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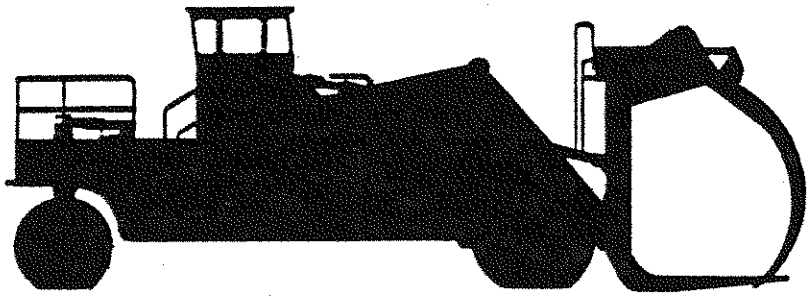


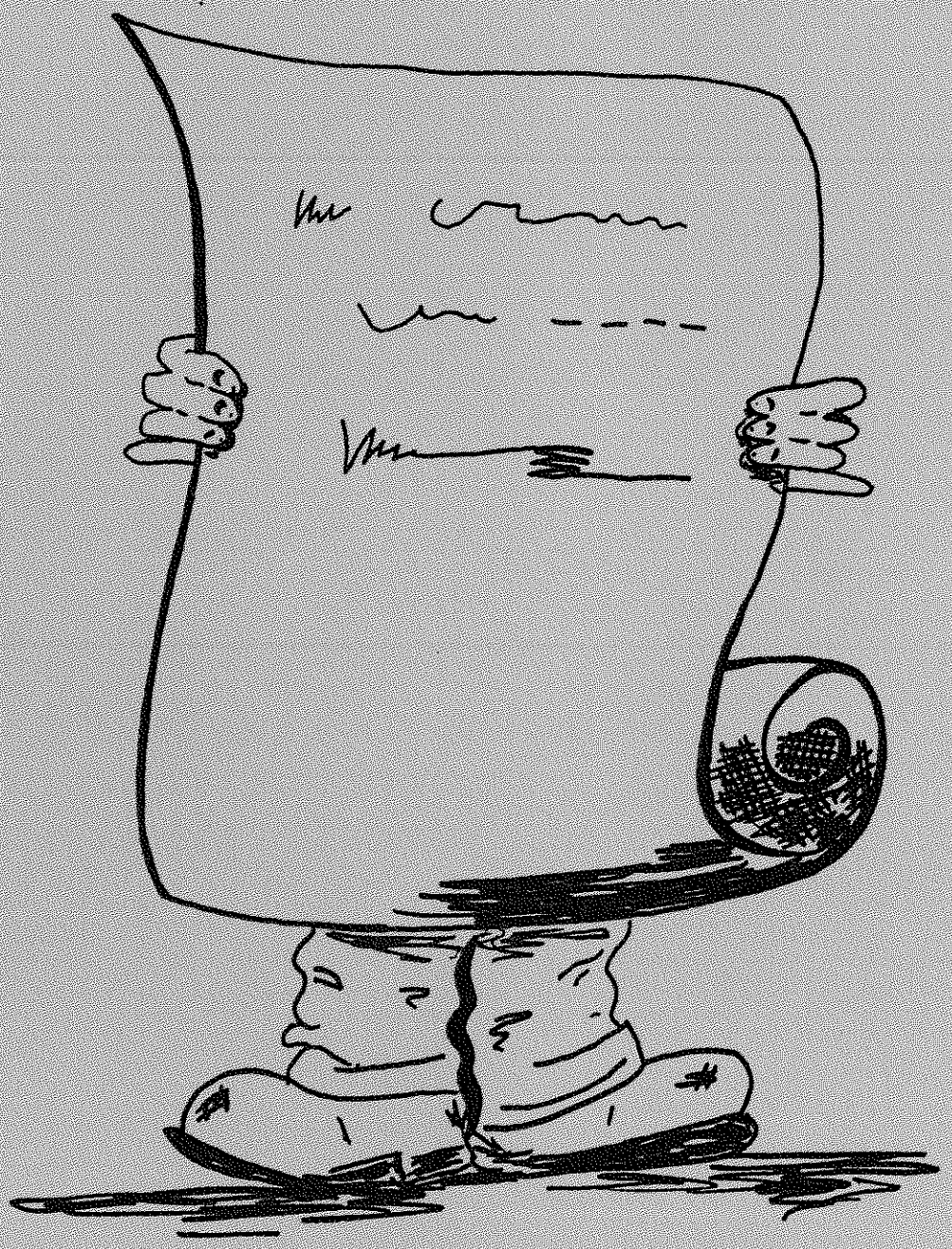
LUMBERJACK

L-90S

OPERATOR'S MANUAL

1

GENERAL INFORMATION



Section 1

General

Fig. 1-1 Typical Wagner Lumberjack

1.1 Introduction

This manual is your guide to correct operation of the **Allied Wagner Lumberjack.** Become familiar with it, understand it, and use it. Read all instructions carefully prior to operation. They will help you understand the unit, its capabilities, and its limitations.

As an operator, it's your responsibility to make certain that your Lumberjack operates at maximum efficiency, with the greatest possible safety. It is also your responsibility to keep it in top operating condition through proper operating techniques and correct operator maintenance. Remember, safe and efficient operation is up to you - the operator.

The Lumberjack, workhorse of the logging industry, has proved itself the world over. It can unload a full truck load or rail car load of logs with a single bite. And...the load may be decked, dumped in mill ponds, or transported directly to the mill, covering every distance with speed and agility. The Lumberjack is also a time and labor saver in splitting loads and sorting within log yards.

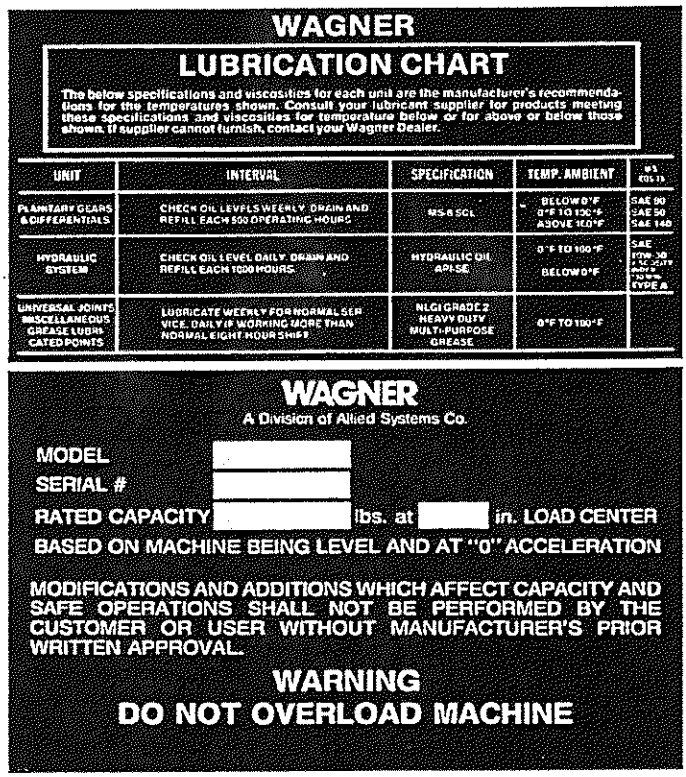
Rugged construction and ease of service contribute to the Lumberjack's long life and low maintenance. And the Lumberjack's superior visibility and responsive controls result in a fast, efficient and safe operation.

1.2 Machine Identification

Typical MODEL, SERIAL NUMBER, and LUBRICATION plates are shown in Fig. 1-2. These plates are securely fastened to the cab superstructure on the right side.

The lubrication plate lists the time intervals, specifications, temperature limits, and viscosity requirements of lubricating oils and greases. For further lubrication information, see Section 5 of this manual.

NOTE: The importance of the machine's model and serial numbers cannot be overstated. Always have these numbers at your fingertips when requesting parts, service, or operation information of any kind. It is from these numbers that our Service Department creates a unit file in which a complete history of your machine is maintained.



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LUBRICATION CHART

The below specifications and viscosities for each unit are the manufacturer's recommendations for the temperatures shown. Consult your lubricant supplier for products meeting these specifications and viscosities for temperature below or for above or below those shown. If supplier cannot furnish, contact your Wagner Dealer.

UNIT	INTERVAL	SPECIFICATION	TEMP. AMBIENT	
PLANTARY GEARS & DIFFERENTIALS	CHECK OIL LEVELS WEEKLY. DRAIN AND REFILL EACH 500 OPERATING HOURS	MS-6 SCL	BELOW 0°F 0°F TO 130°F ABOVE 100°F	SAE 90 SAE 50 SAE 140
HYDRAULIC SYSTEM	CHECK OIL LEVEL DAILY. DRAIN AND REFILL EACH 1000 HOURS	HYDRAULIC OIL API-SE	0°F TO 100°F BELOW 0°F	SAE TYPE A
UNIVERSAL JOINTS MISCELLANEOUS GREASE LUBRICATED POINTS	LUBRICATE WEEKLY FOR NORMAL SERVICE. DAILY IF WORKING MORE THAN NORMAL EIGHT HOUR SHIFT	NLGI GRADE 2 HEAVY DUTY MULTI-PURPOSE GREASE	0°F TO 100°F	

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MODEL

SERIAL #

RATED CAPACITY lbs. at in. LOAD CENTER

BASED ON MACHINE BEING LEVEL AND AT "0" ACCELERATION

MODIFICATIONS AND ADDITIONS WHICH AFFECT CAPACITY AND SAFE OPERATIONS SHALL NOT BE PERFORMED BY THE CUSTOMER OR USER WITHOUT MANUFACTURER'S PRIOR WRITTEN APPROVAL.

WARNING

DO NOT OVERLOAD MACHINE

Fig. 1-2 Lubrication and Identification Plates

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L-90S

LUMBERJACK

SPECIFICATIONS

Engine

Make and Model	Caterpillar 3406T
Max Horsepower	325 @ 2100 RPM
Max Torque	1010 Ft/Lbs @ 1500 RPM
Bore and Stroke	5.4" x 6"
No. of Cylinders	6
Displacement	893 Cu/In (14.6 liters)

Air Cleaner

Donaldson Two Stage Dry Type

Electrical System

Type	12 Volt Neg. Ground/24 Volt Start
Alternator	105 AMP
Circuit Breakers (lights)	30 AMP
Circuit Breakers (accessory)	20 AMP
Batteries (2)	12 Volt-8D @ 205 AMP Hr. each

Torque Converter

Allison Single Stage polyphase 4 element/stall torque Ratio 3.13-1

Transmission

Allison Planetary type, full power shift, 3 ranges forward and reverse, single lever range control, foot controlled forward and reverse valve.

Speed Range	Forward & Reverse
Low	0-4 mph (6.4 km/h)
Intermediate	0-7.5 mph (12.0 km/h)
High	0-15.0 mph (24.1 km/h)

Axles

Fabricated	Allied Wagner
Make	Clark
Model	FD-85501 Series
Type	Planetary
Brakes	Air over Hydraulic Disc
Brake Size	32" Dia. (813mm)

Tires

Size (Driver)	33.5 x 33-44PR
Size (Tail)	23.5 x 25-20PR

Hydraulic System

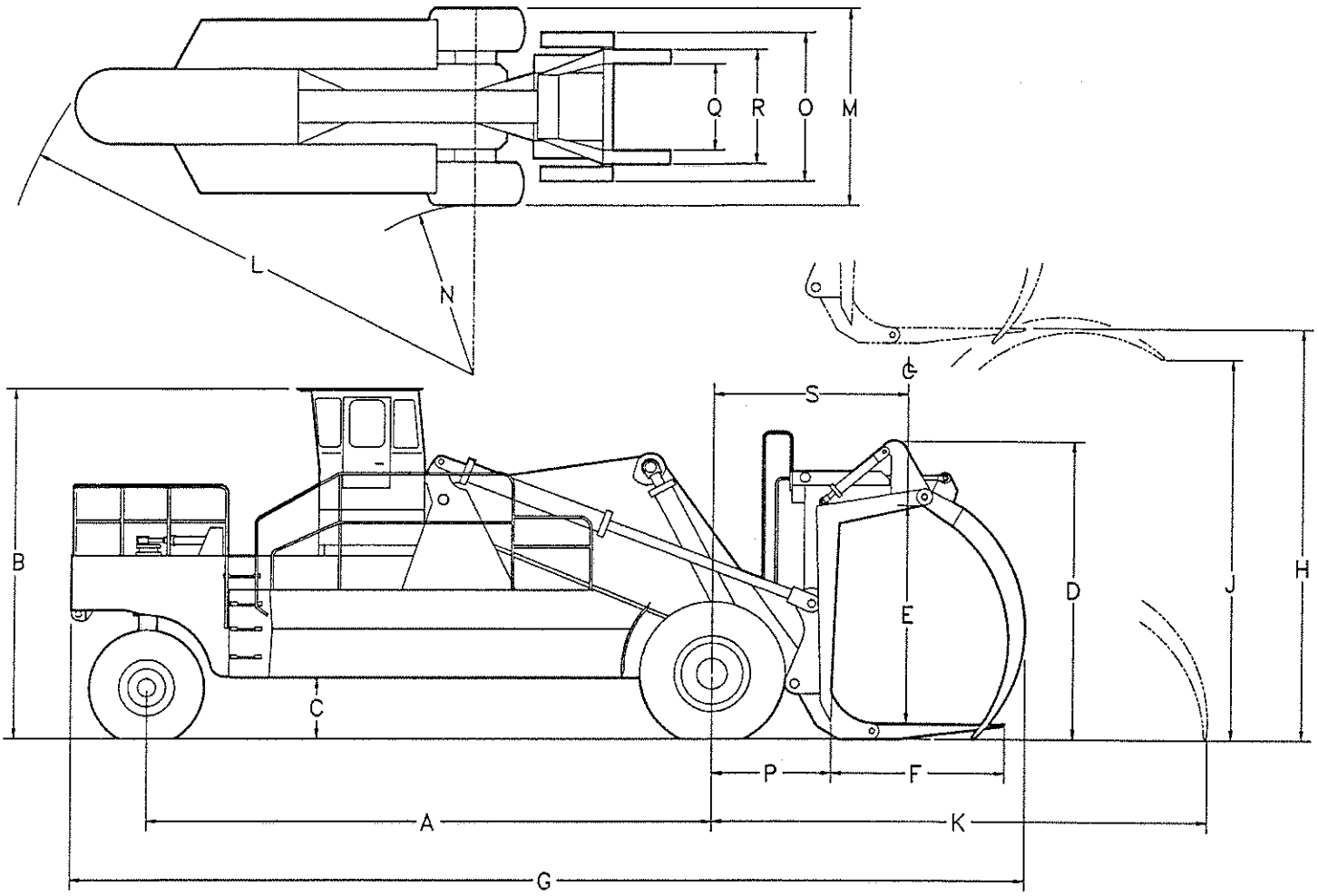
"Power Beyond" hydraulics with total capacity of all pumps in the system for multiple use simultaneously. Function controls are air over hydraulic or optional hydraulic over hydraulic.

