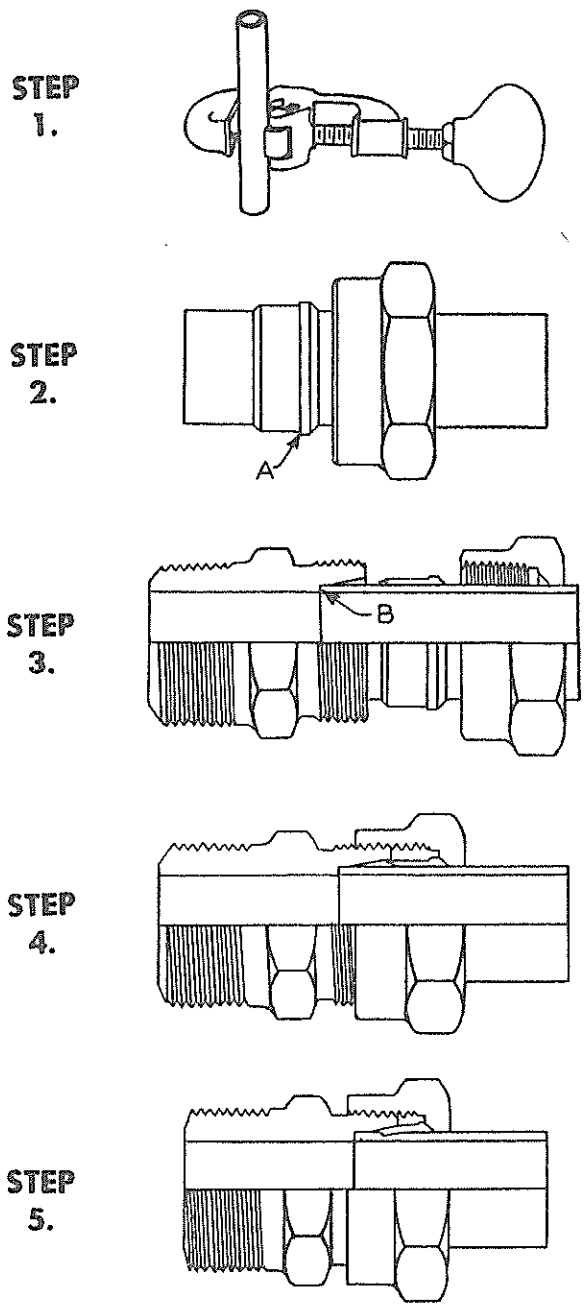
Step 4. Tighten Finger Tight.

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.



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.

177. HYDRAULIC PUMP WITH DRIVE PULLEY. (See page 145)

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.

To adjust pump belt (22), remove pump pulley cap screws and transfer shim, or shims (21), from between pulley flanges to a position under cap screw heads. (See page 145.)

b. Hydraulic Pump Dismantling and Reassembly. (For machines equipped with Vickers pump)

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 instruction at top of page 145.) 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:

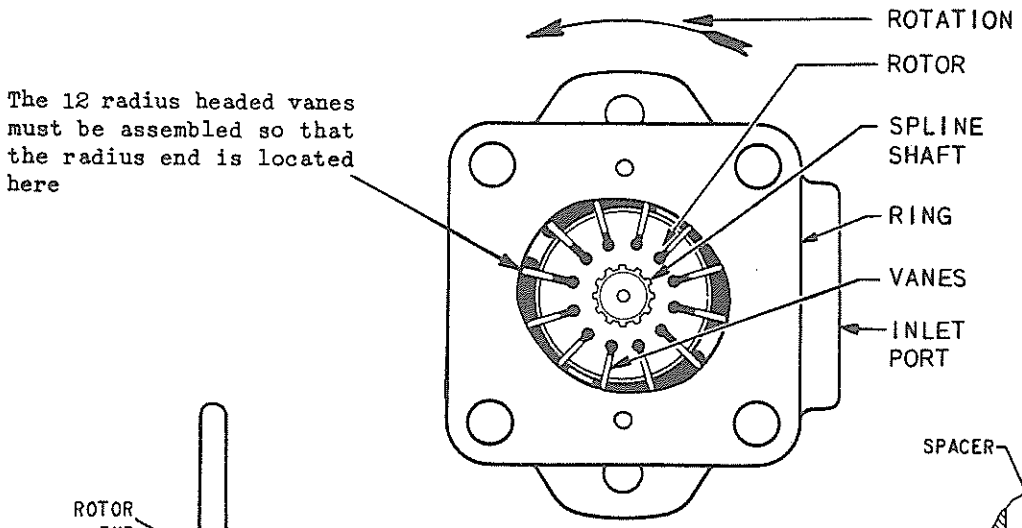
The opposite end of the pump must be opened to gain access to the shaft parts. Remove the snap ring (17). The shaft (14), with bearing (16), may now be pulled out of the body (11). The stamped steel oil seal (13) can then be inspected. The seal (13) should be renewed to prevent air leaking into the pump (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.) Oil the bearings and bearing compartment before installing the shaft.

d. Hydraulic Pump Rotation.

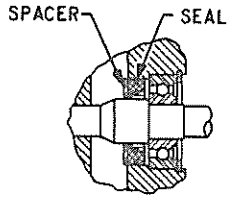
The pump drive pulley on this grader rotates right hand or clockwise, therefore the internal parts, such as vane, etc., must be assembled as shown at top of page 145, under "Right Hand Rotation". If the pump is assembled for left hand rotation, it will not operate. (That is, develop 1500 lbs. pressure and deliver nine gallons of oil per minute.)

Cover End View of Pump
(Right Hand Rotation)

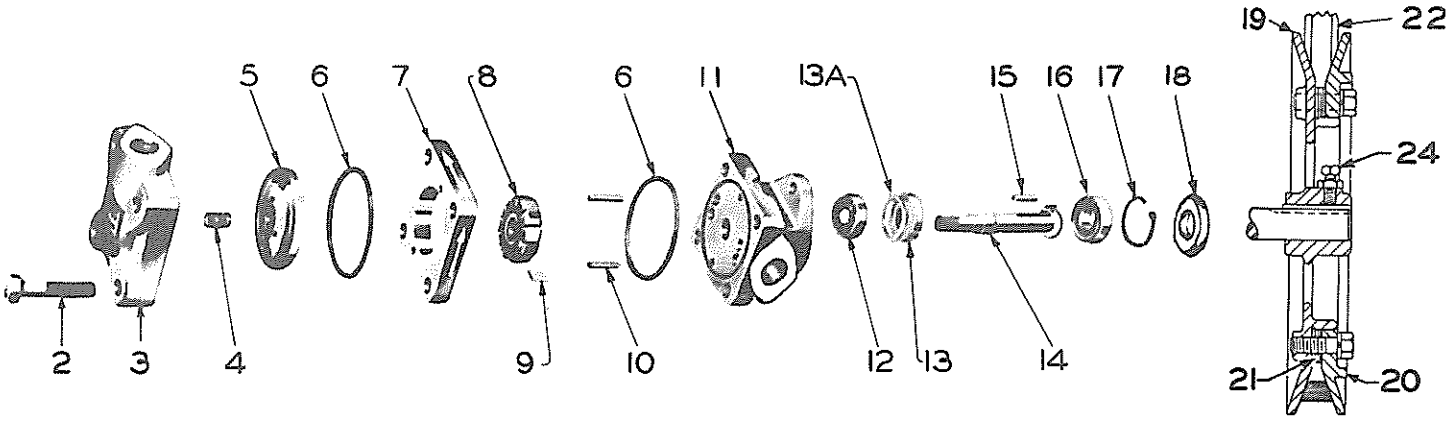
With Pump Cover (3) and Pressure Plate (5) with Spring (4) Removed



Enlarged End View
Of Radius Headed Vane

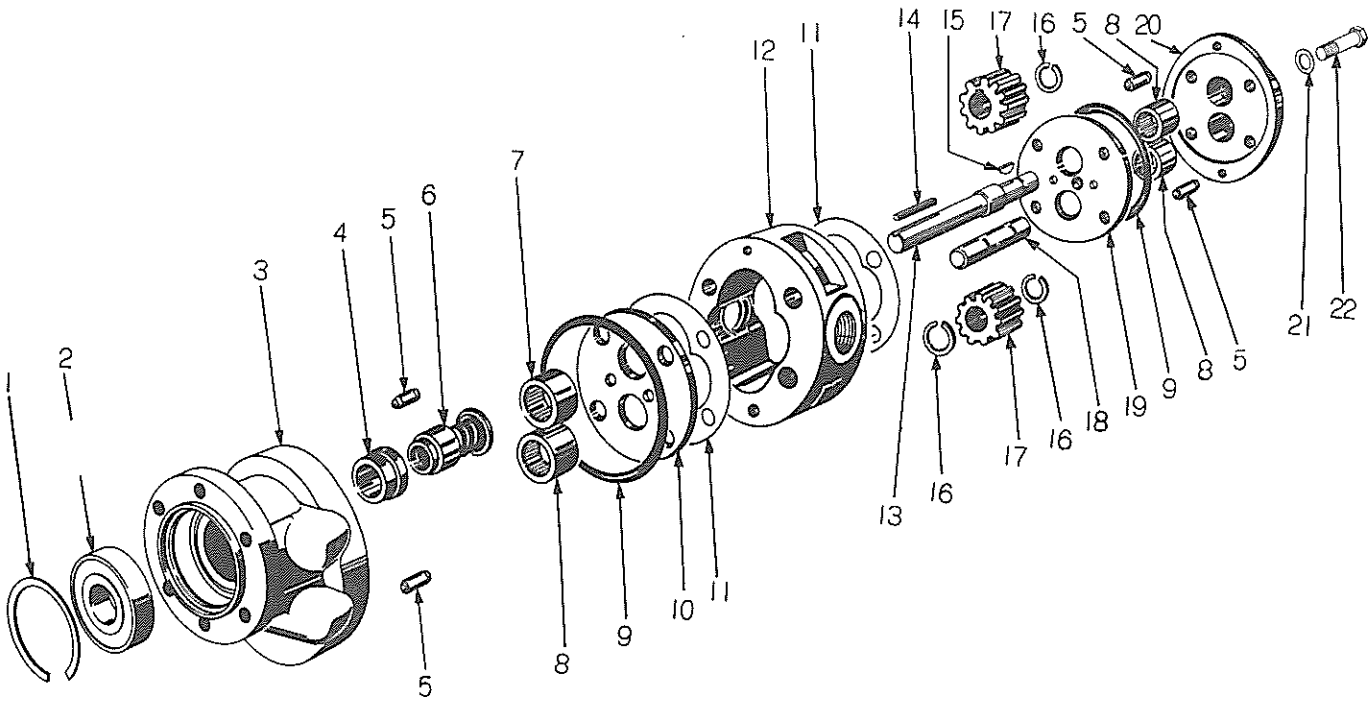


Spacer
and Seal Assy.