Steering Cylinder (2)	4" x 20" (102mm x 508mm)
Hoist Cylinder (2)	10" x 92" (254mm x 2489mm)
Tilt Cylinder (2)	10" x 52" (254mm x 1320mm)
Holddown Cylinder (2)	6" x 34" (152mm x 864mm)
Kickoff Cylinder (2)	6" x 26" (152mm x 660mm)

Service Refill Capacities

Fuel Tank	450 Gals (1703 liters)
Hydraulic Oil	334 Gals (1264 liters)
Crankcase w/Filter	13 Gals (49 liters)
Cooling System	24 Gals (91 liters)

L-90S



Dimensions (approximate)

A.	Wheelbase	26' 0" (7925mm)
B.	Height to Top of Cab	15' 8" (4775mm)
C.	Ground Clearance Chassis	2' 6" (762mm)
D.	Carriage Height	15' 0" (4572mm)
E.	Mouth Opening	11' 0" (3352mm)
F.	Tine Length	9' 0" (2743mm)
G.	Overall Length	43' 10" (13360mm)
H.	Ground to Fork-Hoist Up	16' 6" (5029mm)
J.	Ground to Holddown Tip Carriage Down/Holddown Up	16' 2" (4928mm)
K.	Distance from Axle to Holddown Tip for Reach	26' 0" (7925mm)
L.	Turning Radius Tail Swing	35' 6" (10820mm)
M.	Width Outside Chassis Tires	14' 8" (4470mm)
N.	Inside Turning Radius	13' 9" (4191mm)
O.	Carriage Width	11' 1" (3378mm)
P.	Axle to Face of Carriage Hoist Down	7' 4" (2235mm)
Q.	Width Inside of Tines	6' 5" (1956mm)
R.	Width Outside of Tines	8' 6" (2591mm)
S.	Axle Centerline to Load Center	11' 0" (3607mm)

Weights and Functions (approximate)

Unit Weight	125,000 lbs	(56,750 kg)
Drive End	105,000 lbs	(47,628 kg)
Tail End	52,000 lbs	(23,587 kg)
Rated Lift Capacity 54"LC	90,000 lbs	(40,823 kg)
Rated Lift Capacity 54"LC with 36" Extension	70,000 lbs	(31,752 kg)

Forward Tilt @ Ground Level	45°
Forward Tilt @ Max Height	24°
Backward Tilt @ Ground Level	12°
Backward Tilt @ Max Height	45°

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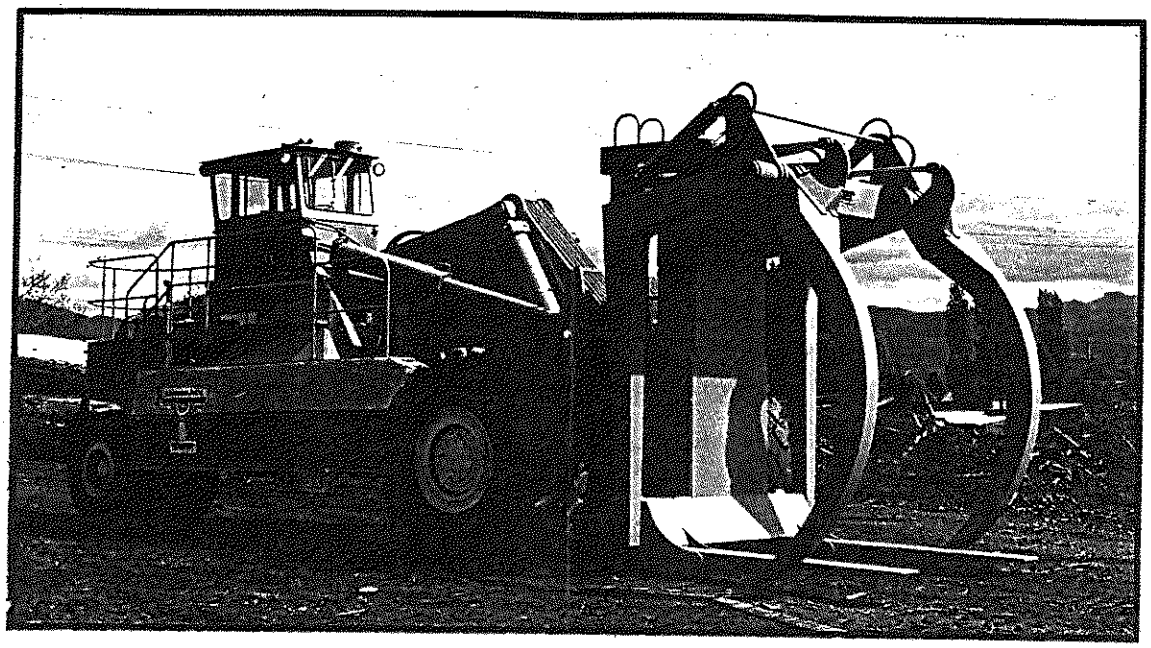
L-90S

LUMBERJACK

SPECIFICATIONS



Engine

Make and Model	Cummins NTA-855C-335
Max Horsepower	335 @ 2100 RPM
Max Torque	1010 Ft/Lbs @ 1500 RPM
Bore and Stroke	5.5" x 6"
No. of Cylinders	6
Displacement	855 Cu/In (14 liters)

Air Cleaner

Donaldson Two Stage Dry Type

Electrical System

Type	12 Volt Neg. Ground/24 Volt Start
Alternator	105 AMP
Circuit Breakers (lights)	30 AMP
Circuit Breakers (accessory)	20 AMP
Batteries (2)	12 Volt-8D @ 205 AMP Hr. each

Torque Converter

Clark 8000 Series Single Stage, 3 Elements

Transmission

Clark 5000 Series Power Shift - Spur Gear; 4 Speeds Fwd and Rev.

Range	Ratio	Speed (Unladen)
1	4.09:1	4.4 mph (7.1 km/h)
2	2.27:1	7.6 mph (12.2 km/h)
3	1.29:1	12.7 mph (20.4 km/h)
4	.72:1	Blocked

Axles

Fabricated	Allied Wagner
Make	Clark
Model	FD-85501 Series
Type	Planetary
Brakes	Air over Hydraulic Disc
Brake Size	32" Dia. (813mm)

Tires

Size (Driver)	33.5 x 33-44PR
Size (Tail)	23.5 x 25-20PR

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"Power Beyond" hydraulics with total capacity of all pumps in the system for multiple use simultaneously. Function controls are air over hydraulic or optional hydraulic over hydraulic.

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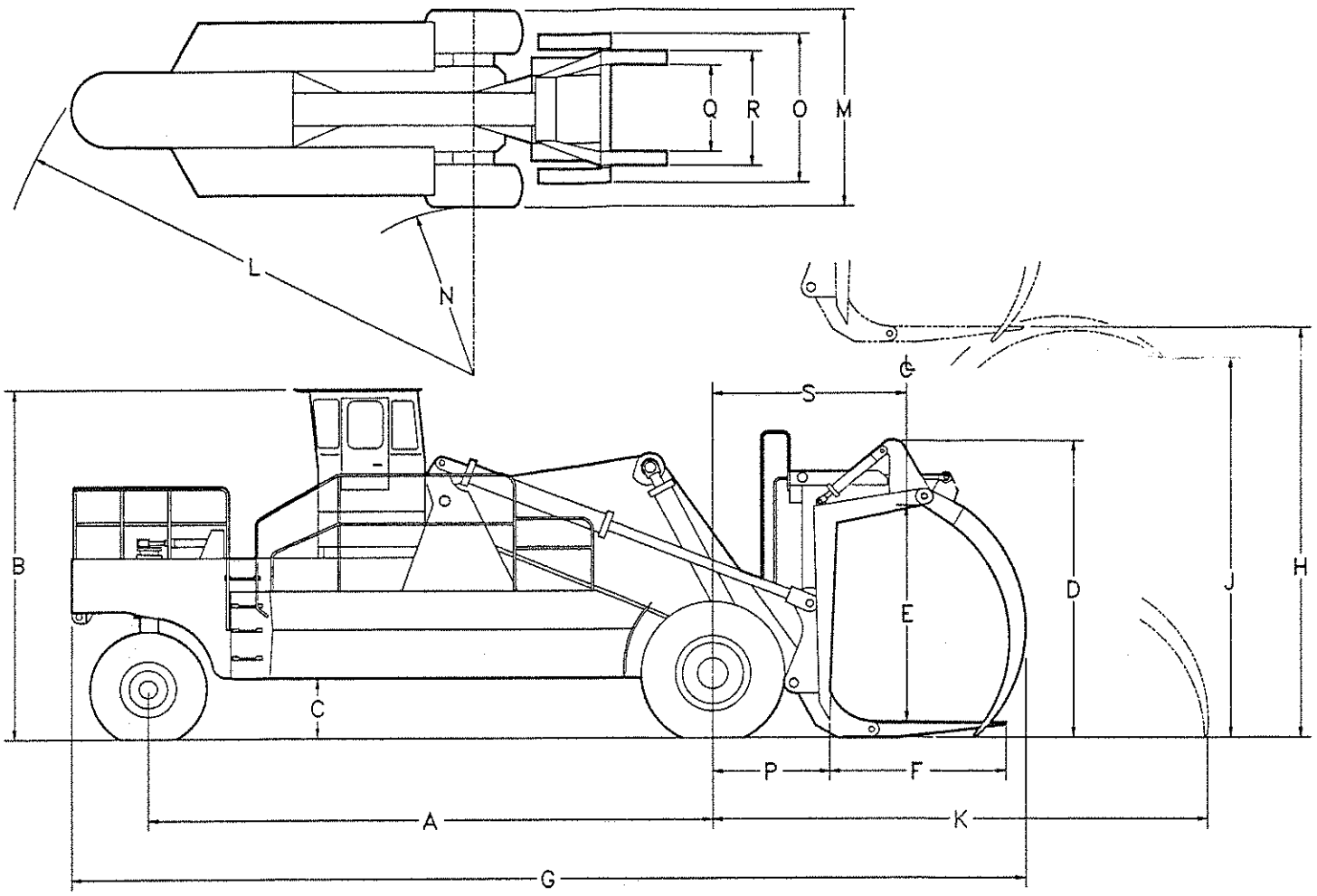
Kickoff Cylinder (2)	6" x 26" (152mm x 660mm)

Service Refill Capacities

Fuel Tank	450 Gals (1703 liters)
Hydraulic Oil	334 Gals (1264 liters)
Crankcase w/Filter	11 Gals (42 liters)
Cooling System	22.5 Gals (85 liters)

L-90S



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Forward Tilt @ Ground Level	45°
Forward Tilt @ Max Height	24°
Backward Tilt @ Ground Level	12°
Backward Tilt @ Max Height	45°

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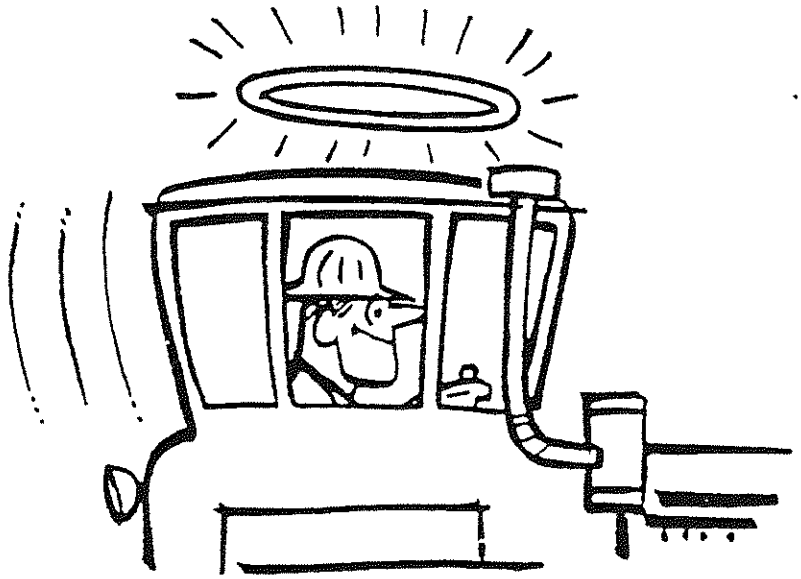
Section 2

Safety



2.1 Safety Is Your Business

Why? Because **SAFETY**, based on knowledge, technical skill, and years of experience has been carefully built into your Wagner Lumberjack. Time, money and effort have been invested in making your machine a safe product. The dividend from this investment is **YOUR PERSONAL SAFETY.**

However, it must be realized that no power-driven equipment can be any safer than the person behind the controls. If you don't operate and maintain your Lumberjack safely, our efforts will have been in vain.

The safety instructions and warnings, as documented in this manual and shipped with the machine, provide the most reliable procedures for the safe operation and maintenance of your Lumberjack. It's your responsibility to see that they are carried out.

The following terms define the various precautions and notices in this manual:

NOTE: Whenever information exists that requires additional emphasis beyond the standard text, the term "**NOTE**" is used.

IMPORTANT: Whenever information exists that requires special attention to procedures or to ensure proper operation of the equipment or to prevent its possible failure, the term "**IMPORTANT**" is used.

CAUTION: Whenever potential damage to equipment exists, requiring correct procedures for prevention, the term "CAUTION" is used.

⚠ WARNING

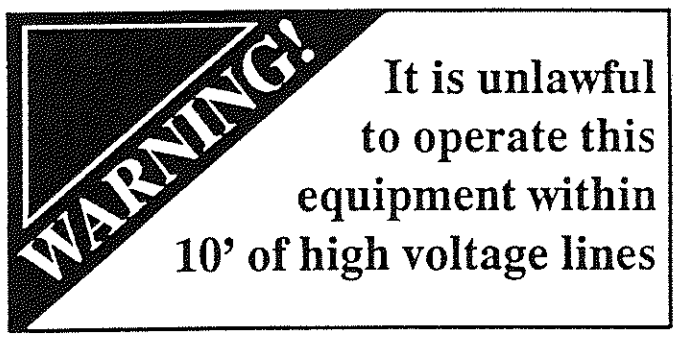
Whenever potential personal injury or death situations exist, requiring correct procedures or practices for prevention, this "WARNING" symbol is used.

This safety alert symbol indicates important safety messages in this manual. When you see this symbol, carefully read the message that follows and be alert to the possibility of personal injury or death.

NOTE: All possible safety hazards cannot be foreseen so as to be included in this manual. Therefore, the operator must always be alert to possible hazards that could endanger personnel or damage the equipment.

2.2 Operation Warnings

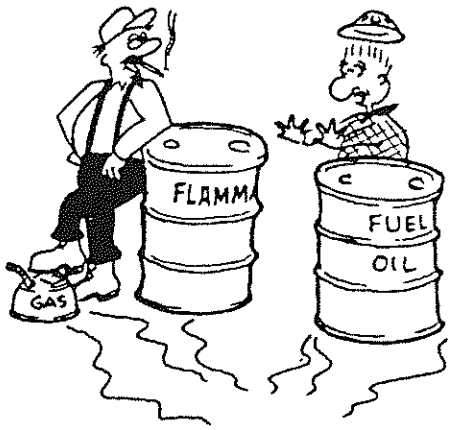
- You must be trained in the operation of this machine prior to operation.
- Be extremely careful if you do not normally operate this machine. Re-orient yourself to the machine before starting, and then proceed slowly. However, you must not operate without having received proper training.
- Know your company's log yard rules. Some have specific loading directions and procedures. The methods outlined in this manual provide a basis for safe operation. Because of special conditions, your company's log handling procedures may be somewhat different from those shown in this manual.
- Always face the ladder when going up and down ladders. Use both hands.
- Never jump on or off the machine.
- All walking surfaces (steps, ladders, etc.) must be free of ice, grease, oil, or other materials that could cause or contribute to a slip or fall.
- The only person required on the machine is the operator. Never allow anyone to ride on the machine or its attachments.
- Do not operate this machine if you know of malfunctions, missing parts, and/or mis-adjustments. These situations can cause or contribute to an accident or damage to the machine. Stop the machine immediately if problems arise after starting.
- The hydraulic tank heater and/or engine block heater use a 110 or 220VAC external power source. An electrical shock could be fatal.
- All electrical cables and connectors must be in good condition. Use caution in wet weather to avoid danger from electric shock. The hydraulic tank and/or engine block heater must be properly grounded.
- Do not operate the machine before disconnecting hydraulic tank or engine block heaters.
- Do not start the engine if the key has been tagged with a "**DO NOT START**" or "**RED**" tag.
- Never operate any of the cab controls from anywhere other than the operator's seat.
- Sound the horn to alert personnel in the area before starting the engine, and make sure everyone is clear. Be sure that all controls are in neutral before starting the engine.
- Be aware that several people can stand in the engine compartment, completely out of sight of the operator.
- For maximum visibility and overall safety, travel in reverse whenever possible. Always travel in reverse when the machine is loaded. Keep the load as low as is practical. Be aware that the stability of the machine can vary with changes in slope, load, and the position of the attachments. Do not exceed the rated load of this machine.
- Never allow the binder chains to be removed from the load until it is securely clamped by the holddown arms or secured by some other means provided by your company.
- Never pass a load over the head of anyone. Sound the warning horn and wait for the area to be cleared before moving the machine or load.
- Be accurate in load placement. It's important to know what the load will do when it's released.
- Lower or remove the load before leaving the cab or shutting down the engine.



- Electrical energy under high voltage can discharge to ground through the machine without direct contact with the machine's structure. Minimum clearances from energized power lines or other power sources must be maintained. If electrical energy does discharge through the machine, **Remain In The Cab. Do Not Permit Anyone To Come Into Contact With The Machine's Structure.**

2.3 Maintenance Warnings

- Maintenance, lubrication and repair of this machine can be dangerous unless performed properly. Each person must satisfy himself that he has the necessary skills and information, proper tools and equipment, and that his work method is safe, correct, and meets his own company's requirements.
- Do not attempt to make adjustments, or perform maintenance or service unless you are authorized and qualified to do so.
- Unless specified in this manual, never attempt maintenance or lubrication procedures while the machine is moving or the engine is running.
- Keep hands, feet, long hair and clothing away from power-driven parts. Do not wear loose fitting clothing or jewelry while performing maintenance and lubrication.
- Before performing maintenance or service under the machine, move the machine to a level surface, engage the parking brake and stop the engine.
- Tag the key switch with a "**DO NOT START**" sign, and/or remove the key.
- Block the tires to keep the machine from rolling.
- Perform all maintenance and lubrication procedures with the machine on level ground, parked away from traffic lanes.
- Never rely on the hydraulic system to support any part of the machine during maintenance or lubrication. If necessary, support components with appropriate safety stands. Never stand under a component that is supported only by the hydraulics. Make sure it is resting on its mechanical stops.
- Use caution when working around hot oils. Always allow lubricating and hydraulic oil to cool before draining. Burns can be severe.
- Diesel fuel and hydraulic oil are flammable. Do not smoke when checking levels or filling tanks. Keep open flames and sparks away from the machine.



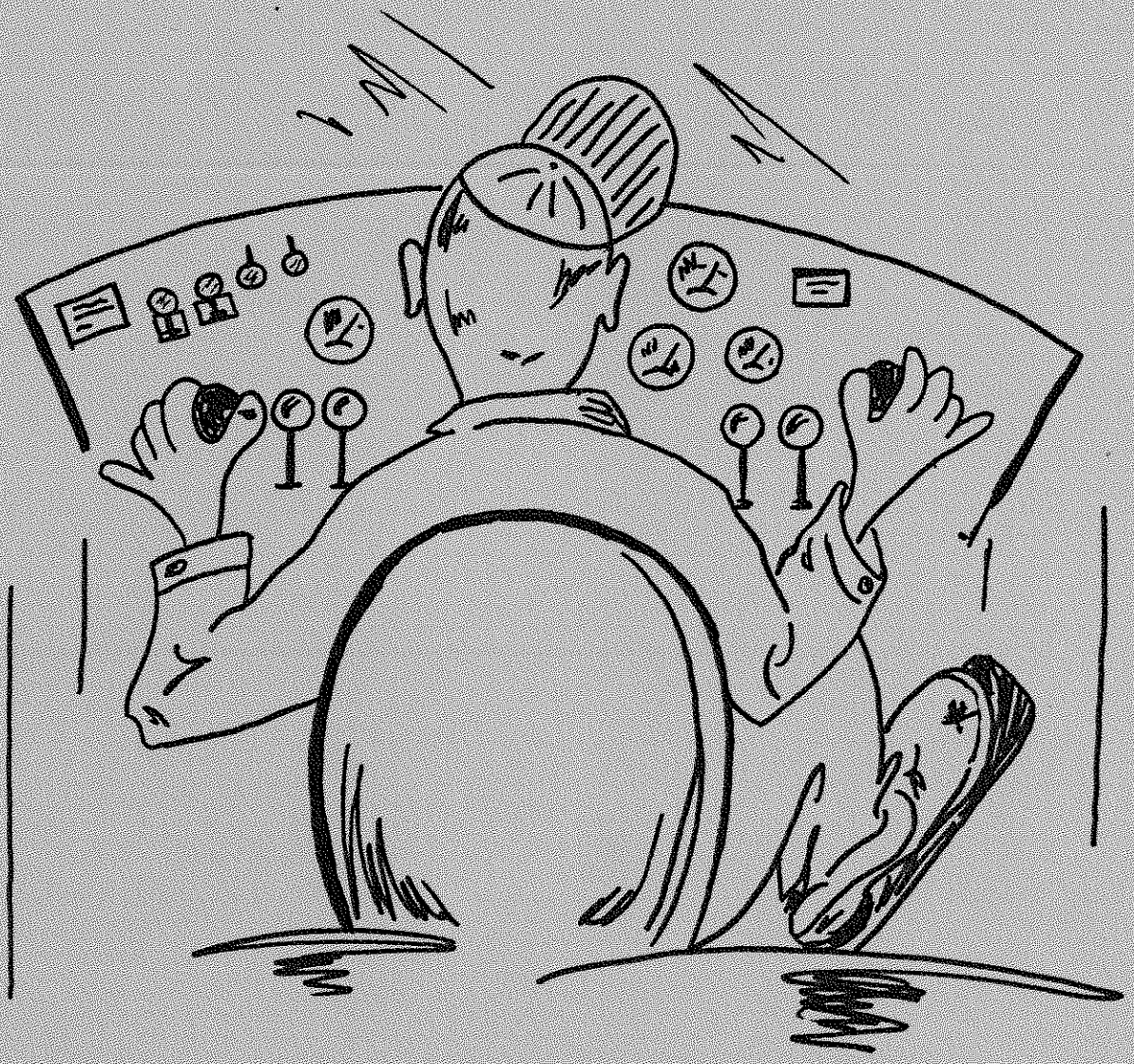
- Keep the machine free of oil, grease and trash accumulations. Regular steam cleaning is recommended for fire prevention and general safety.
- Never overfill the fuel or hydraulic tanks. Any overflow could cause a fire. Immediately repair any hydraulic or fuel leaks and clean up any spills.
- Use extreme caution when using compressed air to blow parts dry. The pressure should not exceed 30 psi (208 kPa). Never use air to blow yourself off. Air pressure penetrating your skin can be fatal.
- Engine exhaust fumes can cause death. If it is necessary to run the engine in an enclosed space, remove the exhaust fumes from the area with an exhaust pipe extension. Use ventilation fans and open shop doors to provide adequate ventilation.
- DO NOT remove the radiator cap when the engine is hot. The coolant will be under pressure and can flash to steam with explosive force, causing severe burns. To prevent burns, remove the radiator cap only when the engine is cool.
- Before disconnecting hydraulic lines, be sure to lower all loads and relieve all hydraulic pressure. The load could fall on you, or escaping hydraulic oil could cause severe personal injury.

- Batteries produce explosive gases. Keep sparks, flame and cigarettes away. Ventilate when charging or using in an enclosed space. Always shield your eyes when working near batteries.
  When removing battery cables, always turn the battery disconnect switches OFF first, then disconnect the (-) negative cable.
  When installing a battery, always connect the (+) positive cable first.
  This procedure will help to prevent a spark which could cause an explosion.
- Before making adjustments on the engine or electrical system, disconnect the battery. An electrical spark could cause a fire, explosion or severe burns.
- Batteries contain sulfuric acid which can cause severe burns. Avoid contact with skin, eyes or clothing.
- Due to the extreme height of the upper lube points, it is essential to personnel safety that safe ladders, personnel lifts and/or scaffolding be used while servicing this machine. Always use safety tread walks and hand holds to reach lubrication points or to inspect or adjust the machine. These areas can be dangerously slick under conditions of rain, frost or oil smears.

CAUTION

1. Before operating: Know your machine, Read the Operator's Manual.
2. Operate at low speeds in crowded areas or soft terrain
3. Avoid abrupt changes in boom direction. Do not drop load.
4. Lower hydraulic equipment before leaving operators position.
5. Shut power off before lubricating or making equipment adjustment unless otherwise specified in the Operator's Manual..
6. Keep hands, feet and clothing away from power driven parts.
7. Keep off equipment while operating unless seat or operators platform is provided. Keep all others off.
8. Make certain everyone is clear of equipment before operating.
9. This machine is not designed for lifting or moving of persons.

2
OPERATION



INSTRUMENTS
&
CONTROLS

INSTRUMENT PANEL

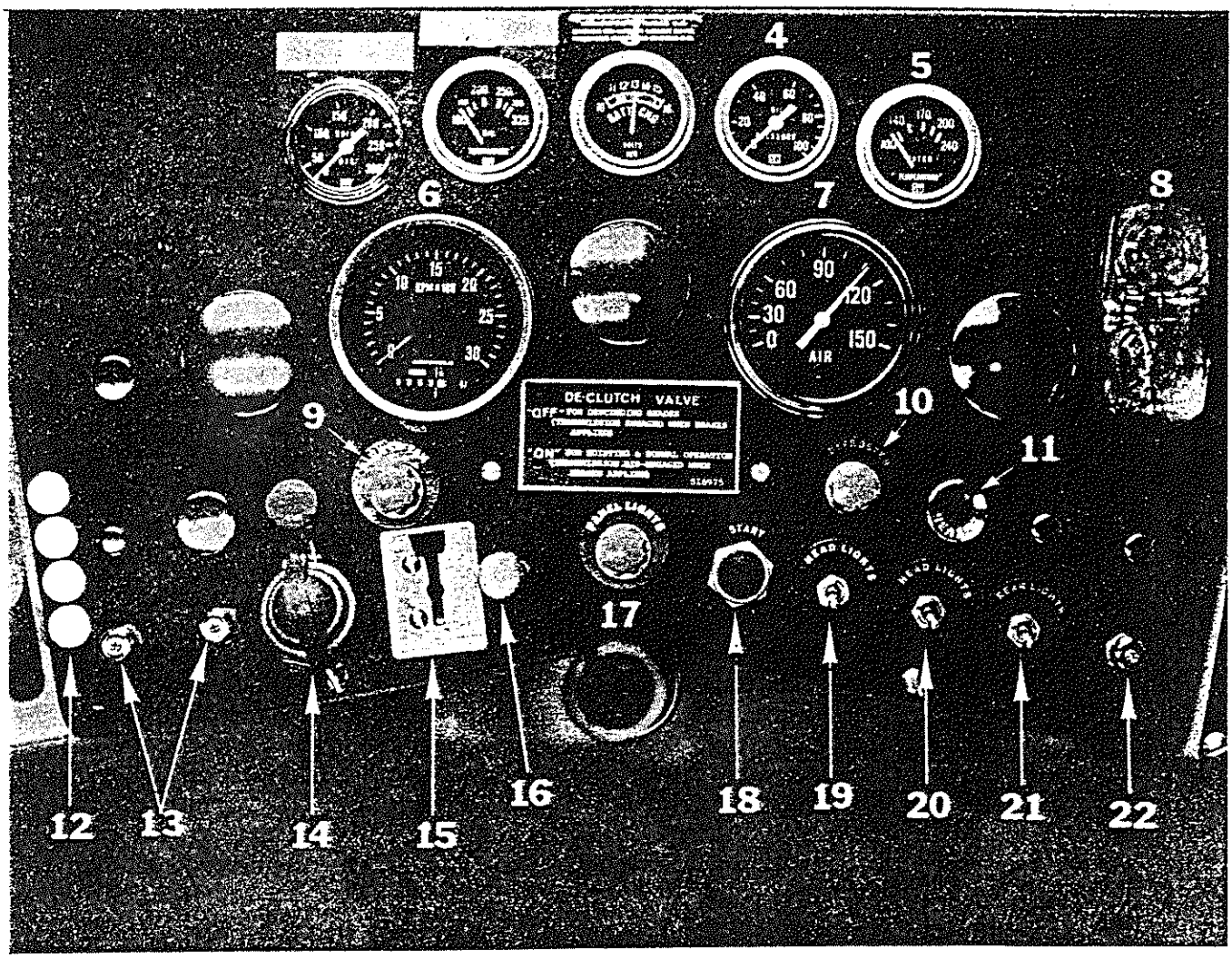


FIGURE 1

INSTRUMENT FUNCTION

FIGURE 1 illustrates a typical ***LUMBERJACK*** instrument panel. Instrument function is as follows:

1. DRIVE OIL: Transmission oil pressure. This is the pressure that operates the oil clutches.

2. OIL TEMPERATURE: Converter oil temperature. This gauge should read between 200°F/250°F, and never over 250°F. A converter "stall condition" will be indicated here with a rise above normal in temperature.

3. VOLTMETER: The voltmeter indicates the voltage condition of the battery, whether the alternator is or is not charging. The numbers 10-16 indicate volts, not ampere, and the dial is color coded for easy reference.

4. OIL PRESSURE: Engine lubricating oil pressure. Determines pressure only - not the amount. Should this pressure drop below normal during operation - stop the engine immediately and determine the cause.

5. WATER TEMPERATURE: This gauge indicates engine coolant temperature. Should temperature hold steady at 200°F or above - stop and determine the cause.

6. RPM: An electrical tachometer indicating engine revolutions per minute. To read, multiply indicated number by 100. Example: Indicated 20 x 1000 = 2000 RPM. Also, the gauge indicates hours of engine operation.

7. AIR GAUGE: Indicates the amount of pressure in the air reservoir. Operating pressure is 60 = psi. Below 60 psi a red warning light (within the gauge) will come on.

8. EMERGENCY BRAKE LIGHT: If the key switch is "ON" and the emergency brake is set, this light will be on.

9. BLOWER FAN: Switch for cab pressurizing fan motor. Variable speed.

10. DEFROSTER: Switch for defroster fan motor. Variable speed.

11. HEATER: Switch for heater fan motor. Variable speed.

12. GEAR SHIFT: Transmission gear shift ranges. Can be up-shifted from first through third without reducing RPM. The transmission can be down-shifted in the same manner. However, it is advisable to reduce RPM as you can over-speed the engine.