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
18.	Felt
19.	Pulley - inner half
20.	Pulley - outer half
21.	Shim
22.	"V" belt
24.	Set screw

Hydraulic Pump and Pulley



e. Hydraulic Pump Dismantling. (For machines equipped with Hydreco pump)

(1) Clean outside of the pump with an oil solvent, fuel oil or gasoline, and dry thoroughly. With file or oil stone remove sharp edges or burrs from shaft splines, drill point, keyway or shaft end before proceeding with disassembly. Mark sections of pump with prick punch for proper reassembly.

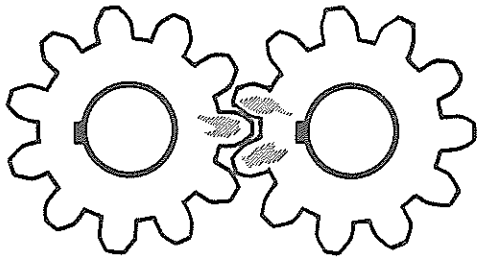
NOTE: Servicing is facilitated by bolting the adapter to a special bench mounted assembly plate. (See page 146F.)

(2) Remove the four cover cap screws (24) (see above). Remove the cover (20) which may come off separately or with the housing (12).

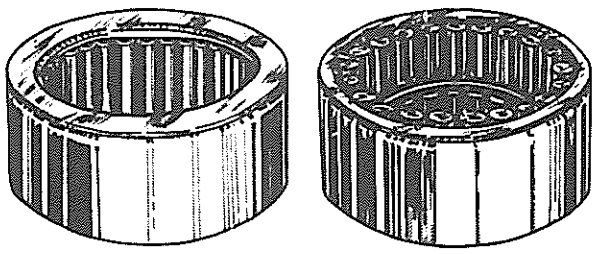
To prevent possibility of leakage, avoid scoring or nicking machine surfaces of pump sections. DO NOT USE A SCREW DRIVER to pry the sections apart. Tap with fibre hammer, if necessary, to loosen.

Note position of relief pocket and drilled holes in the wear plate (10) and (19) for proper reassembly. Mark the drive and driven gears (17) with an India stone, (see right, above) for proper reassembly.

Note the location and number of gaskets when disassembling.



Remove driven shaft (13) and gear (17). Unbolt adapter end from bench plate. By pressing on keyed end of shaft, press out the bearing (7). Remove seal assembly (4) and (6) and snap ring (16), freeing shaft (13) and wear plate (10). This pump is equipped with an outboard ball bearing. Be sure to coat end of shaft with white lead and remove any burrs before pressing out to prevent the



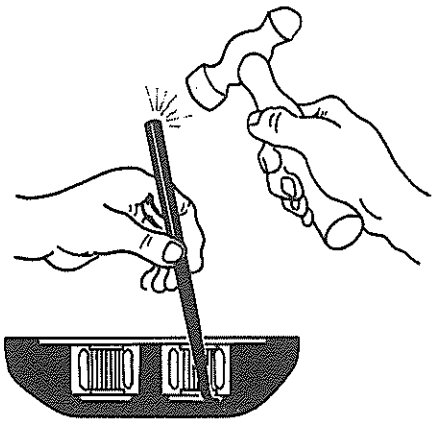
Type "A" Bearing Type "B" Bearing

bearing from being scored. Remove dowel pins (5) from adapter (3) and cover ends (20), with pliers or a lever jaw wrench.

(3) Type "A" Roller Bearings. (See page 146)

Check bearings for freeness of rollers and pitted, broken or excessively worn rollers. Replace bearing if it is possible to insert a feeler of .020" thickness between rollers.

More gap indicates rollers are worn excessively. Remove roller bearings by starting them with a tool shown on page 146F. Insert tool under the bearing and into the cored hole between the bearing bores (see below). Complete removal of bearing using puller (see page 146F) and tap out with heavy bar (shown below).



(3A) Type "B" Roller Bearings. (See page 146)

Remove retaining ring and all rollers. Start bearing shell out with tool, (page 146F). Complete removal with puller, (page 146F). Tap out with heavy bar as shown below.

(4) Ball Bearing. (Outboard bearing)

(a) Remove outboard bearing retaining snap ring (1) with ring pliers.

(b) Reach down through the drive shaft bearing bore with a brass drift and tap out the outboard bearing (2). Tap opposite sides alternately.

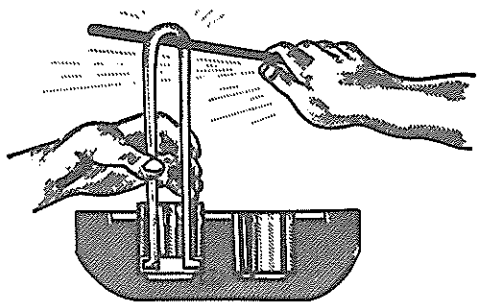
CAUTION: Replace roller or ball bearings only if necessary, and then only with the SAME MAKE AND TYPE as originally installed.

(5) Seal Seat.

The seal seat (4) should not be removed unless the seal face is excessively worn or damaged. To remove the seal seat, invert the adapter (3) and drive out the seat (4) with a wooden block. If a new seat (4) is required, press into adapter, using a seal seat driver (page 146F).

(6) Gears.

If gears or shafts must be replaced, remove snap rings (16) and press off gears on an arbor press. (Some models may be furnished with shaft and gear made in one piece). To reassemble, coat gear bore with white lead, and after installing one snap ring, press onto shaft until the gear covers approximately one quarter of the key slot. Hold key in place and press gear onto shaft until it contacts snap ring. Install second snap ring. The same procedure is used for driven shaft except no key is required.



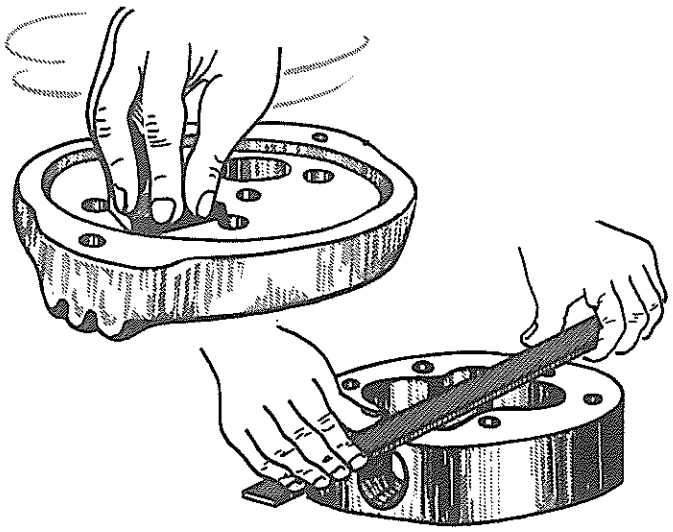
CAUTION: To prevent bending of drive shaft, push (drive or keyed end of shaft) through the gear and press on straight end of shaft.

f. Inspection and Check of Pump Parts For Wear.

(1) Wash all parts in oil solvent, or fuel oil. Dry thoroughly with clean cloths or dry compressed air.

(2) Inspect all parts of the pump.

(3) With a small piece of flat file remove nicks and burrs from around the bearing bores and drilled holes of adapter (3) and cover (20) (see top of page 146B). Clean up burrs and nicks on the machined mating surfaces of housing (12), cover (20) and adapter (3) (see top of page 146B) with India stone and a fine mill file. Rewash before assembly.

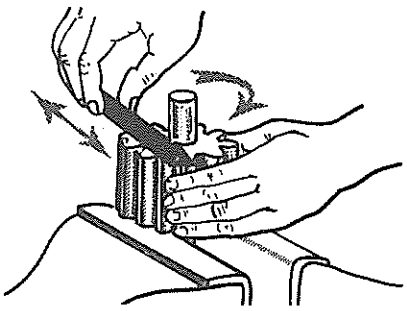


(4) Shafts.

Inspect at bearing points and seal areas for rough surfaces and excessive wear.

(5) Gears.

Inspect edge of teeth and gear face for scoring. Stone face of gears (see below) and edge of teeth before reassembly.



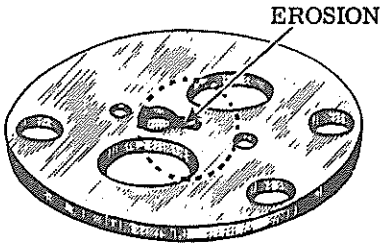
(6) Gaskets.

Always replace housing gaskets (11) if damaged. Replace all seal rings (9).

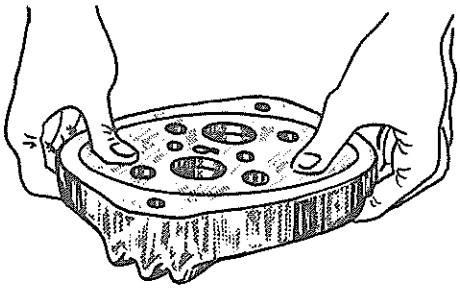
(7) Wear Plates.

Replace if found scored or excessively worn.

NOTE: Do not turn wear plate (10) and (19) as counterbored relief pocket is on gear side only. If wear plate is steel backed, bronze side should be next to gears. Even though slight wear is shown on gear pattern, check for erosion path in vicinity of relief pocket, (see right, above) and replace if in evidence.



(8) Check for proper seating of wear plate in adapter or cover, (below). A rocking motion indicates either a burr on face of adapter or cover.



(9) Recommended Wear Tolerances.

(a) Discard any housing (12) whose gear bores measure greater than 3.259" through the dowel pin hole centerline.

(b) Replace both gears (17) if the differential between the housing width and the gears, with no gaskets in the pump, is in excess of .0035".

(c) Assembled, the total end clearance between the gear faces and the housing width should be .0025" minimum and .0035" maximum.

(d) Replace shaft (13) and (18) if wear at the roller pattern exceeds .001" from that of the major diameter.

(e) Replace wear plates (10) and (19) that have severe score marks or show erosion marks in the vicinity of the counterboard relief pocket.

(f) If the pump shafts have been replaced because wear at the roller patterns exceeded .001", also replace the bearings.

(g) Replacement of seal assembly (6) and seat (4) is recommended if drive shaft is replaced.

g. Pump Assembly.

(1) Type "A" Roller Bearings.

Lubricate rollers (7) and (8) with light grease. Coat I.D. of bearing bore with white lead. Press bearing assembly into bearing bore of adapter and cover with tool. (See page 146F.)

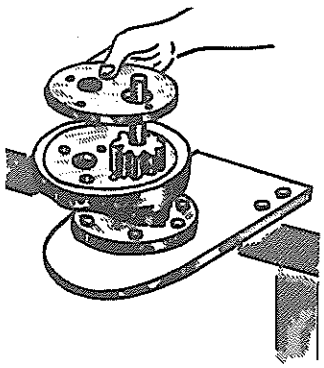
(1A) Type "B" Roller Bearings.

Coat rollers with light grease, bearing bore with white lead and press bearing into bearing bore of adapter and cover.

(2) Final Housing and Cover Assembly.

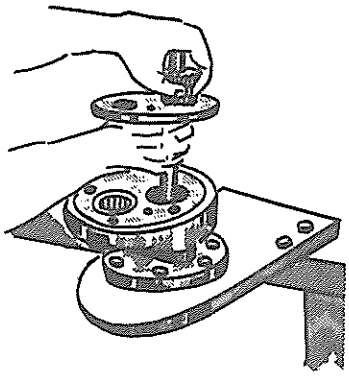
(a) Install dowel pins (5) in adapter (3).

(b) To assemble the wear plate (10), bearing and seal assembly (4) and (6), use the adapter end (3) bolted to the bench plate as a support. (See below). Insert the drive shaft (13) in the adapter end with the long end UP in the side that has a bearing driven in. Put the wear plate over drive shaft making sure the counterbored relief pocket is FACING the gear.



Place the bearing on the drive shaft. Now assemble the oil seal parts in the following order: Back up washer, coil spring, synthetic rubber ring. (Lubricate this ring with a light grease or oil) and the seal cup with lapped surface UP. Make certain the rubber ring (9) is not cut when placing it on the shaft and when passing it over the key slot or spline. Press the entire seat assembly down against the spring and compress it. When released, the spring should return the cup to the position held before compressing. If it sticks on shaft, replace the oil seal assembly.

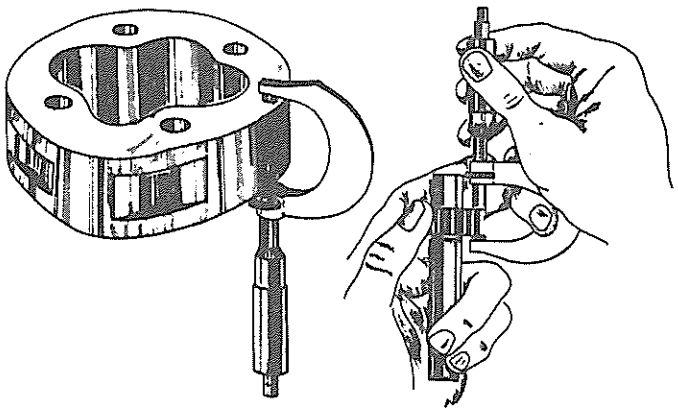
(c) Wipe off any foreign matter from seal seat. Lubricate the lapped surfaces of the seal seat and seal cup with light oil. Turn the entire drive shaft assembly over and install in adapter end as shown below. Use a composition hammer to drive entire assembly down, driving bearing into bearing bore. Place "O" ring seal around wear plate. Lubricate with light oil the section of the wear plate that comes into contact with the gear face.



(d) Pumps with Outboard Bearings.

With an India stone polish out any scratches on drive shaft that were made when shaft was driven out through the bearing.

(e) Clearance between gear face and wear plate is provided by the plastic shim gasket between housing, adapter and cover. With micrometer, measure housing width and width of gears. (See below).



(f) Insert driven assembled gear (17) and shaft (13) into adapter end. Line up marks previously made on gear faces if original gears are reinstalled.

(Page 146.) If new gears are used keep keyways 180° apart. Note that on some models shaft and gear are made in one piece. Lubricate face of gears with light oil.

(g) Place proper gasket as selected by chart (below), over gears and on face of wear plate (10). If it is not practical to use micrometers to measure gears and housing use a gasket that measure .002" thickness.

(h) Line up punch marks and place pump housing (12) over gears and gasket. Tap down with fibre hammer.

(i) Select another gasket from chart or if no measurement (2e) is available use a gasket of .002" thickness. Place gasket on housing face. Lubricate gear face with clean oil.

(j) After selecting proper gasket from the chart, and putting it in place on the housing face, install the wear plate, making sure that the 1/16" deep counterbored relief pocket is in its original position facing the gears and is rotated 180° from the pocket of the adapter wear plate. Place seal ring (9) around the wear plate and position on wear plate with an equal air gap around each shaft. Put cover (20) in place and tap down, being careful not to pinch "O" ring seal (9).

Chart below indicates color, number and location of shim gaskets to be used to provide proper clearance between gear face and wear plate.

CLEARANCE CHART			
	Gear Width Greater (+) or less (-) THAN HOUSING WIDTH	NOTE: Only plastic shim gaskets are used on 1500 Series Pumps ADAPTER SIDE	COVER SIDE
1500 SERIES PUMPS	+.002	.002	.002
	+.001	.001	.002
	.001	.001	.001
	-.001	--	.001
	-.002	--	--
COLOR CODE:	.001 - Amber	.002 - Red	.0015 - Purple

If gears are so worn that housing width becomes more than .0035" greater than gear width, both gears (17) should be replaced.

(k) Install dowel pins (5) in cover. Line up punch marks previously made on housing and cover and put in place. Tap cover down on dowel pins with fibre hammer until cover bottoms on housing. Be careful not to pinch "O" ring seal around wear plate.

(l) Install four cap screws. Pump may be furnished with either hollow head cap screws or hex head type. If hex head, be sure that proper washer (23) is in place before installing. If for any reason replacement of cap screws is required, always use same type as originally furnished. If hollow head cap screws are used, the shoulder of the screw must ride against the spot face of the cover and both surfaces should be free of burrs to prevent leaks.

Tighten gradually opposite cap screws, using torque wrench set at 60 ft. pounds torque. After assembly turn shaft with a 6" Crescent wrench. If shaft will turn with a slight drag and not too freely, proper clearances are assured between gears and wear plate. If shaft is too tight or too free add or remove (.001) or (.002") gaskets as necessary for proper clearance.

(3) Assembly of Outboard Bearings.

(a) Coat I.D. of bearing bore with white lead.

(b) Lubricate the bearing (2) with light grease.

(c) Drive outboard bearing (2) down over drive shaft with special tool, until it bottoms. (See page 146F.)

(d) Insert snap ring (1) in bearing bore.

(e) Remove grease plug and repack outboard bearing bore with good quality bearing grease. Use fingers for repacking. A grease gun will force grease into the oil seal and cause it to leak.

h. Break-In of Repaired Pumps.

(1) If shop test stand is available on which the pump can be mounted and operated against full pressure and at maximum speed, the following procedure is recommended for break-in and test.

(a) Start pump and run for 2 minutes at zero pressure. Be sure that test stand reservoir is filled and that all inlet and outlet lines are open.

(b) By restricting pump discharge line with needle valve, raise discharge pressure to 500 PSI for 10 seconds and lower to zero pressure for 10 seconds. Continue this procedure for 5 minutes.

CAUTION: Do not apply pressure for more than 10 second intervals.

(c) Stop pump and rotate drive shaft coupling by hand to determine if drive shaft is free. If it cannot be turned freely, remove and rebuild pump.

(d) Resume test and apply 1000 PSI for 10 seconds intermittently for 5 minutes.

CAUTION: Do not apply pressure for more than 10 second intervals.

(e) Stop pump and check freeness as in (c). Check for possible leaks at mating surfaces of adapter, housing and cover and around seal assembly and the four assembly cap screws.

(f) Be sure oil level is up to normal in oil reservoir. Start pump and run pressure to 1500 PSI and run flow test by whatever means is available on the test stand.

(2) If a shop test stand is not available, the following alternate break-in and test procedure may be used:

(a) Mount repaired pump in place on equipment and run pump at one quarter engine speed for 5 minutes at zero pressure.

(b) Operate control valve until relief pressure is attained, then hold in this position for 10 seconds and release for 10 seconds. Follow this procedure for 10 minutes.

(c) Increase engine speed to one-half throttle, and repeat step (b) for 10 minutes.

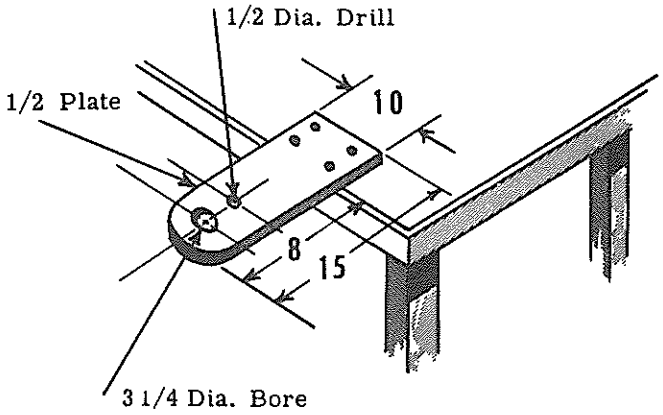
(d) Increase engine speed to full throttle, and repeat step (b) for 5 minutes.

(e) Idle engine and check pump for possible leaks at mating surfaces of housing, adapter end cover, shaft seal area, and any of the cap screws.