13. BRAKE BUTTONS: Operational buttons to apply the brakes on the left hand drive wheel or the right hand drive wheel.

14. KEY SWITCH: Ignition type key switch that opens or closes the accessory and alternator circuits.

15. DECLUTCH CONTROL: A system that controls the re-engagement of transmission ranges, thus allowing the transmission to re-engage at 900 RPM. NOTE: When changing directions bring the vehicle to a full stop.

16. WIPER: Windshield wiper "ON" and "OFF" control valve. Variable speed.

17. PANEL LIGHTS: Switch for instrument panel lights.

18. STARTER: Diesel engine starter button.

19. HEAD LIGHTS: Toggle switch for cab mounted head lights.

20. HEAD LIGHTS: Toggle switch for carriage mounted head lights.

21. REAR LIGHTS: Toggle switch for cab mounted rear lights.

22. NEUTRAL BUTTON: Optional with Twin-Disc transmission.

The following controls are floor mounted:

AIR BRAKE PEDAL: Engages both driver wheels simultaneously, variable application.

REVERSE FOOT CONTROL BUTTON: Engages the transmission in reverse gears, will not engage with engine RPM above 900.

FORWARD FOOT CONTROL BUTTON: Engages the transmission in forward gears, will not engage with engine ROM above 900.

THROTTLE: Engine foot throttle.

The following controls are not illustrated:

4WD DISCONNECT LEVER: Allows the operator to disconnect the rear axle from the drive train when four wheel drive is not required, i.e. during dry summer months or on hard road surfaces.

To Engage The Four Wheel Drive Mechanism . . .

1. Bring the machine to a complete stop with bogie in a straight line with the chassis.

2. Slowly roll the machine while pushing the lever to the "engage" position. When the gears line up the lever should easily move into position.

To Disengage the Four Wheel Drive Mechanism . . .

1. Bring machine to a complete stop with bogie and chassis lined up straight.

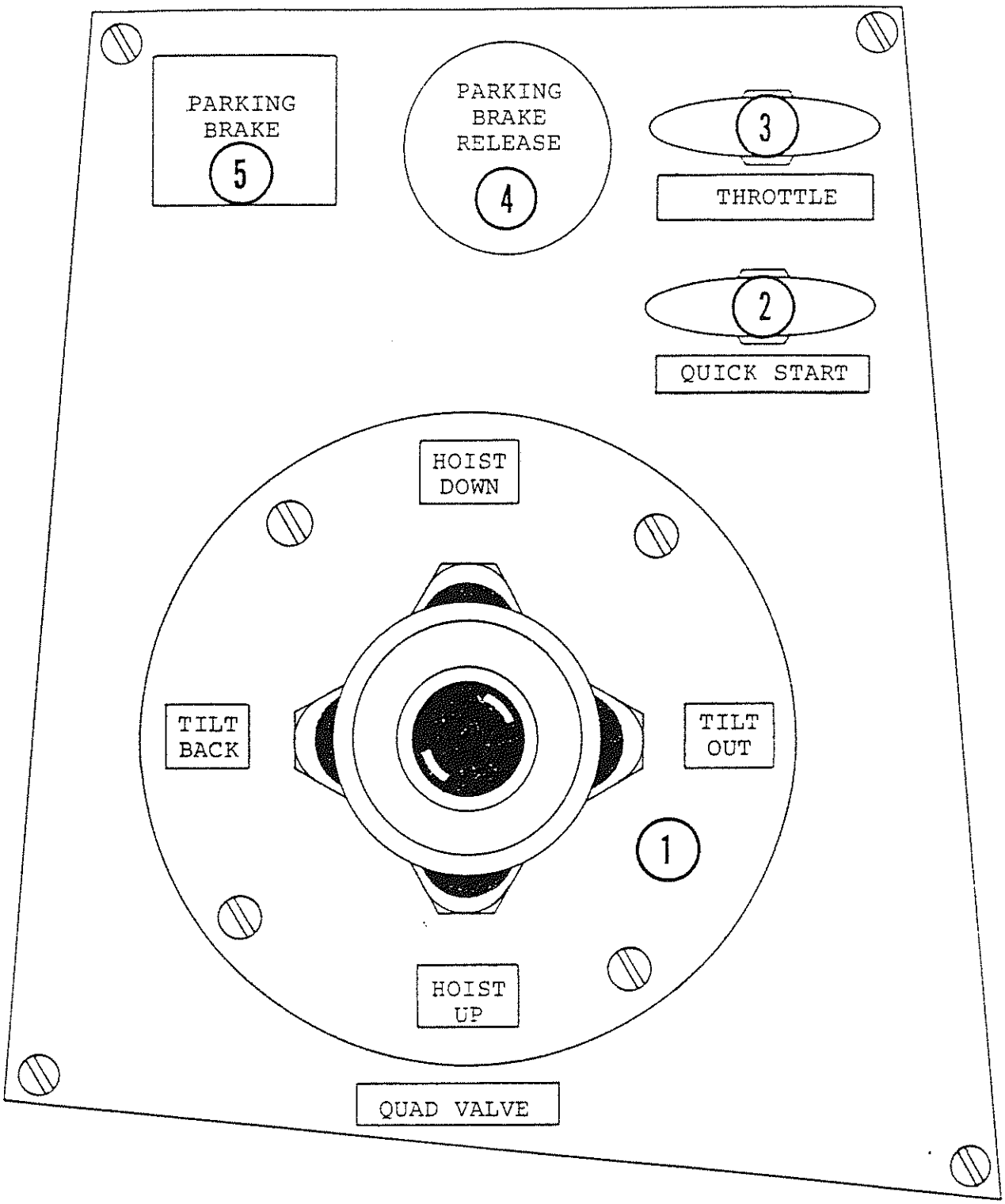
2. Slowly roll machine while pulling the lever towards the "disengage" position.

HORN: The dual air horns are controlled by a pull chain located at the front of cab just above eye level.

SEAT: There are two seat control levers; one is the forward and back adjustment and one is the swivel lock. The seat can be adjusted to the operators height and weight. Also, the seat has a "tilt back" feature.

All instrument panels have additional mounting holes (plugged) for switches, controls or gauges as determined by options and engine installation.

All units are equipped with a fire extinguisher.



TYPICAL R.H. PANEL

FIGURE 1

CONTROL FUNCTION

During 1975 the "Air Over Hydraulic" control system was introduced and superseded the previous method of "Oil Over Oil" system for the Lumber Jack series. Control operation of the hoist, tilt, holddown and kickoff is a system whereby an air valve on the instrument panel actuates a slave cylinder which in turn, actuates a valve spool in a high pressure hydraulic control valve.

Also, this provides a "Mono" control for the hoist and tilt actuation resulting in an effortless fingertip control. FIGURE 1 illustrates a typical right hand control panel. Control function is as follows:

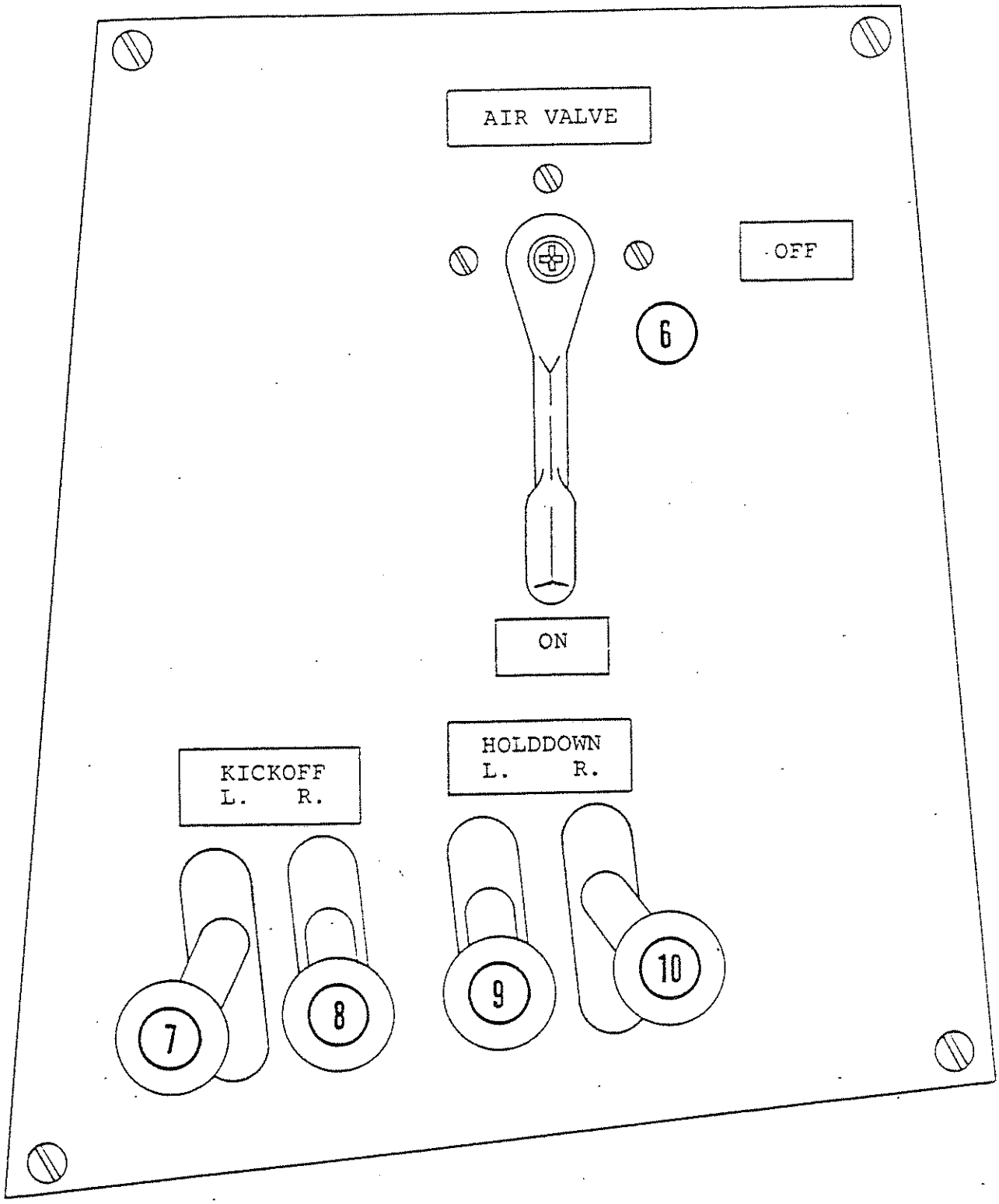
1. QUAD VALVE: A single lever air valve that raises or lowers the boom and tilts the carriage forward or back. The valve is spring loaded to neutral and the load will hold at the position it is in at the time of valve lever release.

2. QUICK START: Manual control for an injection of quick start vapor for cold weather engine operation.

3. THROTTLE: Manual control, pull out for RPM increase. Overrides the foot throttle. To lock in "OUT" position turn clockwise. NOTE: The engine controls shown are applicable to Cummins or Allis-Chalmer installations. On Detroit Diesel installations there are two additional cable controls, one for emergency stop and one for manual shutdown control.

4. PARKING BRAKE RELEASE: This is an emergency release to override a vehicle air system failure in which the brakes would set automatically. To move the vehicle under such conditions "PRESS IN" the button and hold. If you release the button the brakes will reset. This emergency air system operates out of an air receiver independent of the vehicle air system, and has a reserve pressure sufficient to release the brakes three times before the pressure is exhausted.

5. PARKING BRAKE: Pull button "OUT" to set the brakes. Push "IN" to release. This control sets the wheel and transmission driveline brakes simultaneously.



TYPICAL L.H. PANEL

FIGURE 2

FIGURE 2 illustrates a typical left hand control panel. Control function is as follows:

6. AIR VALVE: "ON" or "OFF" safety feature that shuts off all air to the panel controls.

7. KICKOFF: Push the lever forward to move the LEFT Kickoff Arm "out", in order to clear the tine. Pull the lever toward you to retract the arm.

8. KICKOFF: Push the lever forward to move the RIGHT Kickoff arm "out", in order to clear the tine. Pull the lever toward you to retract the arm.

9. HOLDDOWN: Push the lever forward to move the LEFT Holddown Arm "out", in order to release the tine load. Pull the lever toward you to "hold" or "clamp" the tine load.

10. HOLDDOWN: Push the lever forward to move the RIGHT Holddown Arm "out", in order to release the tine load. Pull the lever toward you to "hold" or "clamp" the tine load.

The kickoff and holddown control valves are spring loaded to neutral. This means that a released valve will return to neutral, and the arm will "hold" at the position it is in at the time of valve release. All valves can be operated independently or in unison. As an example, to unload the tines raise the holddowns together, and move out or extend the kickoffs in unison.

Section 4

Operation

4.1 Introduction

You, the operator, have a key position in your company's log handling operation. Skill and alertness on your part are essential for maximum productivity as well as the safety of yourself and others.

The operating instructions in this manual are here to help you get the maximum use of your Lumberjack, with the greatest possible safety. Become completely familiar with all of the instruments and controls. Learn the unit, its capabilities and limitations. Study the operating techniques given so that through experience, you can develop additional techniques of your own and contribute to the success of your team.

Safety First

Your co-workers depend on you to operate safely. Before operating the Lumberjack, read and observe the safety precautions given in this manual. BE A SAFE OPERATOR. A good safety record can be rewarding.

4.2 General

The Wagner Lumberjack is easy to operate, even though it has the capacity to handle tremendous loads and perform many operations. To get the most production from this unit with the least effort, and in a safe, reliable manner, it's important to become familiar with all the components and their functions.

Drivetrain

The drivetrain consists of a diesel engine, a torque converter combined with a full power shift transmission, drivelines and planetary drive axle.

Engine

The diesel engines are standard industrial units, selected for the power characteristics and operating speeds required for each size model. They are equipped with electric starting motors and cold weather starting aids and will start in the same easy way as your automobile. We want to emphasize the importance of maintaining the correct engine rpm, for maximum engine service life and proper hydraulic pump operation.

Torque Converter

The torque converter is connected directly to the engine flywheel, eliminating a manually operated clutch, thereby simplifying operation and reducing operator fatigue. It also, to a major degree, hydraulically protects the engine, transmission, drivelines and axle from damaging shock loads and harmful engine lugging and stalling - provided the correct engine rpm is maintained. It also multiplies engine torque in each transmission gear range, automatically adjusting the power output to the load demand.

Transmission

The transmission is a "full power shift - full reversing" unit.

"Full power shift" means that the transmission can be shifted from one range to the next, either up or down.

When shifting down, the engine rpm must be reduced sufficiently to prevent over-speeding the engine when the lower range engages.

IMPORTANT: Never shift the range selector up or down without momentarily relaxing the throttle pedal. Severe damage to the drivetrain could result.

"Full reversing" means that you have approximately the same speeds forward and reverse in all speed ranges.

CAUTION: Always brake to a full stop when changing directions. Drivelines are simply not strong enough to withstand the forces created when tons of vehicle and load are reversed suddenly.

The transmission uses constant mesh gearing in all ranges, forward and reverse. All gears are engaged by means of hydraulically controlled multiple disc clutches, through the control valve actuated by the shift lever in the cab.

Drivelines

Drivelines transmit the engine torque (after being multiplied by the converter and transmission) to the drive axle.