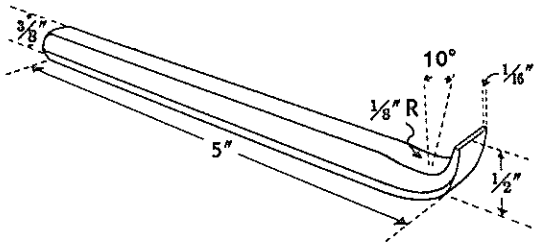
TROUBLE SHOOTING

POSSIBLE PUMP TROUBLES	CAUSES	REMEDIES
I. Cavitation, pump unusually noisy.	a) Low oil supply. b) Heavy oil. c) Dirty oil filter. d) Suction line too small. e) Restriction in suction line.	a) Fill to proper level. b) Change to proper oil. c) Clean and replace filter. d) Increase size of suction line. e) Remove.
II. Pump takes too long to respond or fails to respond.	a) Low oil supply. b) Insufficient relief valve pressure. c) Pump worn or damaged.	a) Fill to proper level. b) Reset to correct pressure setting using gauge. c) Inspect, repair or replace.
III. Oil heating up.	a) Foreign matter lodged between the relief valve plunger and relief valve seat. b) Using very light oil in a hot climate. c) Dirty oil. d) Oil level too low. e) Insufficient relief valve pressure. f) Relief valve pressure too high. g) Pump worn (slippage).	a) Inspect and remove foreign matter. b) Drain and refill with proper oil. c) Drain, flush and refill with clean oil. d) Fill to proper level. e) Set to correct pressure. f) Same as "e". g) Replace or repair.
IV. Oil foaming.	a) Air leaking into suction line from tank to pump. b) Wrong kind of oil. c) Oil level too low. d) Improper tank or reservoir baffling.	a) Tighten all connections. b) Drain and refill with a non-foaming type of hydraulic oil. c) Fill to proper level. d) Baffle correctly.

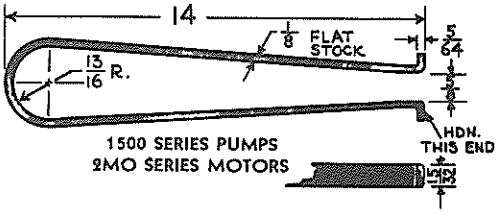
i. Special Tools for Pump Repair. (Not furnished. Can easily be made locally)



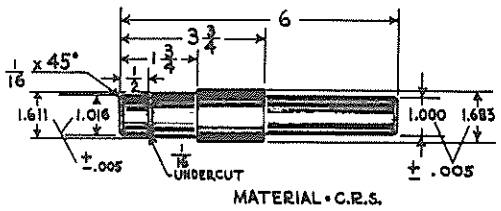
Bench Mount



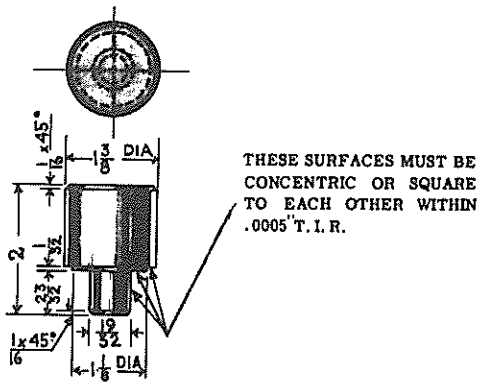
Bearing Pry Bar



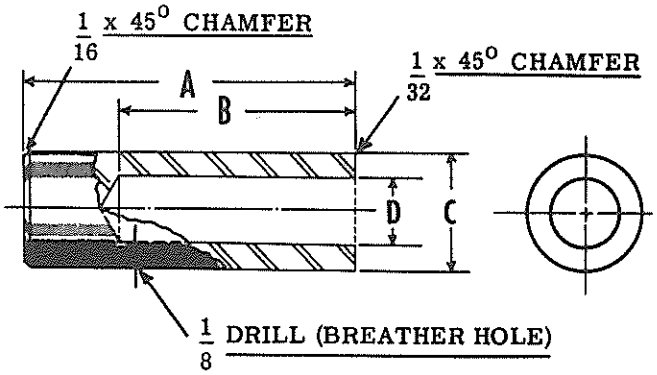
Bearing Puller



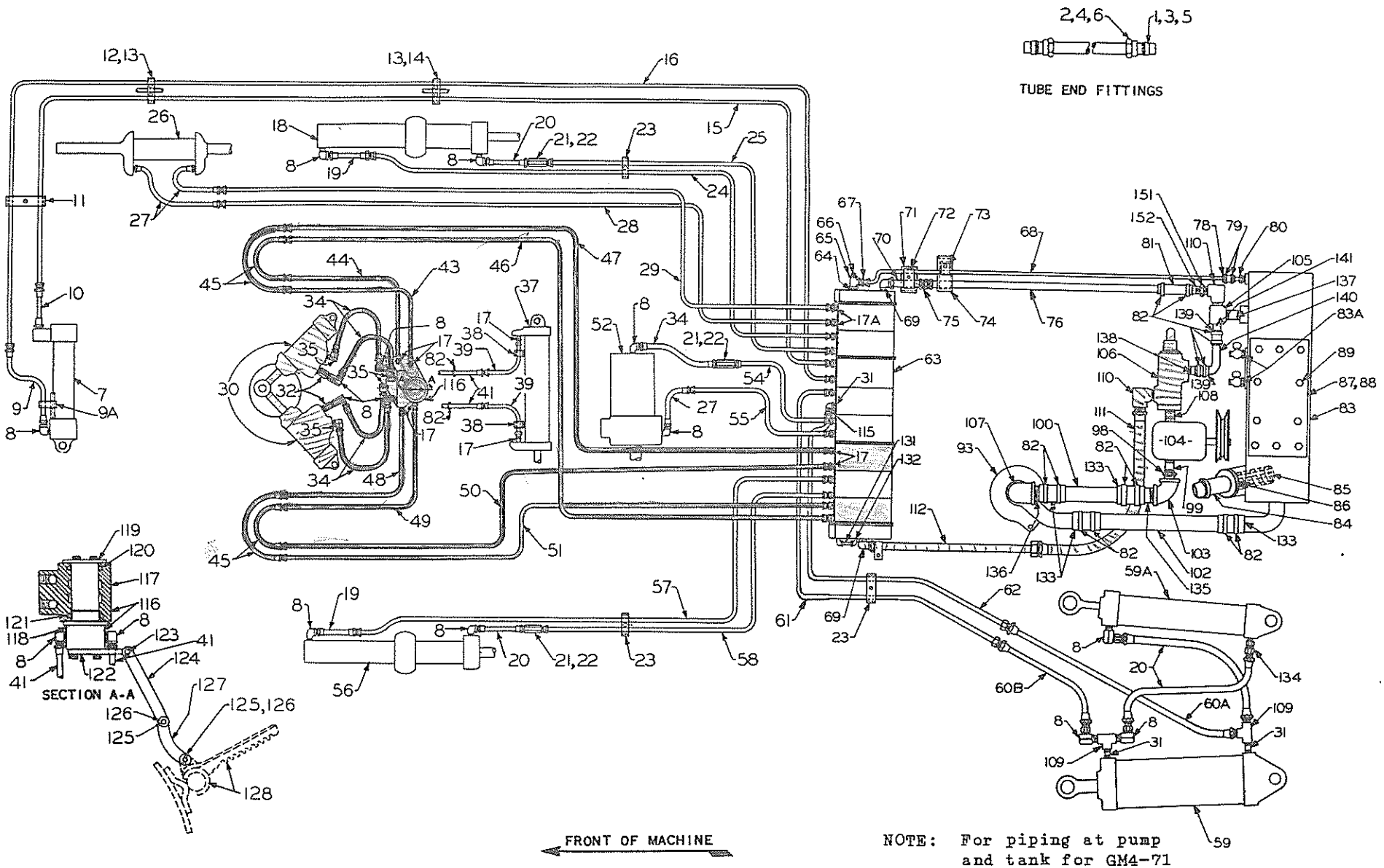
Seal Driver



Roller Bearing Driver

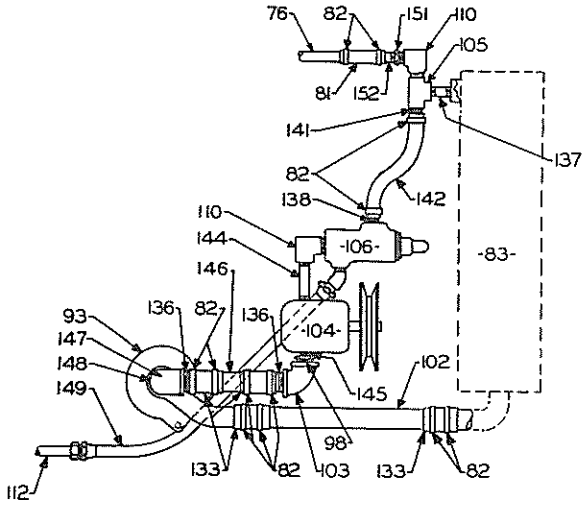


Outboard Bearing Driver

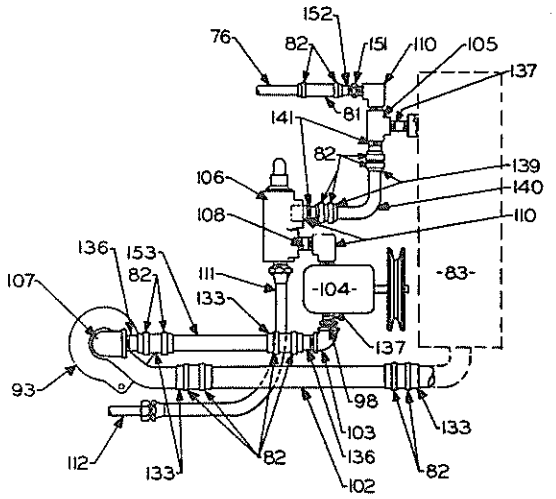


NOTE: For piping at pump and tank for GM4-71 and UD-14A engines, see page 148.

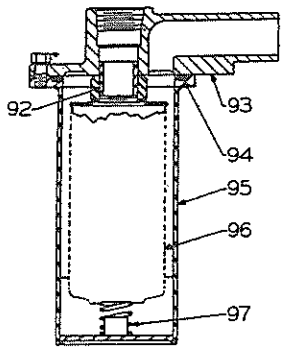
Hydraulic Piping Diagram
(For GM-4080 Engine with Hydreco Pump)



FOR GM 4-71 ENGINE



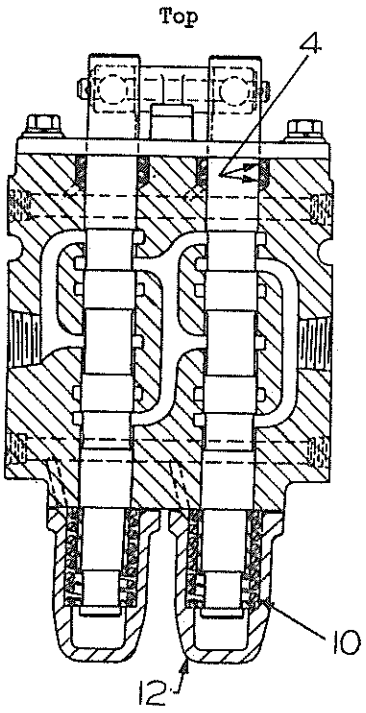
FOR IHC UD-14A ENGINE



STRAINER GROUP

NOTE: For balance of grader piping, see page 147.