Drive Axles

The drive axles not only support the unit and load, but also further multiply the engine torque through gear reductions. The first reduction occurs at the ring gear and pinion in the differential. The second reduction is made in the outer planetary ends of the axle.

Rear Bogie

The rear bogie provides a mounting for the rear axle. It is fully articulated - hinged for steering, and can swivel to negotiate rough terrain. Steering is accomplished by hydraulic cylinders.

Hydraulic System

The Wagner Lumberjack features advanced principles of hydraulic engineering. Instead of a single pump operating each function, all multiple pump applications have a primary and a secondary function. When any pump output is not being used for its primary function, instead of returning directly to the reservoir, the control valve diverts its flow to its secondary function. This principle is known as "power beyond".

Example 1: When only the hoist circuit is being used, you have the total capacity of three pumps to operate the hoist function. When hoisting and tilting the carriage simultaneously, the flow from the three pumps is divided between the hoist and tilt functions. When maximum power is required for hoist or tilt, operate the functions individually.

Example 2: When the carriage is tilted back (as in cold decking at maximum height), and the kickoff arms are actuated simultaneously, the primary flow of the holddown and kickoff pumps is directed to the kickoff cylinders. Any remaining flow is diverted to assist the hoist and tilt circuits if required.

Example 3: Since the individually controlled holddown and kickoff arms are actuated by "series" type valves, flow from the RH holddown and kickoff pump will allow actuation of the RH holddown, and the return flow from that cylinder will allow the simultaneous actuation of the RH kickoff. Any remaining flow is diverted to assist the hoist or tilt functions.

Log Handling

An easy way to understand the overall idea of Lumberjack operation is to visualize the carriage as a giant hand that can pick up, sort, spread and deck logs. See Fig. 4-1

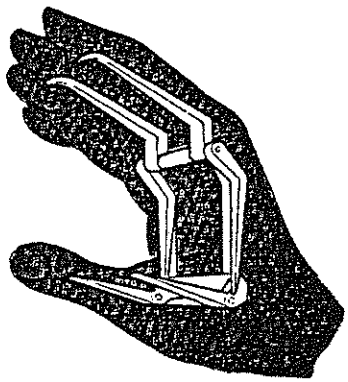


Fig. 4-1

The carriage functions consist of hoist, lower, and tilt forward or back.

The holddown arms are used to clamp the load against the carriage. They're also used to "rake" logs off a pile.

The kickoff arms push the logs off of the tines. They can also be used to help secure a partial load.

The holddown and kickoff arms can be actuated individually or in unison.

4.3 Break-in Period

The initial break-in period for your unit is limited to engine break-in. The hydraulic system and other components are ready for full operation.

The way you operate your new engine during the first 50 - 100 hours will have an important effect on its service life. Its moving parts are closely fitted, and even though most diesel engines are dynamometer run before leaving the factory, an additional period may be required before uniform oil films are established between mating surfaces.

Generally speaking, proceed with a new engine as follows:

1. Operate most of the time at one half to three quarters full throttle. Do not operate at maximum horsepower for more than five or ten minutes at a time.
2. Don't idle the engine for long periods. This may cause cylinder wall glazing, resulting in excessive oil consumption and loss of power.
3. Keep a close watch on the instruments. Reduce rpm if water temperature reaches 200 ° F.
4. Operate in a gear low enough so that you can accelerate under any condition.
5. Study and follow the engine's operation manual for specific information.

The operator must assume the responsibility of engine care during operation. This is an important job and one that will determine to a large extent the success of the operation. Premature engine failures are very expensive because of lost productivity and the high cost of engine repairs or replacement. Protect your company's investment!

4.4 Start and Stop Procedures

Engine Pre-Start

Before operating this machine, the operator must have prior operator training, a familiarity with this manual, and a complete understanding of all the procedures and functions that may be performed with this machine.

Pre-start Inspection

Planned maintenance and inspections are to be performed after the machine has been delivered, and prior to each shift. The operator should be aware of these procedures and be able to perform spot checks during operation.

> **NOTE:** These inspections may be performed by maintenance personnel or by the operator. In either case, it is the operator's responsibility to see that the machine is ready for operation prior to starting.

Refer to the planned maintenance chart, Section 5, for a complete list of the daily checks that are to be performed.

Engine Oil Level

The oil level should be checked prior to starting the engine.

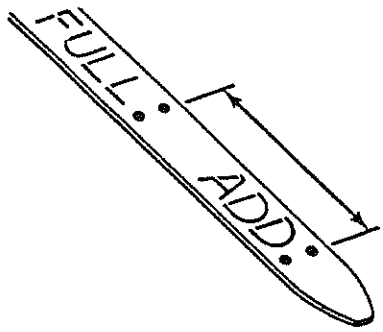


Fig. 4-2 Typical Dipstick

> **NOTE:** A 15 minute drain-back time is recommended (if the engine has been running) to obtain an accurate reading.

The oil level must be maintained between the "L" (low) or "add" mark, and the "H" (high) or "full" mark. Maintain the oil level as close to the "H" or "full" mark as possible.

> **CAUTION: Never operate the engine with the oil level below the "L" (low) mark, or above the "H" (high) mark. Refer to the engine's Operation and Maintenance manual for detailed engine service information.**

> **CAUTION: Use only approved engine oil (see Lubricant Specifications Chart, Section 5). Do not overfill.**

Engine Coolant Level

⚠ WARNING

Never remove the radiator cap if the engine is hot. The coolant will be under pressure and could flash to steam with explosive force, causing severe burns. Remove the radiator cap only when the engine is cool.

Daily inspection of the coolant level is recommended. Cooling systems using anti-aeration baffles restrict visual observation of the true coolant level. If the coolant can be seen, the system may not be full. To gain a true fill, add water slowly up to the bottom of the fill neck and allow a 30 second settling period. Remember to compensate for the loss of anti-freeze when adding water.

NOTE:If the engine is hot, the coolant level will be higher than when it is cold.

Inspect the radiator daily for restriction caused by leaves, paper or other foreign material. Inspect the radiator, cap, hoses, and connectors for any signs of leakage or damage.

Hydraulic Oil Level

Always check the hydraulic oil level prior to operation. The dipstick and fill pipe are located on the RH chassis deck, to the right of the operator's cab.

CAUTION: Always open the tank breather petcock (located on the breather pipe) before removing the dipstick, filler cap, or in-tank filter cover plate. Failure to vent the tank can result in personal injury and/or a substantial oil spill. Be sure to close the petcock before operating the machine.

The oil level should be checked with the hoist cylinder retracted (down). The oil level should be at or near the "H" (high) mark on the dipstick. Fill with approved hydraulic fluid as required (See Lubricant Specifications Chart, Section 5). Do not overfill.

Transmission Oil Level

Always check that the transmission dipstick shows at least some oil prior to starting the engine. The level should be checked after engine warm-up, with the transmission at normal operating temperature. The dipstick and fill tube are located on the chassis deck, near the valve module and hydraulic brake actuators. Always check the level with the engine running, at operating temperature, with the transmission in neutral. The oil level should be between the "H" (high) and "L" (low) marks. Fill with approved fluid only (See Lubricant Specification Chart, Section 5).

"Walk Around" Inspection

Perform a "walk around" inspection, looking for leaks, loose or missing fasteners, damaged hoses, structural cracks or damage, etc.

Do Not operate the machine until all problems have been corrected.

Tires

Visually inspect the tires for low air pressure and damage to the tread and side walls. If a tire appears suspect, appropriate maintenance personnel should thoroughly check it prior to operation.

Engine Pre-start

1. Make sure that oil and coolant levels have been checked before attempting to start the engine.
2. Sit in your normal operating position and adjust the seat for your personal comfort. It is recommended that you wear your seat belt.
3. Check for emergency/parking brake engagement: Pull the knob to set the brake.
4. Place the transmission range selector in the "neutral" position, "N" on the gear quadrant.

   NOTE: All current Wagner units are equipped with a neutral start switch which prevents the engine from starting unless the transmission is in neutral.
5. Give warning that you are going to start the engine. Remember, there is ample space within the engine, transmission, and driveline compartments for several people, and you cannot see them from the cab. Be sure that the area around the machine is clear of all personnel and obstructions.

⚠ WARNING

Don't start the engine if the key switch has been tagged with a "Do Not Start" or "red" tag.

6. Turn the key switch to the ON position. The emergency brake light and circuit lights should come on.

Also, the engine protection system bell and light should come on.

7. With Caterpillar and Detroit Diesel Engines, check that the emergency shutdown control is pushed IN.

Engine Start-up

1. Turn the key switch to the START position. Release the switch to the RUN position as soon as the engine starts.

   CAUTION: If the engine does not start within 30 seconds, allow the starter to cool for at least 2 minutes before re-engagement.

   In cold weather it may be necessary to use the cold weather starting procedure.

2. After the engine starts, let it idle. Do not accelerate. Remember, high rpm and full load conditions on cold oil can severely damage the engine, transmission and hydraulic system.

   The engine warning light and bell should go out within a few seconds after starting. If engine oil pressure fails to rise sufficiently after approximately 40 seconds of running, the engine may automatically shut down.

   IMPORTANT: Your Lumberjack is equipped with and audiovisual engine protection system. If oil pressure drops below a safe level, or coolant temperature becomes excessive, the engine warning light and bell will come on. With some models, if the condition continues, the engine will shut down automatically. If your unit is not equipped to shut down automatically, it is vitally important that you immediately shut down the engine if the light and bell go on.

3. If a rise in oil pressure of the engine or transmission is not observed within 5 seconds, or a rise in air pressure is not observed in 10 seconds, shut down the engine and have maintenance determine the cause of the problem. Do not operate the machine until the problem has been corrected.

4. Warm the engine at idle until the air pressure reaches at least 60 psi, then recheck that the transmission is in neutral and that the parking brake is applied.

   Using the hand throttle, continue to warm the engine at 1000 rpm until the engine temperature reaches at least 130° F, and the air pressure rises to 120 psi.

5. Release the hand throttle. Meanwhile, observe the gauges for proper readings and operation. Also, check the operation of all safety equipment and accessories.

Cold Weather Starting Procedure:

NOTE: For maximum engine protection and easier starting:

Keep the batteries fully charged.

Keep the fuel clean and free of water.

Change the engine oil to the recommended viscosity for the air temperature.

1. Before cranking the engine, pull the "cold start" handle out. Wait 3 seconds for the valve to fill.

2. While cranking the engine, push the handle in to discharge the ether into the engine.

3. In extremely cold weather additional shots may be required to keep the engine running.

⚠ WARNING

Starting fluid is extremely flammable and toxic. Never smoke while using staring fluid. Never make a hole in the starting fluid container. Do not use near an open flame or put the container into a fire. Use only small amounts of starting fluid. Never store starting fluid in a hot area or the operator's cab.

Temperatures below 32° F (0° C):

1. Let the engine idle for approximately 15 to 20 minutes before putting any load on the engine. Check all gauges for normal readings.

2. After the engine is warm, move the machine to full work capacity slowly until the hydraulic oil is at operating temperature.

Temperatures below 0° F (-18° C):

CAUTION: If the temperature of the hydraulic oil is below its pour point, do not start the engine. The high oil viscosity could cause immediate pump cavitation, resulting in severe damage. The oil in the hydraulic tank must be heated prior to engine start-up.

If the machine will be shut down for several hours or longer with ambient temperatures below 32° F (0° C), the hydraulic tank heater should be plugged in as soon as the machine is shut down. This will help to maintain hydraulic oil temperature.

⚠ WARNING

The hydraulic tank heater uses a 220 or 110 VAC external power source. An electrical shock could be fatal. Don't forget to disconnect the heater cable before beginning operation. All electrical cables and connectors must be in good condition. Use caution in wet weather to avoid danger from electric shock. The heater must be properly grounded.

Let the engine idle for approximately 10 minutes before putting any load on the engine. Check all gauges for normal readings. In extremely cold temperatures, allow sufficient warm-up time.

Engine Shut-down

1. Move the throttle to idle speed, and let the engine idle for at least 5 minutes in order to normalize internal engine temperatures.

   CAUTION: Except in emergencies, never shut the engine down immediately after operation. Allow the engine to idle for at least 5 minutes. Failure to do this could cause severe engine damage.

2. Meanwhile, place all controls in neutral and set the emergency brake.
3. To stop the engine, turn the key switch to the OFF position.

Detroit Diesel and Caterpillar engines

Normal shut-down is with the key switch. An emergency shut-down control is provided with these engines. Pull the handle to stop the engine. After the engine stops, push the "stop" control in and turn the key switch to the OFF position. If emergency stop procedures are ever required to stop the engine, make sure that the problem is checked by maintenance personnel before resuming operation.

4.5 Using Booster Batteries

⚠ WARNING

Batteries produce explosive gases. Keep sparks, flame and cigarettes away. Ventilate when charging or using in an enclosed space. Always shield your eyes when working near batteries.

If the batteries on the machine are weak or discharged, use booster batteries to start the engine. Never try to start the engine by towing or pushing. Use the following procedures:

1. Make sure that the parking brake is applied and that all electrical loads are stopped.
2. To prevent damage to the alternator, use care not to reverse the battery connections. Immediate damage to the alternator can be caused by making an incorrect wiring connection during the starting procedure.

⚠ WARNING

Batteries contain sulfuric acid which can cause severe burns. Avoid contact with skin, eyes or clothing.

3. Connect one jumper cable to the (+) positive terminal of the booster battery. Connect the other end of the same cable to the (+) positive terminal on the machine's battery.
4. Connect the other jumper cable to (-) negative terminal of the booster battery. Connect the other end of this cable to a good ground connection on the machine's frame, away from the battery. This procedure will prevent a spark near the battery which could cause an explosion.
5. Start the engine in the normal manner.
6. After the engine has been started, disconnect the negative cable first, then remove the positive cable.

⚠ WARNING

When removing battery terminals, always disconnect the (-) negative cable first.
When installing battery terminals, always connect the (-) negative cable last.

This procedure can prevent a spark at the battery which could cause an explosion.
Always make the last cable connection away from the battery, such as on the engine block. Use care to keep the cables clear of the fan or any other moving parts.

4.6 Moving, Stopping and Steering

To move the machine:

1. Make sure that the area is clear of obstructions and/or personnel. It is possible for several people to stand under or near the machine, out of sight of the operator. It is recommended that you sound the horn before moving the machine.

   CAUTION: This machine cannot be stopped instantly. A varying distance is required to stop the machine, depending on load and speed. To avoid collisions, be sure to allow ample stopping distance.

2. Check that the air pressure gauge reads between 110 and 120 psi

3. Release the hand throttle.

   CAUTION: Never attempt to operate with the hand throttle instead of the foot throttle. The hand throttle is to be used for warm-up only.

4. Place the Declutch control in the ON position.

5. Lift the carriage, if required, to clear any obstructions you might encounter.

6. Release the parking brake and put the transmission range selector into 1st gear.

   CAUTION: It is recommended that you operate in 1st gear only, until you develop a "feel" for the machine and become familiar with all of its operating characteristics.

7. Push the "forward" or "reverse" floor button. Pushing either of these buttons not only selects the direction of travel, but also shifts the transmission from neutral to "in gear".