Hydraulic Piping Diagram at Pump and Tank
(For GM4-71 and UD-14A Engines with Hydreco Pump)



178. HYDRAULIC CONTROL VALVES.
(See above)

A separate trouble-free movable 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 (10). The spring (10) and parts within cap (12), do not require adjustment or cleaning whatsoever, from one season to another, and this likewise applies to the seals (4).

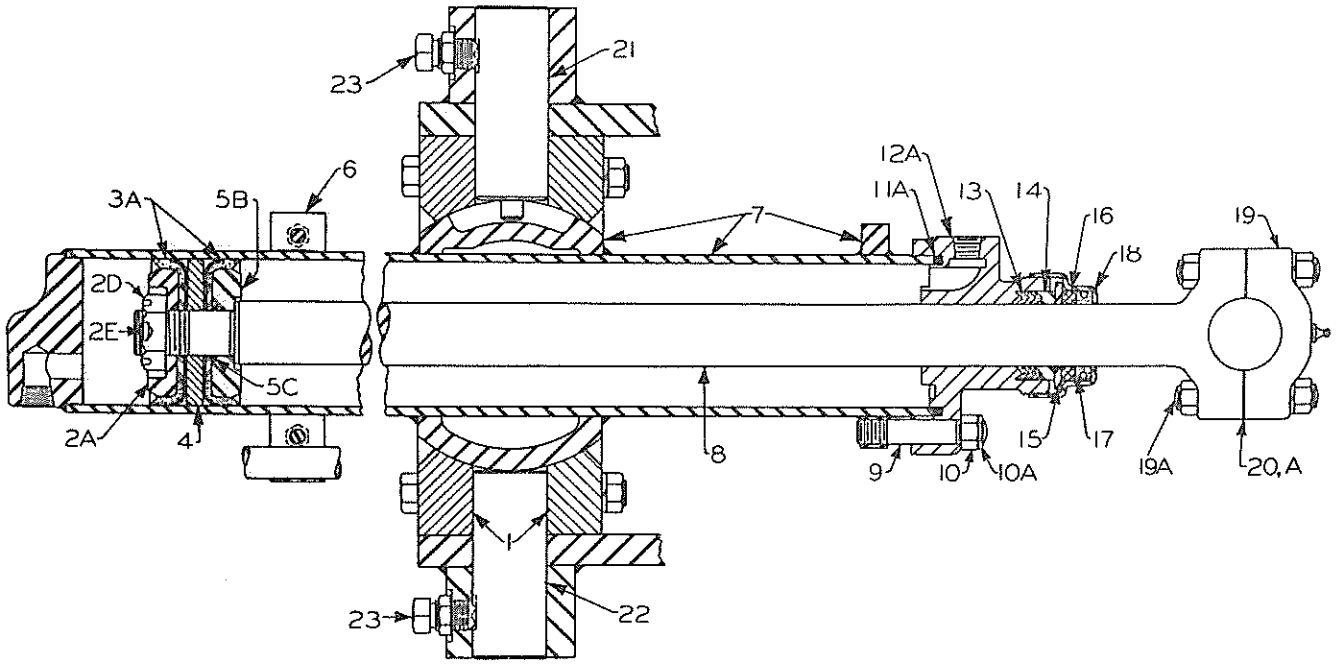
Should you believe the control valve group requires attention, contact your nearest Austin-Western distributor for service assistance.

179. HYDRAULIC RAM CYLINDERS.
(See below)

a. General.

The ram cylinders should require little or no attention through 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.

In making cylinder cup replacements do not replace with leather or other questionable material, as the special moulded steel back cups (3A), 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.



180. BLADE LIFT RAM.
(See page 149)

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 (10A) and (10). The head (12A) with rod (8), may now be pulled out of the cylinder (7) exposing the cups (3A).

(4) To remove the cups (3A) together with the piston (4) and outer spreader (2A) and inner spreader (5B) from the rod (8), clamp the socket end of rod in a vise. By means of a suitable long wrench remove nut (2D). After removing the nut (2D) the cups and parts may be slipped off the rod (8). Loosen cap (18) and remove the head (12A) with seal parts.

(5) Assembly is reversal of the above procedure.

(6) Coat the inner bore of cups (3A) with quick setting compound, such as Perma-Tex #3, before placing them on the rod.

(7) When retightening the nut (2D) 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 (3A) 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 "O" ring (11A) into the recess of the head (12A). 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.

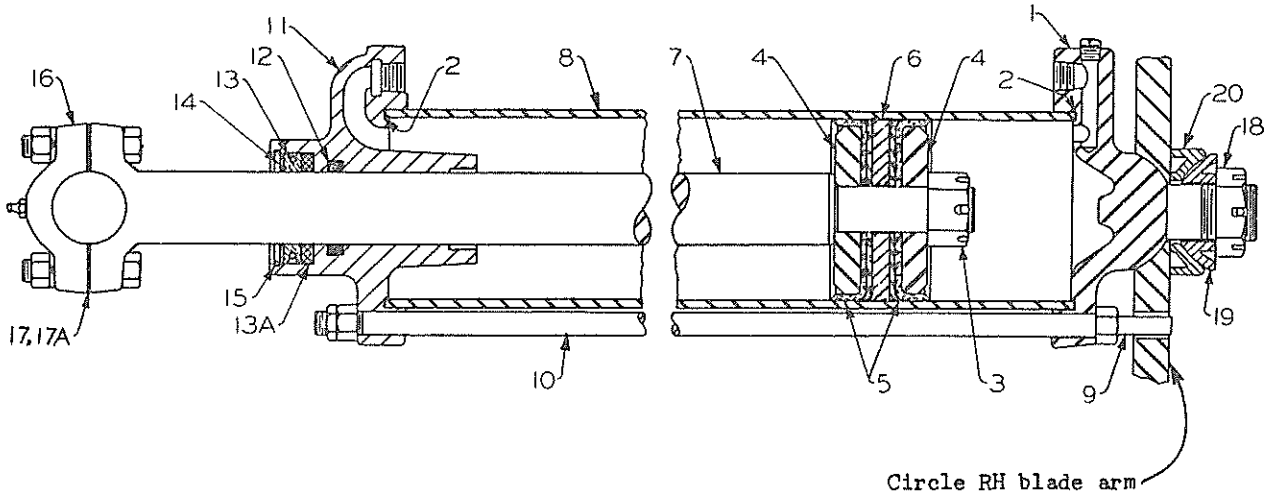
(9) To remove the complete blade lift ram group from the machine, lower the moldboard to the ground and detach the two hydraulic hoses. Detach the ball socket (19). Remove the two set screws (23) and pull out the two pins (21) and (22).

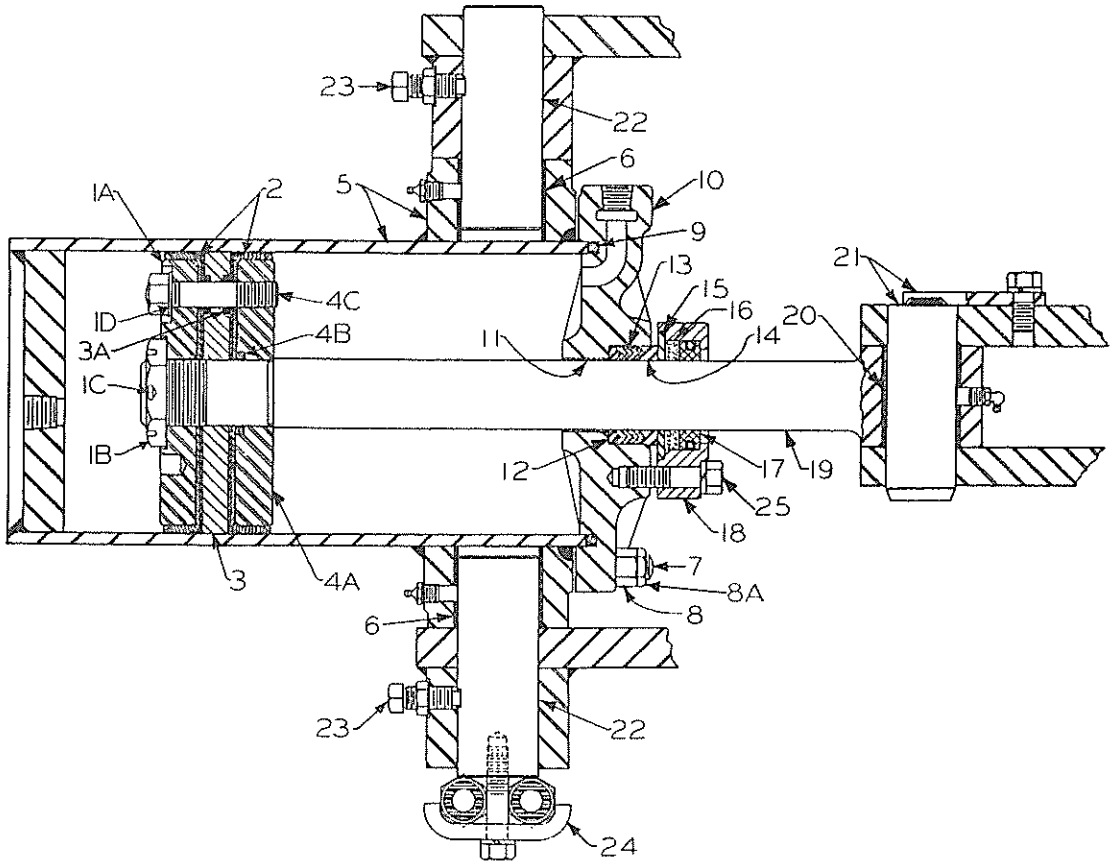
181. BLADE SIDE SHIFT RAM.
(See below)

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 the paragraph 180, (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, then cottered.



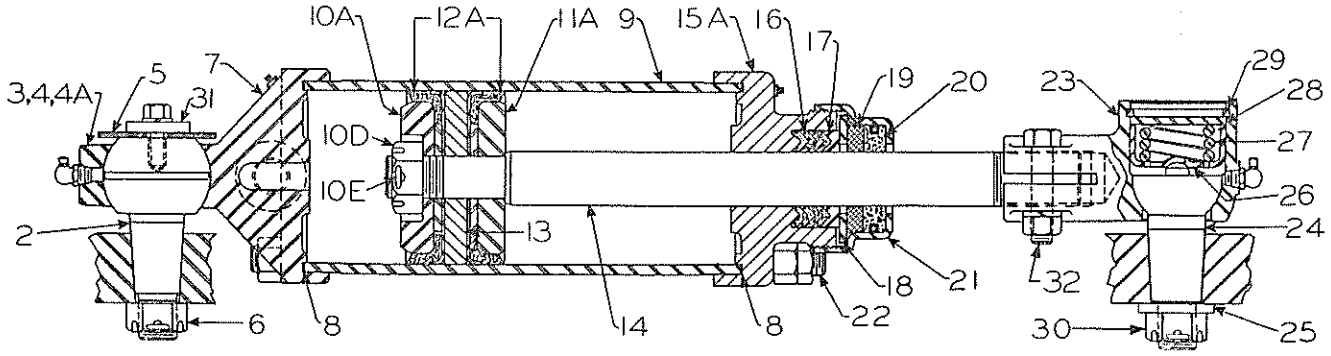


182. HIGH LIFT RAM.
(See above)

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).

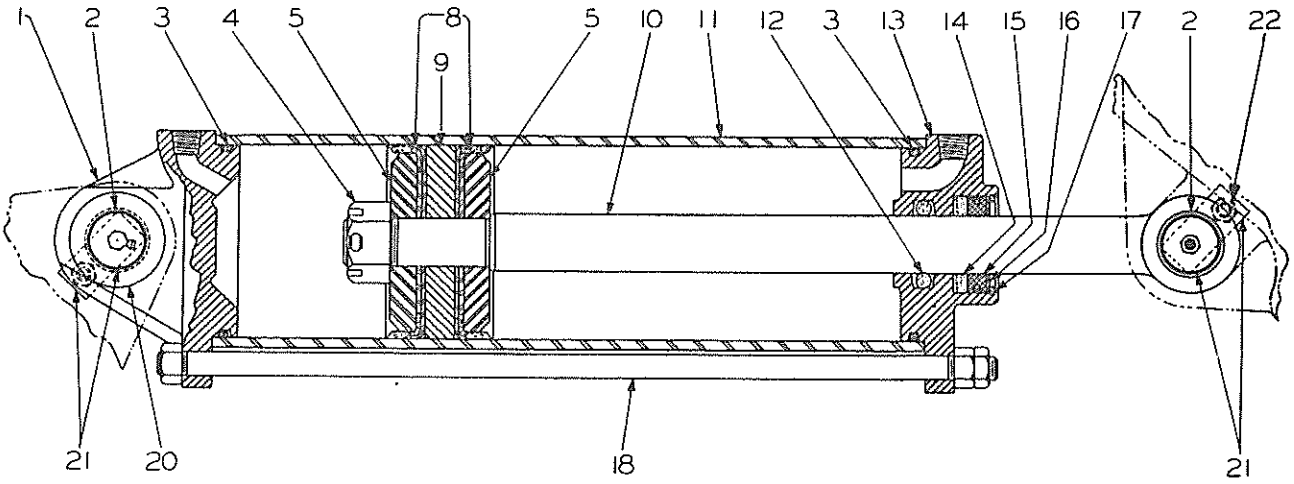
To dismantle and expose the ram cups (2) proceed as shown in paragraph 180, (3) to (8) inclusive.



183. FRONT STEER RAM.
(See above)

Remove cap (3), also disconnect the two hydraulic hoses. Remove nut (30), and then drive ball stud (24) upward to remove the complete ram.

To dismantle and expose the ram cups (12A) proceed as shown in paragraph 180, (3) to (8) inclusive.



184. REAR STEER RAMS.
(See above)

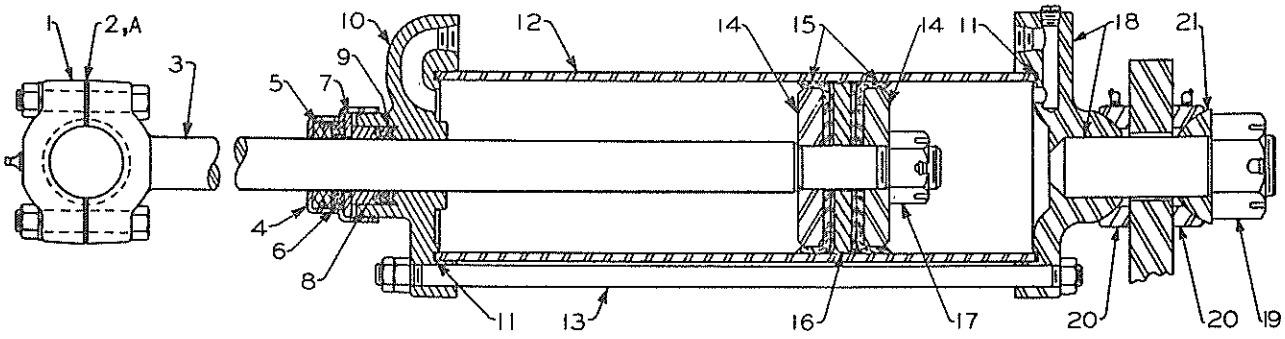
There are two steering rams on this machine, a five inch ram on the left side of the tandem assembly and a three inch ram on the right side of the tandem assembly. The rams should always be mounted in these positions.

To remove a complete ram, remove the two pins (21), also disconnect the two hydraulic hoses.

To dismantle and expose the ram cups (8) proceed as shown in paragraph 180, (3) to (8) inclusive.

When assembling the cups, drive against the spreader (5) in order to seat the cups (8).

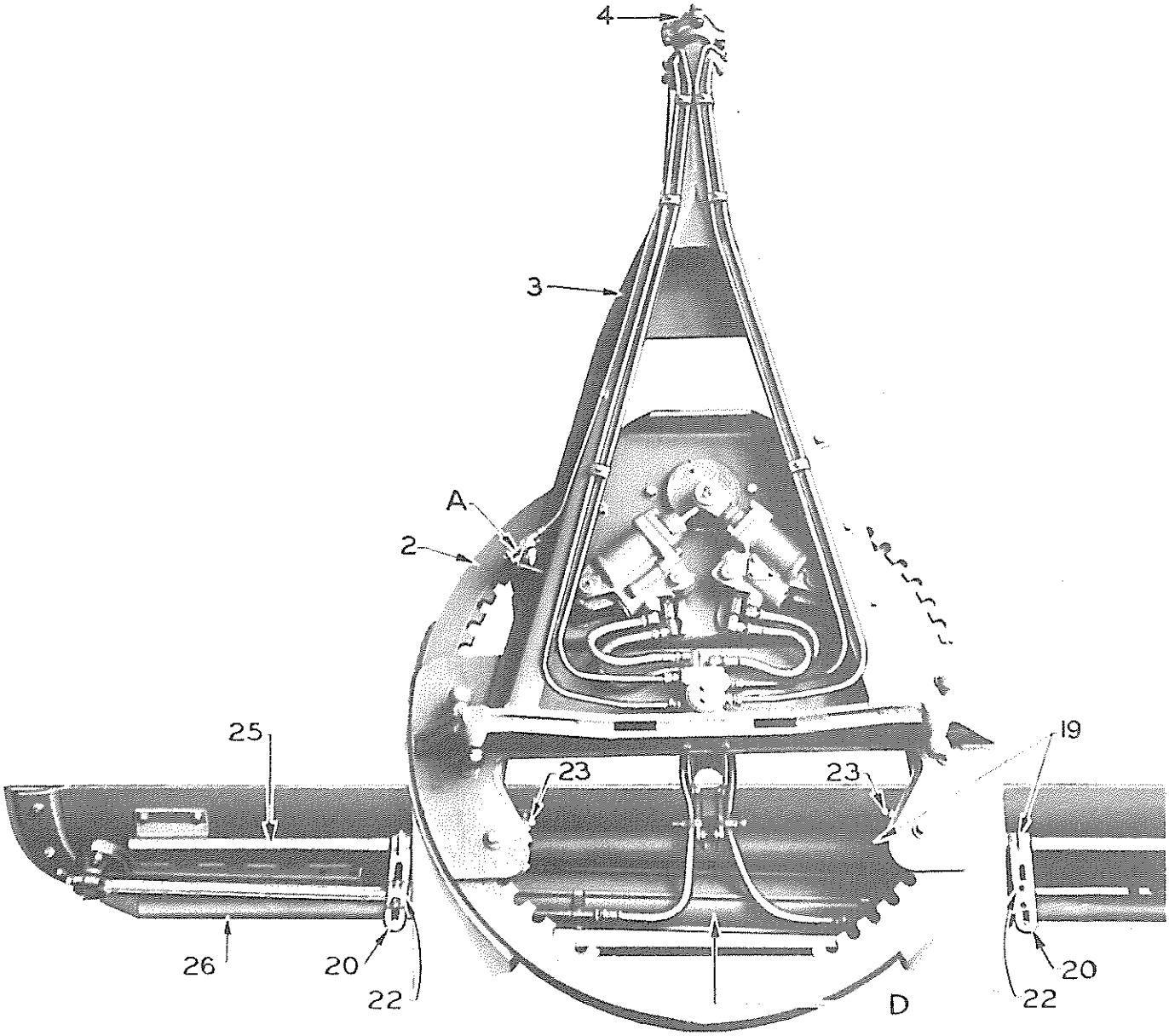
Always install new seals (3), (12), (14) and (15).