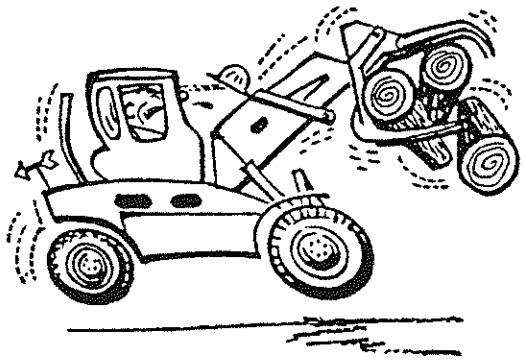
8. Depress the throttle pedal slowly and smoothly. Avoid sudden or jerky starts. Depress the pedal just enough to begin moving slowly.

Steering:

With the operator facing the front, turning the steering wheel clockwise will turn the machine right, while turning the wheel counter-clockwise will turn the machine left.

9. Practice moving the machine around the yard. Make several practice stops to develop a "feel" for the brakes. Practice driving and steering in forward and reverse. Always use the brakes to slow and stop the machine - never gear down.

   CAUTION: Keep the speed low until you feel comfortable with the machine.
   Always bring the machine to a complete stop before changing direction. Changing direction while in motion will put tremendous loads on drivetrain components, especially the drivelines. Premature wear and failure can result.
   For maximum visibility and overall safety, travel in reverse whenever possible. Always travel in reverse when the machine is loaded. Keep the load as low as is practical.



NOTE: It is recommended that you keep the declutch control in the ON position for normal traveling. In this position, the transmission is "declutched" or disconnected whenever the brake pedal is depressed. If a downgrade is encountered, the declutch control may be placed in the OFF position, and the transmission will remain in gear while braking.

⚠ WARNING

For maximum visibility and overall safety, travel in reverse whenever possible. Always travel in reverse when the machine is loaded. Keep the load as low as is practical.

4.7 Unloading

1. Move the Lumberjack up to a truck or trailer with the carriage in the following position:

   The holddown arms out - raised position.
   The kickoff arms fully retracted.
   The tines level and just high enough to clear the bottom of the load.

2. Move in until the back of the carriage is against the load. Partially clamp the load to prevent logs from rolling off. See Fig. 4-3.

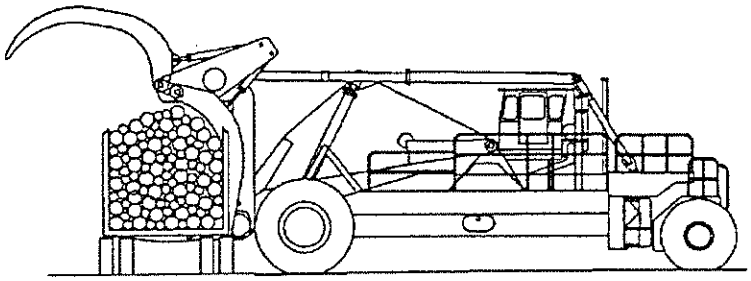


Fig 4-3

3. Raise the boom until the tines begin to make contact with the load.

4. Securely clamp both holddown arms before the binder chains are removed. See Fig. 4-4.

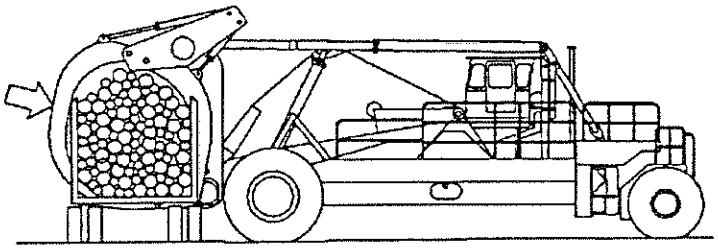


Fig 4-4

⚠ WARNING

Never allow the binder chains to be removed from the load until it is securely clamped by the holddown arms or by some other means provided by your company.

Never allow anyone to walk under the load.

Always try to unload from the binder side of the load. It's very important that you're able to see ground personnel. Never let them out of your sight!

5. Hoist the load clear of the truck or trailer and tilt the carriage back slightly to bring the load center closer to the drive wheel axle. See Fig. 4-5.

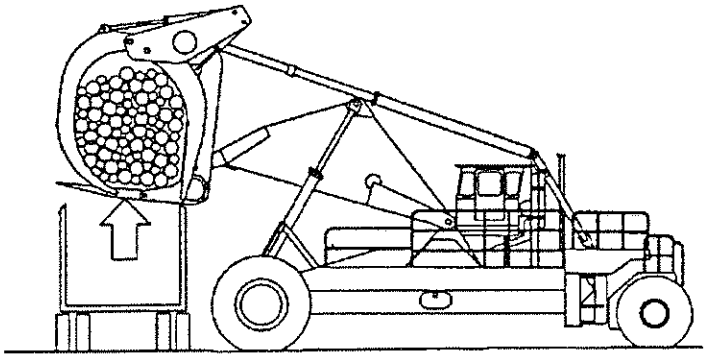


Fig 4-5

6. With the load clear of the vehicle, back away and lower the load to about 3 feet above the ground or just high enough to clear any obstructions on your way to the point of unloading. See Fig. 4-6.

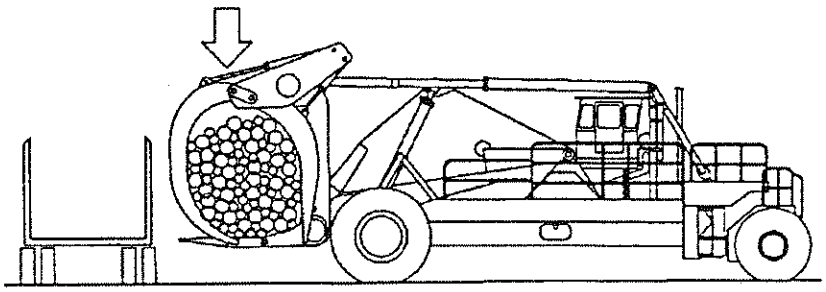


Fig 4-6

4.8 Load Splitting

1. Approach the load with the holddown arms open.
2. Raise the carriage and tilt it forward slightly.
3. Work the tines through approximately 1/3 of the load. See Fig. 4-7.
4. Bring the kickoff arms forward until they make contact with the load and then pull the load in tight with the holddown arms. Tilt the carriage back.
5. Continue to tighten with the holddown arms and raise the carriage until the load is free.

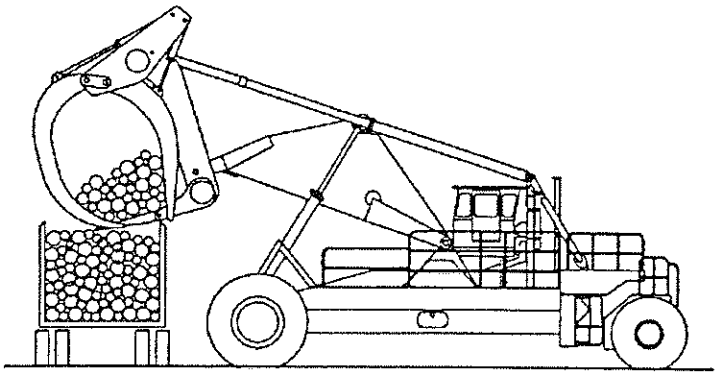


Fig 4-7

4.9 Spreading and Sorting

1. To unload the carriage for scaling or sorting, leave the carriage level or tilted slightly back. Lower the boom until the carriage is as close to the ground as possible. See Fig. 4-8.

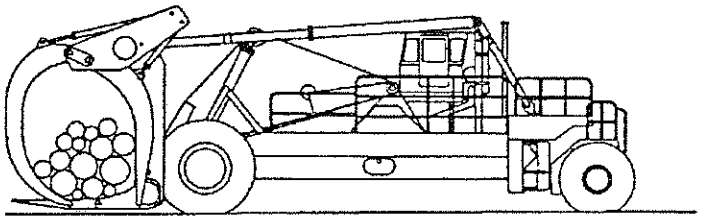


Fig 4-8

2. While backing the machine, slowly open the holddown arms and gradually push the load forward with the kickoff arms. This way, the logs can be dropped individually rather than all at once. See Fig. 4-9.

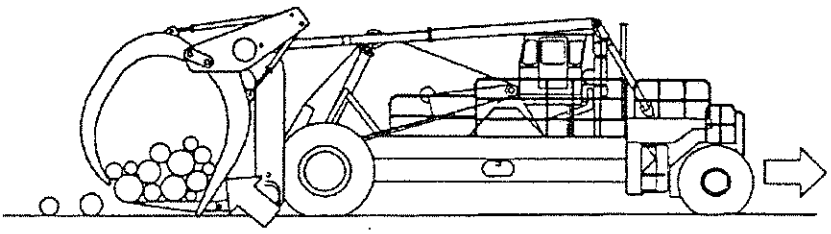


Fig 4-9

3. If several logs fall off at once and form a pile, stop the machine, tilt the carriage forward, and using the holddown arms, rake the top logs back into the carriage.
4. When retrieving spread logs and the last one is beyond the ends of the tines, extra reach can be gained by tilting the carriage forward. This places the holddown arms in a position to rake the logs onto the tines. The distance the top of the carriage extends forward is the extra reach gained at the tip of the holddown arms. See Fig. 4-10.

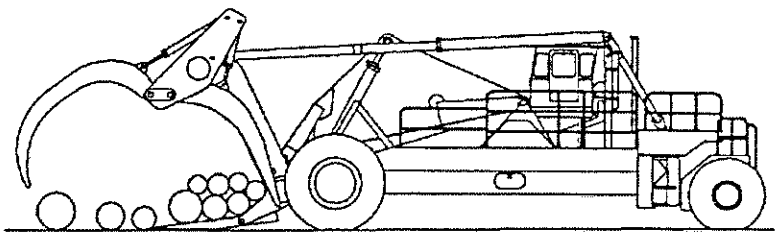


Fig 4-10

4. Fig. 4-11 shows a good example of the Lumberjack's flexibility. The log is under the tines and is held by the holddown and kickoff arms. Partial loads should be held with the holddown and the kickoff arms.

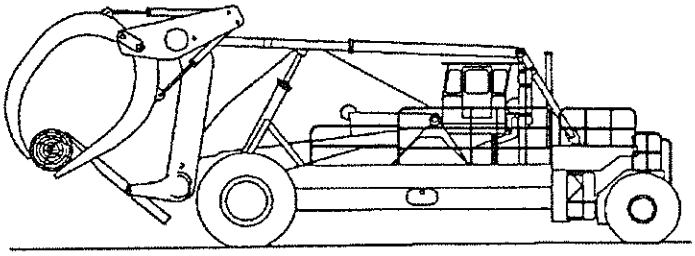


Fig 4-11

4.10 Cold Decking Loose Logs

1. In building a cold deck, be sure that all logs are well balanced on the tines. This will help to prevent one end of a log from dropping down, resulting in "jack-straw" cold decking.
2. Move up to the deck with the load lifted to the necessary height. Place the drive wheel tires tight against the bottom logs, as this firms up the deck and helps prevent logs from shifting when you place the new load on top. See Fig. 4-12.

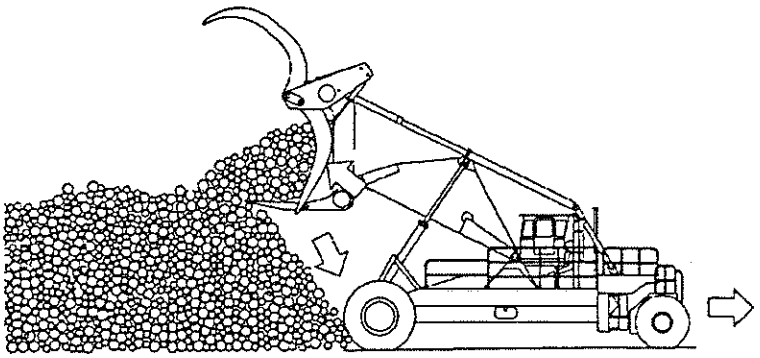


Fig 4-12

3. When the required decking height is reached, push the load off with the kickoff arms and simultaneously lower the carriage and back away slowly. Keep the tines as close to the pile as possible to prevent logs from rolling down in front of the drive tires. See Fig. 4-13.

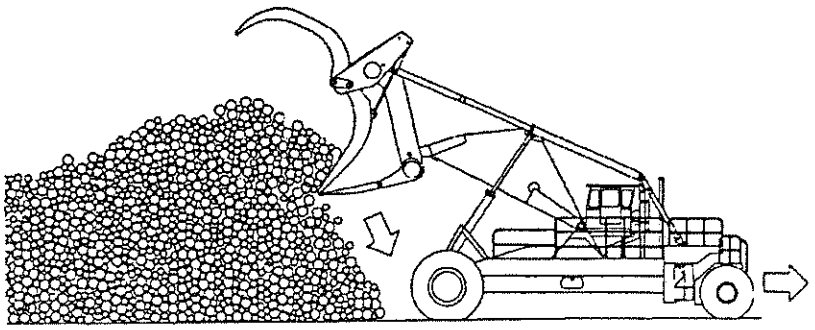


Fig 4-13

4. Continue backing and lowering until all the logs are out of the carriage. See Fig. 4-14.

   NOTE: If a log becomes "jack-strawed", straighten the pile before bringing in the next load. This will make decking and retrieval much easier.

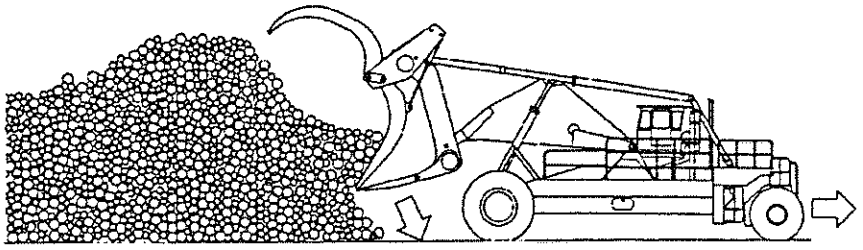


Fig 4-14

4.11 Retrieving Loose Logs

1. To obtain maximum load retrieval of loose logs, raise the holddown arms and tilt the carriage forward slightly before moving into the deck. The tines should be hinged and at ground level.
2. Move into the deck and simultaneously tilt the carriage fully forward. The logs should roll up into the back of the carriage. Move into the deck as far as possible. See Fig. 4-15.
3. Having the carriage tilted forward at this point will allow the holddown arms to gather logs that would be otherwise out of reach. To finish filling the carriage, alternate between clamping with the holddown arms and tilting the carriage back.
4. Tilt the carriage back fully and tightly clamp the load. Back away and lower the load. See Fig. 4-16.
5. Travel with the load as close to the ground as possible. Raise the load only enough to clear obstacles.
5. Occasionally, one log in a bunch will be held by only one holddown arm and will ride on the outside of the other. It's best to drop this log and retrieve it on the next trip. Securely clamp the load with one arm (the side with the log on the outside) and open the other holddown arm. The loose log will fall to the ground. Re-secure the load before proceeding.

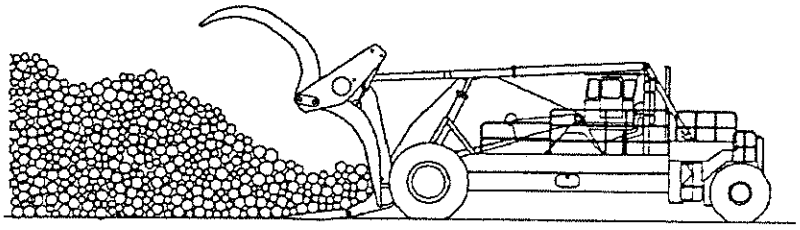


Fig 4-15

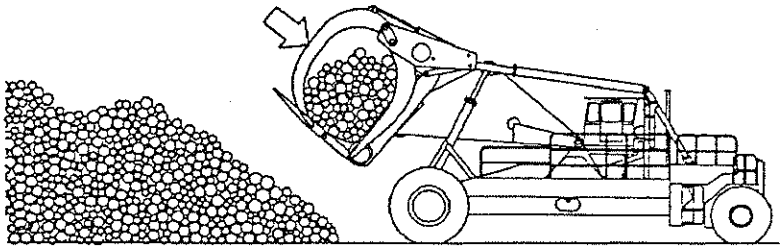


Fig 4-16

4.12 Cold Decking Bundled Logs

1. When approaching the deck with a bundle, clamp the bundle with the auxiliary holddown arms and then raise the main holddown arms. This allows the bundle to be placed tightly against the others. See Fig. 4-17.

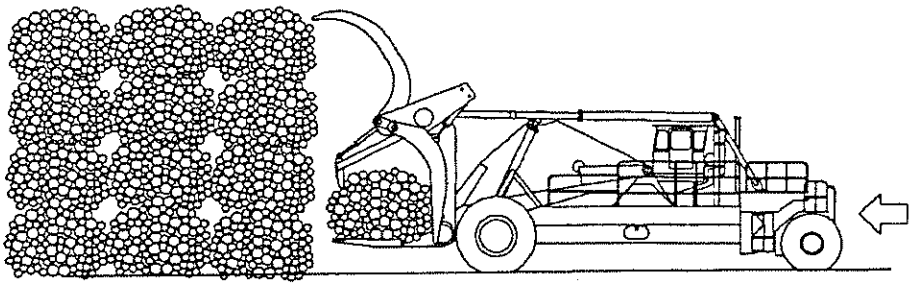


Fig 4-17

2. To place the bundle, set the bundle in position, raise the auxiliary holddown arms and push forward with the kickoff arms while backing up. The bundle will slide off of the tines. See Fig. 4-18.

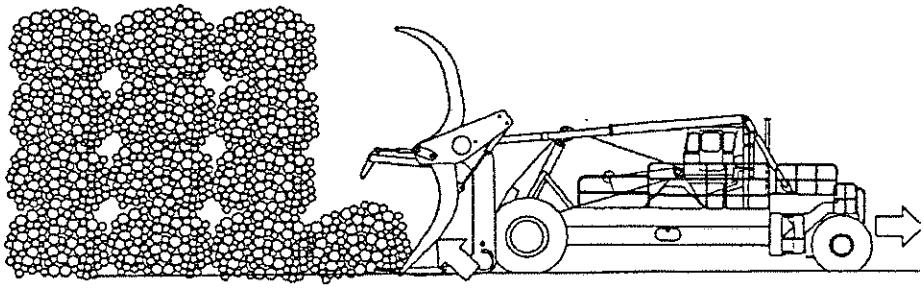


Fig 4-18

3. Always stack bundles in vertical piles - not interlocking. This will make retrieval much easier. Also, when stacking one bundle on top of another, press down on the lower bundle with the carriage. This will flatten the lower bundle and make the deck much more stable and retrieval easier. See Fig. 4-19.
4. Depending on bundle size, it may be possible to stack the bundles four high.

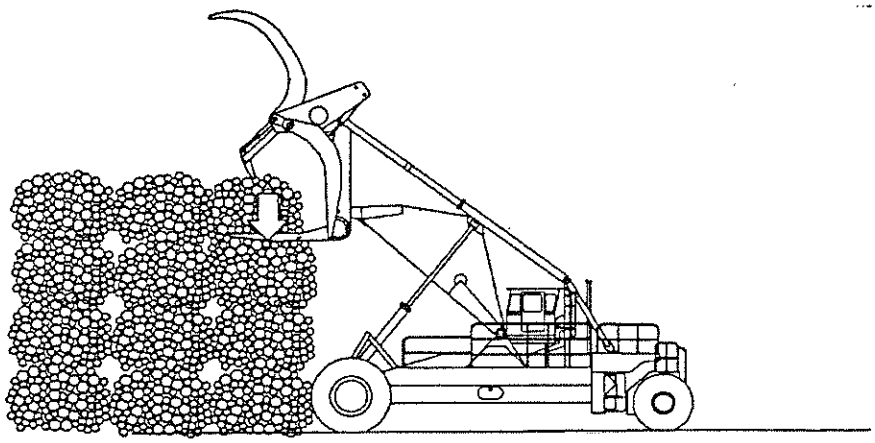


Fig 4-19

4.13 Retrieving Bundled Logs

1. Approach the deck with the carriage tilted forward and all holddown arms (main and auxiliary) fully raised.

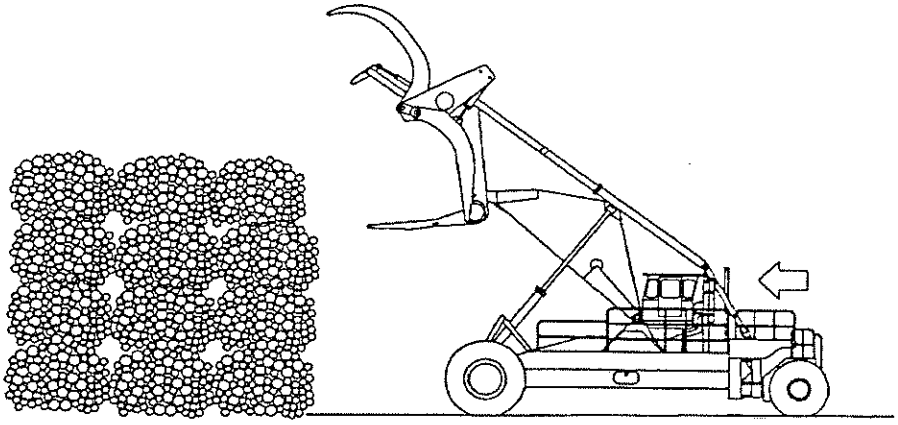


Fig 4-20

2. Work the tines between the bundles. Take care not to hook logs from the lower bundle. Work the tines as far under the bundle as possible.

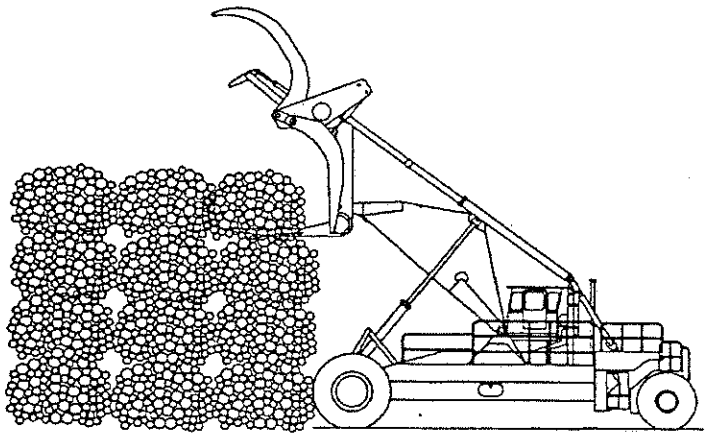


Fig 4-21

3. Clamp the bundle with the auxiliary holddown arms and tilt the carriage back.

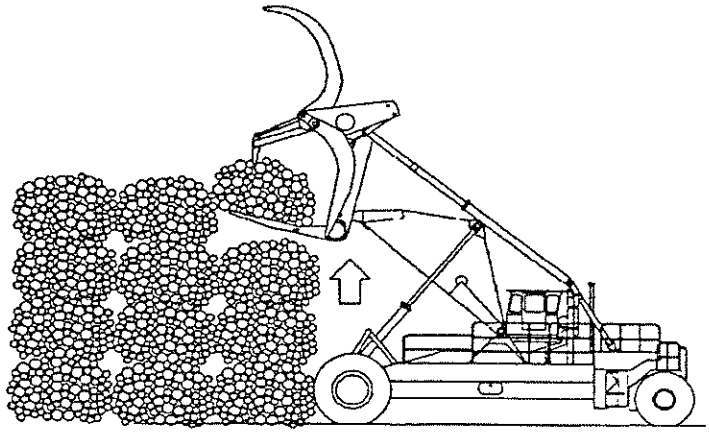


Fig 4-22

4. Lower the main holddown arms as soon as they will clear the remaining bundles.
5. Lower the bundle to the ground and re-clamp if necessary to secure the load. Travel with the load as close to the ground as possible. Raise the load only enough to clear obstacles.

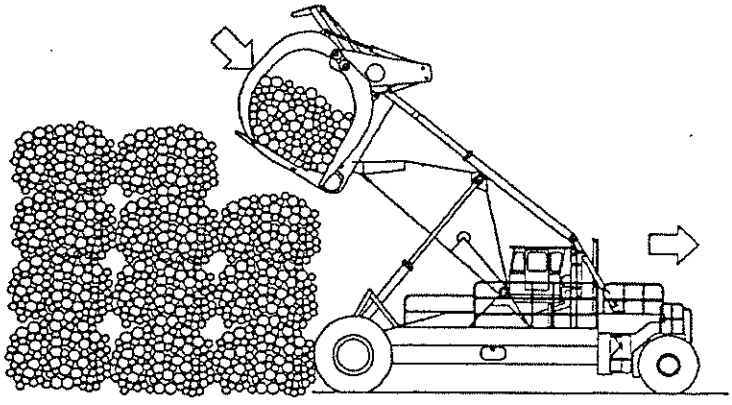
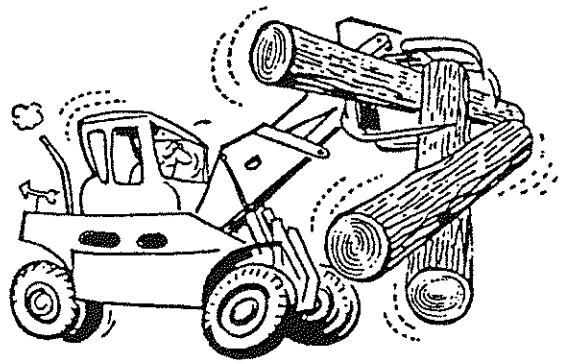


Fig 4-23

4.14 Operating Tips

1. For maximum visibility and overall safety, travel in reverse whenever possible. Always travel in reverse when the machine is loaded. Keep the load as low as is practical.
2. Always make sure that the kickoff arms are fully retracted and against their stops when carrying a full load. Leaving them partially extended could result in damage if the load should shift or roll with any force. To obtain the greatest lift capacity, the kickoff arms must be all the way back. This way the load center is as far back as possible.
3. **WITHOUT FAIL** - always secure a load before allowing the binder chains to be removed, either by clamping the load with the holddown arms, or by some other means provided by your company.



4. The holddown and kickoff arms can be damaged if they are used in any way that opposes the movement of the machine under power. For example, never use the holddown arms to drag a log while moving in reverse.

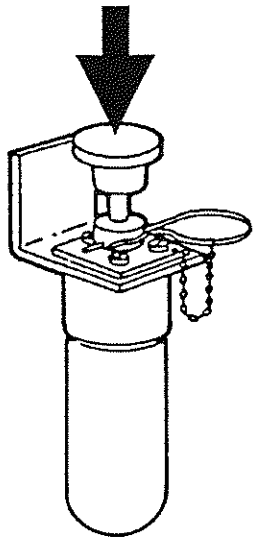
4.15 Determining Load Center

The load center is figured at a specific distance from the face of the carriage towards the tips of the tines.

MODEL	LOAD CENTER	MAX LOAD
L-80, L480	48"	80,000 lb
L-90, L490	54"	90,000 lb
L-100, L4100	54"	100,000 lb
L-120, L4120	60"	120,000 lb
L-130, L4130	72"	130,000 lb

4.16 In Case of Fire

1. Pull the safety pin on the actuator and strike the button. Fire retardant will be released, the engine will shut down, and the batteries will be disconnected from the electrical system.



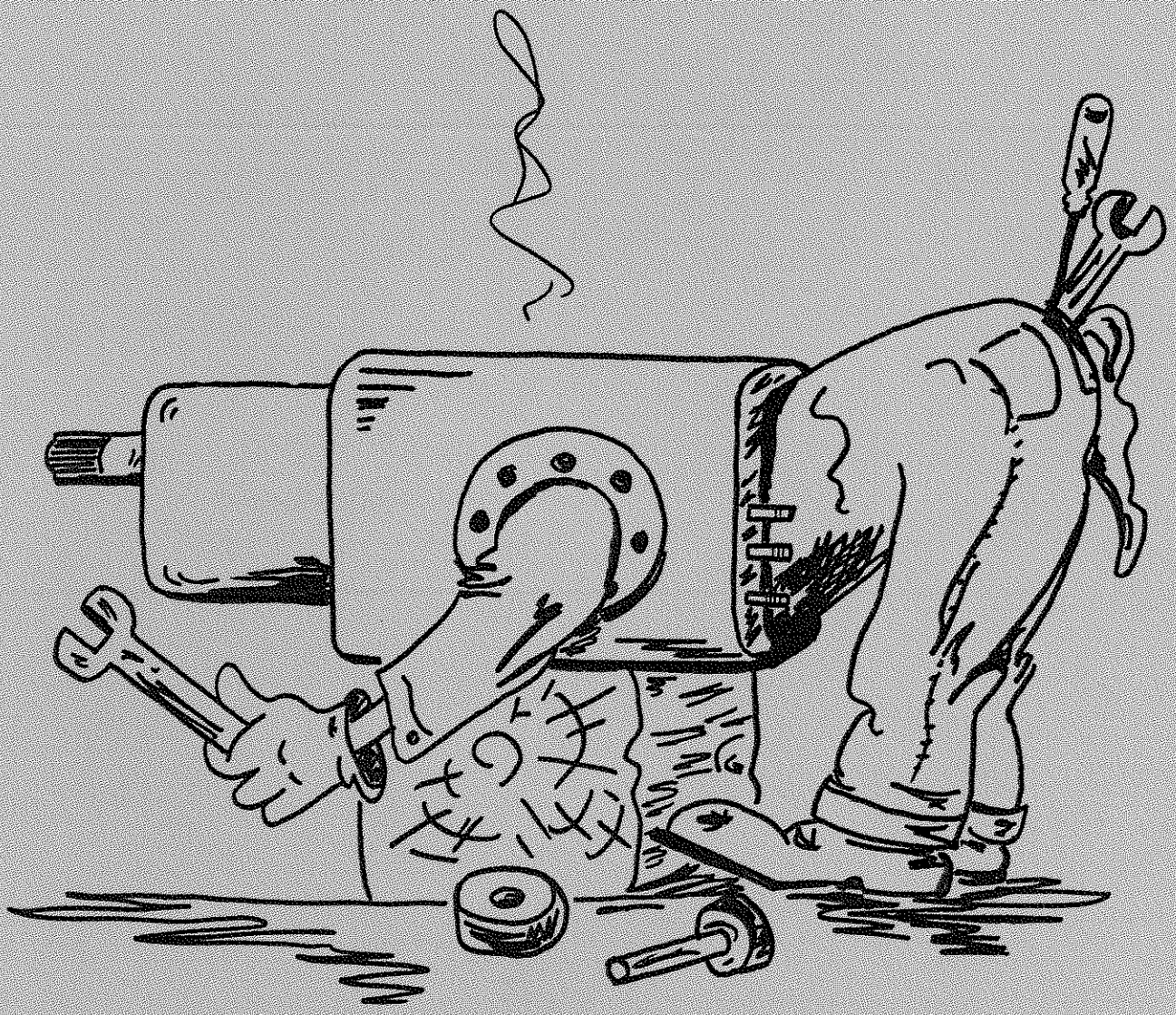
2. Take the hand-held fire extinguisher, if possible, and LEAVE THE VEHICLE. After the system has discharged, watch carefully for flare-ups and spot fires. Call the Fire Department and/or service personnel as soon as possible.
3. Any time the system is discharged, the system must be refilled and recharged before resuming operation. Refer to the Service Manual for complete maintenance procedures.