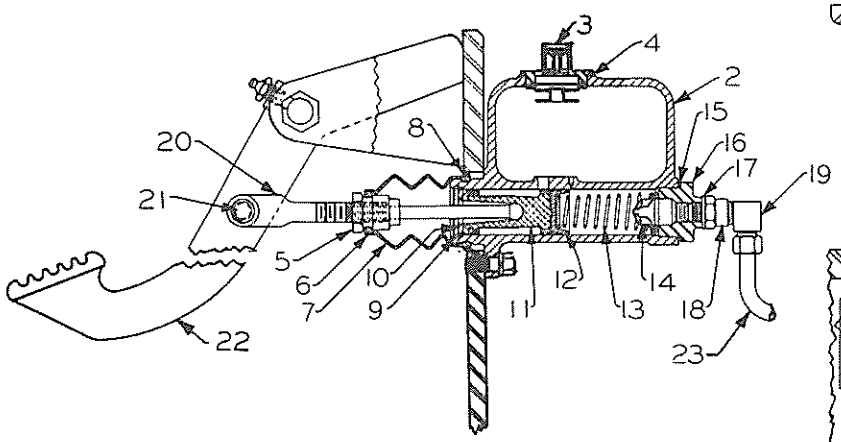
185. SCARIFIER RAM.
(See above) (Also used with Bulldozer and front Snow Plows)

To remove the complete ram, lower the scarifier to the ground. Remove nut (19), also cap (1) and two hydraulic hoses.

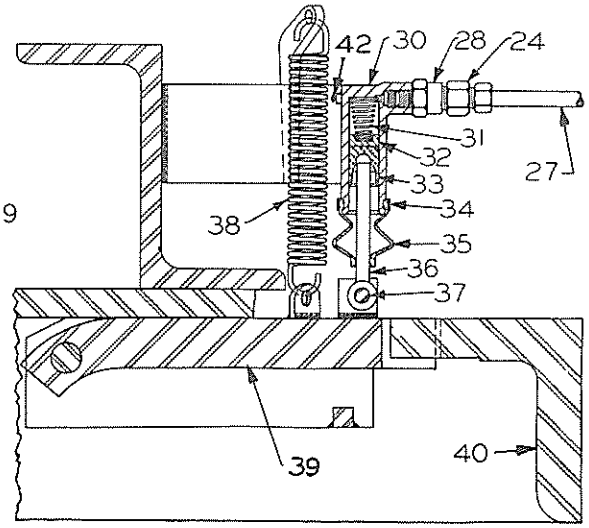
To dismantle and expose the ram cups (15), proceed as shown in paragraph 180, (3) to (8) inclusive.



Circle and Draw Bar



Circle Latch Master Cylinder



Circle Latch and Cylinder

186. CIRCLE AND DRAW BAR.
(See Page 153)

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 vertical bolts which pass thru the slots of link (20) (two on each side).

(3) 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 extenaions are provided to enlarge the usefulness of your machine for light work only.

187. BLADE CIRCLE LATCH.
(See page 153)

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 9, and lift the moldboard and bit out of the ground.

(2) Release the blade circle latch. (Use foot pedal (11), page 9.)

(3) Always rotate the circle as required by using hydraulic power; lever (2), page 9. Never reverse the circle by placing one end of the moldboard in the ground and moving the grader either forward or backward.

188. CIRCLE REVERSE HYDRAULIC MOTOR.
(See page 156)

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) Discount 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 test 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. (Blowing on end of test hose with mouth pressure is O.K. as an alternate test.)

(8) Proceed to adjust slotted cam screw (EE) in the end of the cam lever until the amount of air blown out of the two open ports (A) and (B) is equal. This means that the piston valve (F) is in dead neutral position, while the main 4" cylinder piston (G) is on dead center.

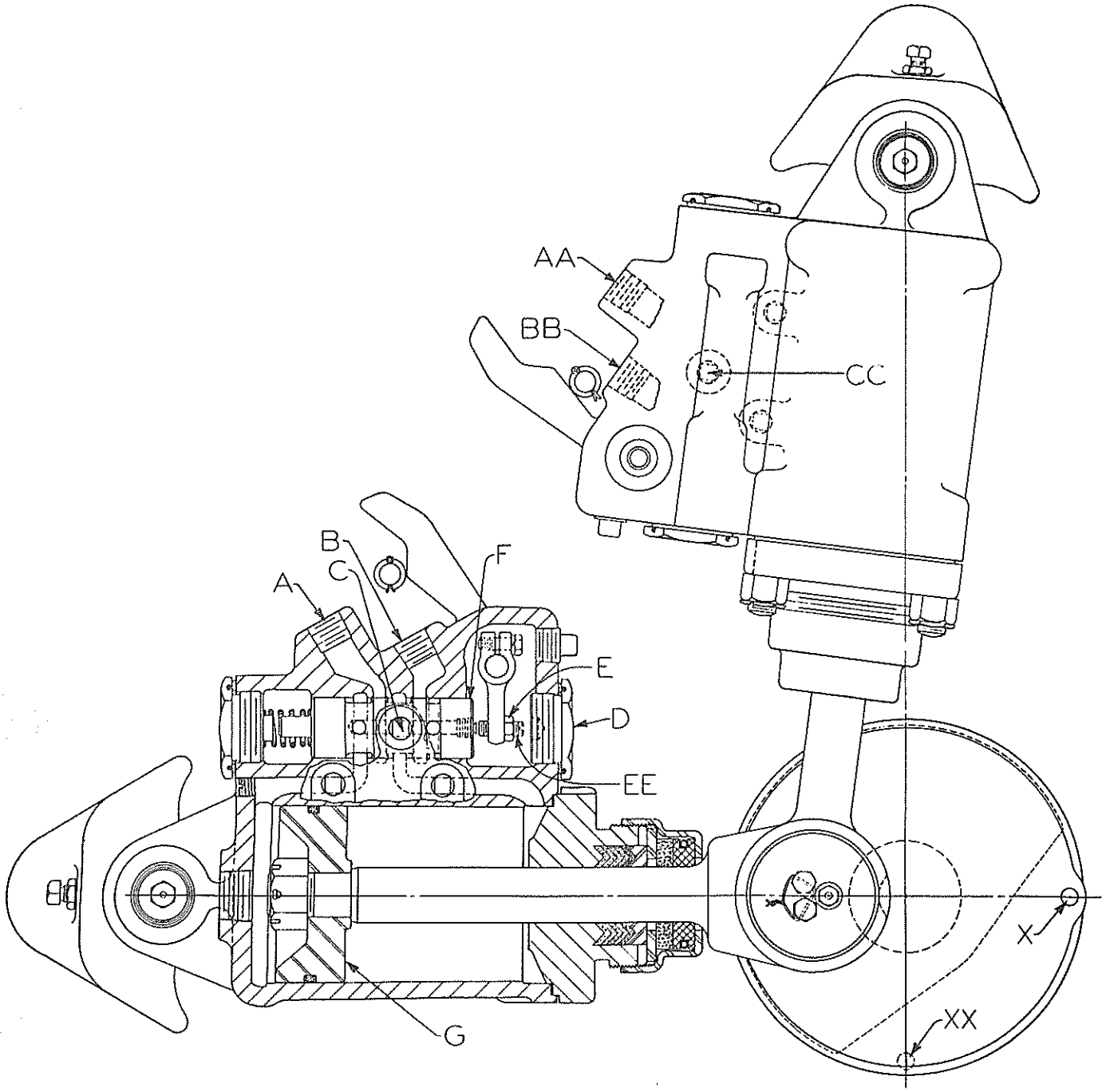
(9) Tighten lock nut (E) and cam adjusting screw, making sure that position of screw (EE) does not change when tightening lock nut.

(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).

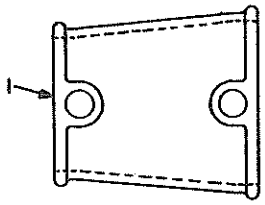
(13) Proceed to time other valve after removing the two hoses at (AA) and (BB), and the one pipe plug (CC) located under the body.



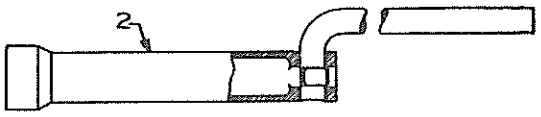
Timing Hydraulic Oil Motor

189. TOOLS.

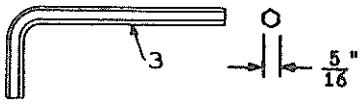
a. Standard Tools.



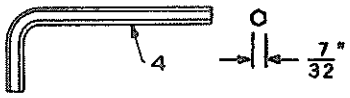
Front Wheel Bearing Wrench



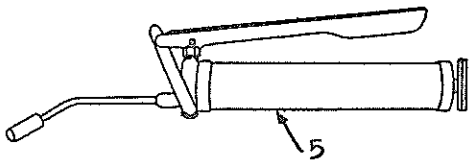
Wheel Stud Wrench



Front Axle Universal Joint Bearing Ring Cap Screw Wrench

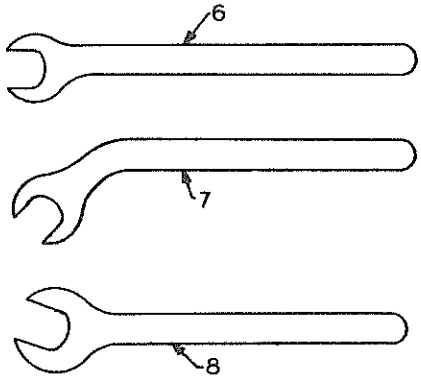


Hydraulic Control Valve Cap Screw Wrench

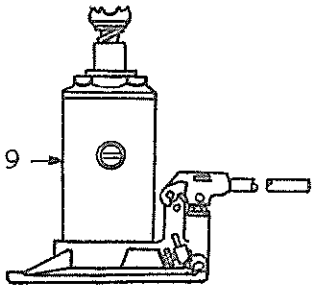


Grease Gun

b. Tools Furnished on Special Order Only.



Wrenches (6), (7), and (8) are for the hydraulic hose couplings



Hydraulic Jack

NOTE: See 99 Series Power Grader Repair Parts Catalog for part numbers of above tools (1) to (9) inclusive.

ALWAYS USE GENUINE — AUSTIN-WESTERN — REPAIR PARTS

SATISFACTORY AND EFFICIENT OPERATION OF THIS MACHINE IS ENDANGERED BY THE USE OF INFERIOR REPAIR PARTS. THE USE OF CHEAP AND IMITATION PARTS INVARIABLY MEANS SHORT LIFE AND HIGHER ULTIMATE COST.

IF REPAIR PARTS COULD BE MADE AT LOWER COST AND SOLD AT LESS PRICE WITHOUT SACRIFICING QUALITY WE WOULD DO SO. THE CORRECT MATERIAL FOR THE PURPOSE AND THE KNOWLEDGE ACQUIRED THROUGH MANY YEARS OF MANUFACTURING ENABLES — THE AUSTIN-WESTERN WORKS — TO PRODUCE QUALITY THAT WILL NOT BE FOUND IN IMITATION PARTS.

YOU TAKE AN UNNECESSARY RISK WHEN YOU USE INFERIOR REPAIR PARTS. WE USE MANY BOLTS, STUDS, CAP SCREWS, ETC., THAT ARE LISTED WITH PART NUMBERS. THESE ARE MADE OF ALLOY STEEL AND HEAT TREATED TO GIVE THEM MAXIMUM STRENGTH. THEY MAY LOOK LIKE ORDINARY BOLTS, STUDS OR CAP SCREWS, BUT USE OF A SUBSTITUTE FOR THEM WILL LEAD TO BREAK-DOWNS, DELAYS AND DAMAGE TO MACHINE.

WHEN ORDERING A TAPERED ROLLER BEARING ALWAYS ORDER A SET, WHICH CONSISTS OF ONE BEARING CUP AND ONE BEARING CONE WITH ROLLERS.

ALWAYS USE GENUINE — AUSTIN-WESTERN — REPAIR PARTS

— SAFETY FIRST —

ACCIDENTS ARE CAUSED BY THE FAILURE OF SOME INDIVIDUAL TO OBSERVE SIMPLE AND FUNDAMENTAL SAFE RULES OR PRECAUTION. ACCIDENTS CAN BE PREVENTED BY RECOGNIZING THE CAUSE OF THE ACCIDENTS AND DOING SOMETHING ABOUT IT BEFORE THE ACCIDENT OCCURS.

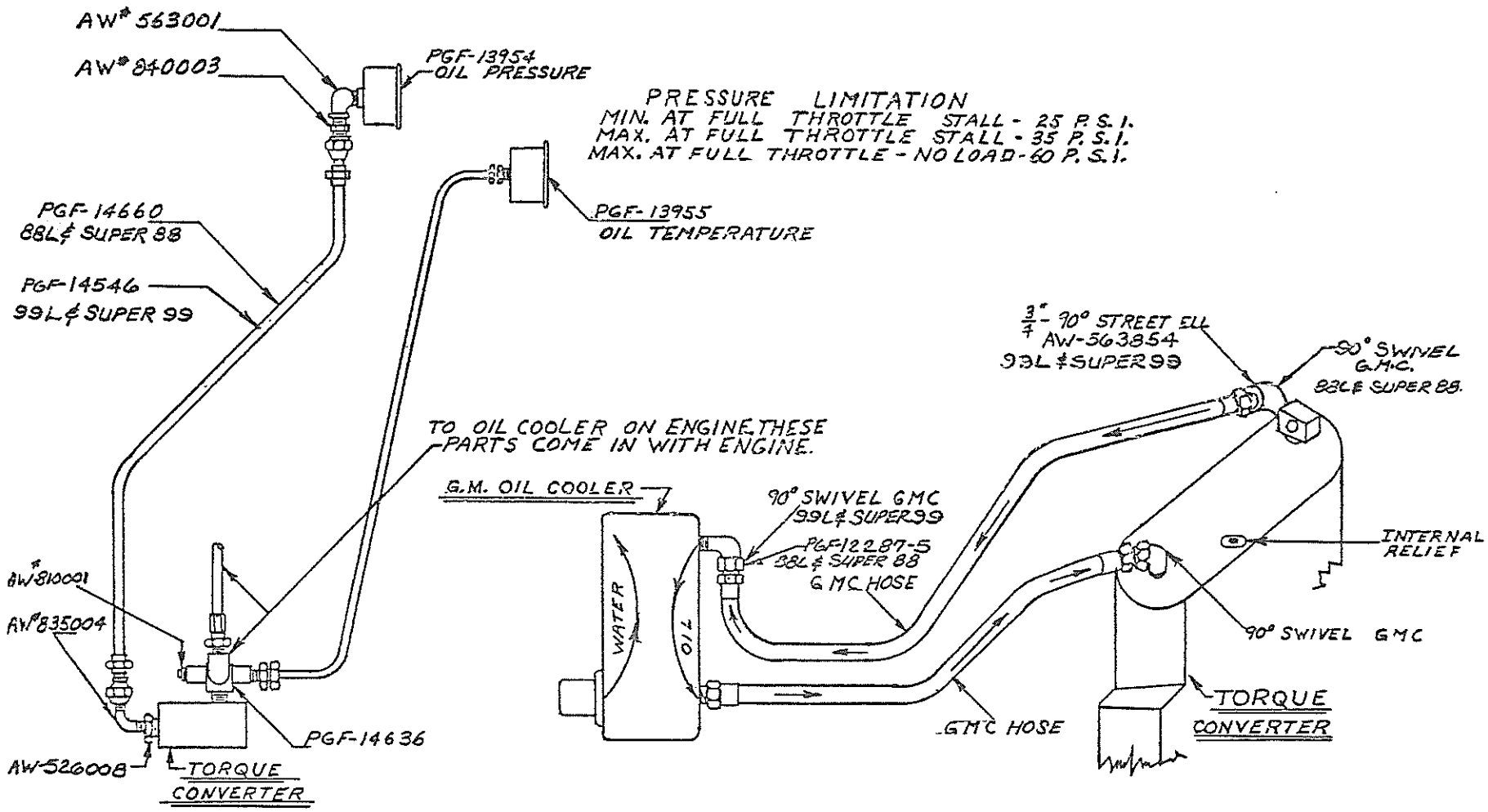
REGARDLESS OF THE CARE USED IN THE DESIGN OF A MACHINE, THERE ARE POINTS THAT CANNOT BE COMPLETELY SAFEGUARDED WITHOUT INTERFERING WITH ACCESSIBILITY AND EFFICIENT OPERATION.

A CAREFUL OPERATOR IS THE BEST INSURANCE AGAINST AN ACCIDENT.

MANY ACCIDENTS WOULD BE PREVENTED IF THE FOLLOWING RULE WERE OBSERVED:

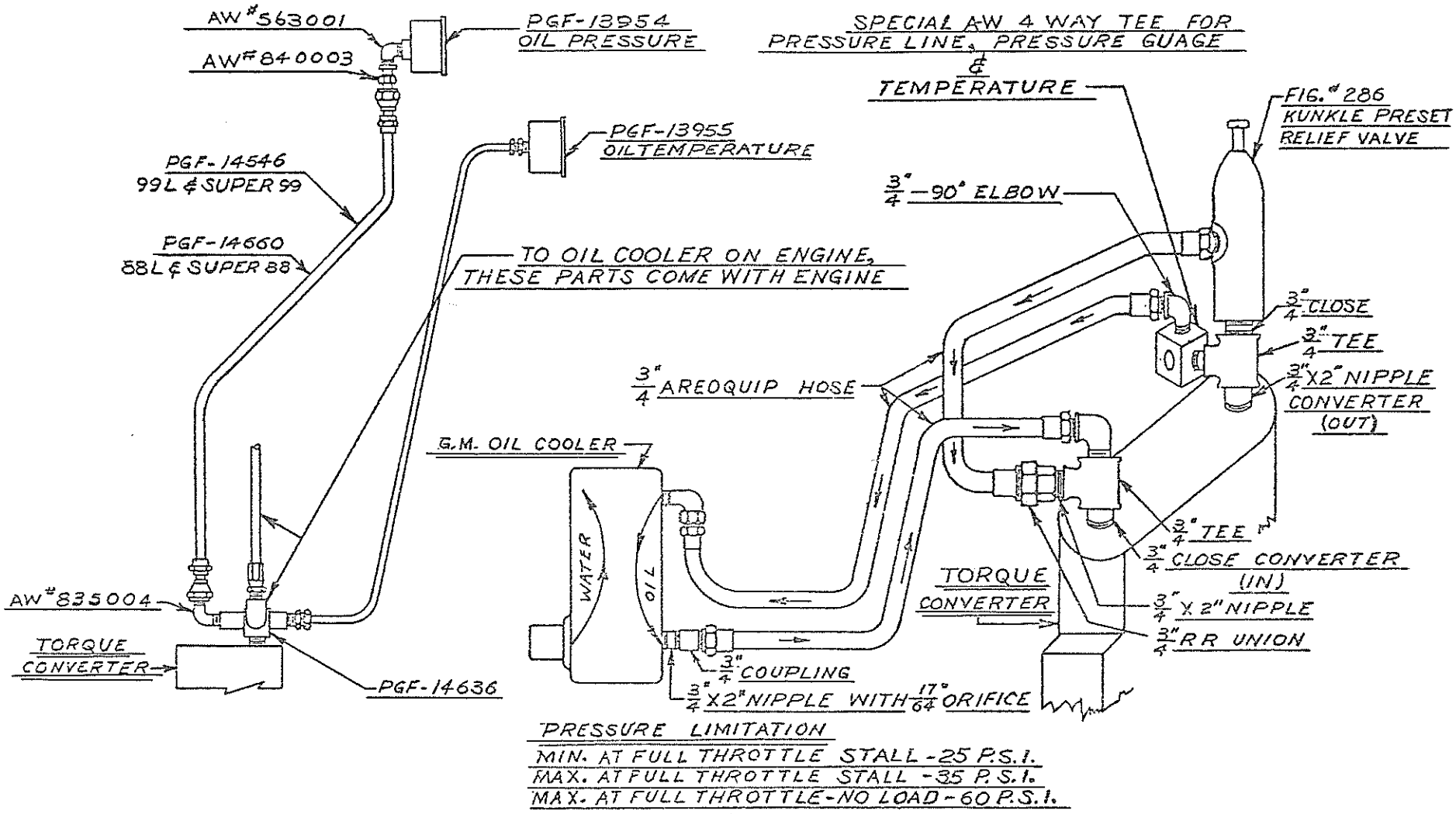
"NEVER ATTEMPT TO CLEAN, OIL, OR ADJUST A MACHINE WHILE IT IS IN MOTION."

Graders equipped with Allison Torque Converter
Serial No. 8073 and up having the internal relief valve



Torque Converter, Instruments and Connections

Graders equipped with Allison Torque Converter
Serial No. below 8073 having the external relief valve



Torque Converter, Instruments and Connections