IMPORTANT: Each unit is equipped with two actuators. One is located in the operator's cab behind the seat to the left. The other is located on the chassis near ground level. This way, the system may be actuated by either the operator or by ground personnel.

NOTE: Some models are equipped with a fire detection system that will automatically discharge the system in the event of a fire. See the Service Manual for details.

3

MAINTENANCE & LUBRICATION



Maintenance and Lubrication

General

A machine that receives regular care from its operators and mechanics generally rewards them with decreased downtime and greater reliability. With the help of the information in this section, you should be able to maintain your Lumberjack at top operating efficiency. The maintenance and lubrication procedures given here can be performed with a minimum of shop tools.

Safety Precautions

Before performing any maintenance or lubrication, review the following safety precautions. They're included for your protection.

1. Read This Manual

   Be sure you understand the procedures outlined in this manual before attempting to carry them out. Pay particular attention to any safety warnings presented. If you have any questions, don't hesitate to ask your WAGNER dealer.

2. Perform Maintenance on Level Ground

   The machine should be on level ground and clear of traffic lanes whenever possible. The parking brake should be set and the wheels blocked.

3. Remove Loads

   The machine should be unloaded, with the carriage down.

⚠ WARNING

Never rely on the hydraulics to support any part of the machine during maintenance or lubrication. If necessary, support components with appropriate safety stands. NEVER stand under a component that is supported only by the hydraulics. Make sure it is resting on its mechanical stops or safety stands.

4. Stop the Engine

   Before performing any maintenance or lubrication, remove the key from the switch, or tag the key switch "**DO NOT START**", to ensure that the engine is not inadvertently started.

5. Use Safe Ladders/Scaffolding

   Due to the extreme height of the upper lube points, it is essential to personnel safety that safe ladders, personnel lifts and/or scaffolding be used while servicing. These areas can be dangerously slick under conditions of rain, frost or oil smears.

Preventive Maintenance

Preventive maintenance is a system that is designed to detect problem areas and prevent equipment failure before trouble can develop to a critical point. The system is based on a series of maintenance checks and servicing points. To be effective, a preventive maintenance program demands strict adherence to a planned schedule of maintenance.

Benefits of Preventive Maintenance

Time spent making the required periodic checks is a real investment in working equipment and efficient use of man hours. Valuable benefits can be realized, all of which mean savings in time and resources.

Preventive Maintenance

- **Promotes Safety** - properly maintained equipment is better able to operate within its design specifications and react positively to the operators control.
- **Improves Equipment Availability** - by minimizing the chances of breakdown.
- **Reduces Unexpected Downtime** - crash repairs are expensive and detract from normal scheduled maintenance.
- **Reduces Equipment Abuse** - provides the ability to predict component life and helps avoid operating equipment to destruction, by replacing parts before they fail.
- **Allows Planning of Daily Production** - by knowing the condition of available equipment.
- **Allows Planning of Maintenance Man Hours** - by distribution of duties and necessary lead time for parts ordering.
- **Provides Complete History of Equipment** - based on performance, frequency and type of repairs and actual man hours expended on maintenance.

Establishing a Preventive Maintenance Program

The key to an effective preventive maintenance program is diligence in following a maintenance schedule set at regular planned intervals. Such intervals should be made compatible with the nature of operation of the equipment and with the capabilities of the maintenance facility. In any event, the intervals and inspection requirements must be planned, regular, and consistent.

This program proposes the following basic schedule which is based on intervals generally used and accepted in the wood products industry.

Specific maintenance should be completed using the following intervals:

- 10 hours (each shift or daily)
- 50 hours (weekly)
- 250 hours (monthly)
- 500 hours (quarterly)
- 1000 hours (semi-annually)
- 2000 hours (annually)

Each successive schedule (e.g. weekly, monthly, quarterly, etc) builds on the former and is accumulative in nature. For example, when performing monthly maintenance, the mechanic will first take note of the shift maintenance reports and remedy any discrepancy; then comply with the shift and weekly maintenance, and in addition will perform the checks specified in the monthly schedule.

Maintenance Record Keeping

The importance of good record keeping cannot be overemphasized. Each scheduled maintenance form should be checked off as the inspections and service is performed. Quantities of replenished lubricants should be recorded, as well as hydraulic pressure readings. All discrepancies should be recorded whether remedied or pending. Operators and mechanics should sign off forms and return them to the maintenance supervisor for approval and retention in an equipment unit file.

Accurately recorded maintenance forms will give the maintenance personnel an overall view of how particular equipment is holding up under normal operating conditions. Good records, and the ease by which they can be reviewed also enable maintenance personnel to identify and evaluate problem areas and allow adjustment in the maintenance scheduling for their particular operation.

Shift Maintenance

Shift maintenance is where preventive maintenance begins. The operator normally completes this inspection. It consists of the routine servicing and lubrication of the machine's major systems. On a daily basis, the operator is in a position to identify, remedy and/or record potential problem areas and is able to quickly recognize any change in the performance of his machine. The comments he records on the shift maintenance report become a valuable tool to the maintenance department, and is an important ingredient to the overall success of a preventive maintenance program.

Shift Maintenance Checklist

A recommended checklist is given here as an aid in developing a practical shift maintenance program if one has not been developed by your company. A shift maintenance report, based on this checklist, should be used to report defects found when making maintenance checks at the beginning of each shift.

Your company may have a different reporting method, however, it is usually a requirement that this form be

filled out at the end of each shift. Accurate shift maintenance reports can help your company anticipate maintenance problems and take action to prevent costly failures.

Using the Checklist

The reference numbers in the left-hand column of the checklist indicate the physical location of each check point or lubrication point as it appears on the shift maintenance diagram. Circled reference numbers on the diagram indicate lubrication points. Boxed numbers indicate maintenance check points.

Shift maintenance details are provided in the Maintenance Procedures section. These procedures consist of checks that can be performed by the operator.

Scheduled Maintenance

Periodic scheduled maintenance is intended to be performed in a complete maintenance facility by trained mechanics. The timely scheduling and completion of these periodic inspections by the maintenance department will determine the length of downtime of a particular machine. Therefore, maintenance scheduling becomes a critical factor in the effective use of man hours and the availability of serviceable equipment.

Scheduled Maintenance Checklist

Actual operating environment governs the maintenance schedule. Some checks should be performed more often under severe conditions, such as heavy dust, extreme temperatures or extremely heavy loads.

These maintenance checklists are designed to be used as a guide until adequate experience is obtained in establishing a schedule to meet your specific needs.

A detailed list of component checks is provided with a suggested schedule basis given in hours of operation, or calendar time.

The engine manufacturer's operation and maintenance manual should be consulted for additional engine related checks and/or details.

A maintenance schedule should be established using these checklists as a guide. The result will be a maintenance program to fit your specific operation.

Using the Checklist

Although specific maintenance is identified in these checklists, location and procedure references are not provided in the columns.

Scheduled maintenance is normally carried out by trained mechanics, who are knowledgeable of the equipment systems and component locations. Scheduled maintenance procedures can be found by referring to the appropriate section of the service manual.

Scheduled Oil Sampling

Use scheduled oil sampling (SOS) to monitor machine condition and maintenance requirements. Oil samples from engine, transmission, axles, and hydraulic system should be taken when the oil is hot and well mixed to ensure an accurate analysis. Contact your Wagner dealer for complete information and assistance in establishing a scheduled oil sampling analysis program for your equipment.

Shift Maintenance Checklist

EVERY 10 HOURS OR DAILY

Note general vehicle condition. Clear away all collected debris - steam clean if necessary. Check for mechanical damage and loose or leaking components. Report faults to maintenance department.

Before Starting Engine - Check The Following:

ITEM	OK	NO	ADD
ENGINE (Check Oil Level - check for leaks)	☐	☐	_____
HYDRAULIC TANK (Check oil level - check for leaks)	☐	☐	_____
RADIATOR (Check coolant level - check for leaks)	☐	☐	_____
AIR CLEANER (Check indicator - clean or change element as required, empty dust cup)	☐	☐	
AIR INTAKE SYSTEM (Check for leaks and damage)	☐	☐	
ENGINE BELTS (Check for adjustment and wear)	☐	☐	
AIR TANKS (Check drain valves for correct operation)	☐	☐	
RADIATOR & OIL COOLER (Are fins clean and unobstructed?)	☐	☐	
WHEELS & TIRES (Check condition and pressure)	☐	☐	_____
HYDRAULIC BRAKE FLUID (Check fluid level)	☐	☐	_____
LUBRICATE CHASSIS (Refer to lube chart)	☐	☐	

After Starting Engine - Check The Following:

ENGINE (Does it sound normal?)	☐	☐	
INSTRUMENTS (Check for normal readings)	☐	☐	
CONTROLS (Check for normal operation)	☐	☐	
EXHAUST SYSTEM (Check for leaks and excessive smoke)	☐	☐	
TRANSMISSION (Check oil level - check for leaks)	☐	☐	_____

Note Anything Abnormal Or In Need Of Repair:

LIGHTS_____ DEFROSTER_____ REVERSE WARNING HORN_____

HORN_____ WINDSHIELD WIPERS _____ _____

HEATER_____ AIR CONDITIONER_____ _____

OPERATOR_____ SUPERVISOR_____ DATE _____

MODEL_____ SERIAL NUMBER_____ HOUR METER _____

Lubrication Points

10 HOURS

	FITTINGS
Steering cylinder pins	4
Boom to chassis pin	2
Boom To Carriage Pin *	2
Hoist cylinder pins *	4

* **When operating in water, lubricate submerged points more frequently**

50 HOURS

Tilt cylinder pins	4
Holddown arm pins	2
Kickoff arm pins	2
Holddown cylinder pins	4
Kickoff cylinder pins	4
Auxiliary holddown arm pins	2
Auxiliary holddown cylinder pins	4
Driveline - converter to transmission * *	3
Driveline - transmission to axle * *	3

* * **Use handgun or low pressure adapter; lubricate sparingly**

250 HOURS

Fan drive bearing (not all engines)	1

500 HOURS

Tailwheel bearing	2
Tailpost	1

Maintenance Checklist

EVERY 50 HOURS OR WEEKLY

1.	Repeat the 10 hour check	OK_____	NO _____
2.	Check for fluid leaks - oil, fuel, water	OK_____	REPAIR _____
3.	Check brakes for adjustment and wear	OK_____	REPAIR _____
4.	Check wheel lug nuts and studs mechanically	OK_____	REPAIR _____
5.	Check battery electrolyte level	OK_____	ADD _____
6.	Lubricate chassis - refer to Lubrication chart	OK_____	NO _____
7.	Record engine rpm	HIGH_____	STALL_____
8.	Check for structural damage - inspect chassis & attachments for bending, cracking & broken welds	OK_____	REPAIR _____

EVERY 250 HOURS OR MONTHLY

1.	Repeat the 50 hour check	OK_____	NO _____
2.	Change engine oil & filters *	OK_____	ADDED _____
3.	Take engine oil sample for analysis *	OK _____	NO _____
4.	Check axle differential oil level	OK_____	ADDED_____
5.	Check axle planetary oil level	OK_____	ADDED_____
6.	Change cooling system filter	OK_____	REPLACE_____
7.	Check all hydraulic pressures and record	OK_____	NO _____
8.	Check fire suppression actuator	OK_____	NO _____

EVERY 500 HOURS OR QUARTERLY

1.	Repeat the 250 hour check	OK_____	NO _____
2.	Service fuel filters *	OK_____	REPLACE _____
3.	Service hydraulic filters *	OK_____	REPLACE _____
4.	Service transmission filters *	OK_____	REPLACE_____
5.	Take oil samples from transmission, axle, and hydraulic system for analysis *	OK_____	NO _____
6.	Inspect brake system & components	OK_____	REPAIR _____

Maintenance Checklist (Continued)

1000 HOURS OR SEMI-ANNUALLY

1.	Repeat the 500 hour check	OK_____	NO_____
2.	Change transmission oil and filters	OK_____	ADDED_____
3.	Clean and flush cooling system	OK_____	ADDED_____
4.	Check pins and bushings for wear	OK_____	REPLACE_____

2000 HOURS OR ANNUALLY

1.	Repeat the 1000 hour check	OK_____	NO_____
2.	Drain, flush and fill differential *	OK_____	ADDED_____
3.	Drain, flush & fill planetaries *	OK_____	ADDED_____
4.	Change hydraulic oil and filters *	OK_____	ADDED_____

* Normal drain period and filter change intervals are for average environmental and duty-cycle conditions. Severe or sustained high operating temperatures or very dusty atmospheric conditions will cause accelerated deterioration and contamination.
Change intervals should be adjusted according to the results of oil sampling analysis. Consult your WAGNER dealer for assistance in establishing an oil sampling program for your equipment.

IMPORTANT: Consult the engine manufacturer's Operation and Maintenance Manual for additional engine related checks and/or details.

Repairs:

Problem:_____

_____

_____

_____

Parts:_____

_____

_____

_____

Mechanic:_____ Hours Labor:_____

Operator:_____ Supervisor:_____

Machine Model:_____ Equipment No:_____

Date:_____ Shift:_____ Hour Meter:_____

Maintenance Procedures

General

The following maintenance procedures should be performed at the beginning of each work shift. The number before each maintenance procedure corresponds with the numbers given in the Maintenance and Lubrication Chart This provides an additional aid in locating each check point.

Before starting engine

Engine Oil Level

The oil level should be checked prior to starting the engine. Make sure that the area around the dipstick is clean and the machine is sitting on level ground.

NOTE: A 15 minute drain-back time is recommended if the engine has been running.

The oil level must be maintained between the "L" (low) mark and the "H" (high) mark, but as close to the "H" mark as possible.

CAUTION: Never operate the engine with the oil level below the "L" mark or above the "H" mark. Refer to the engine's Operation and Maintenance manual for detailed engine service information.

Use only approved engine oil (see Lubricant Specifications Chart, Do not over-fill. Check engine for leaks.

Hydraulic Oil Level

Always check the hydraulic oil level prior to operation. The dipstick and fill pipe are located on the RH chassis deck, to the right of the operator's cab.

CAUTION: Always open the tank breather petcock (located on the breather pipe) before removing the dipstick, filler cap, or in-tank filter cover plate. Failure to vent the tank can result in injury or a substantial oil spill. Be sure to close the petcock before operating the machine.

The oil level should be checked with the hoist cylinders retracted (down). The oil level should be at or near the "H" (high) mark on the dipstick. Fill with approved hydraulic fluid as required (see Lubricant Specifications Chart, Do not overfill.

Engine Coolant Level

Daily inspection of the coolant level is recommended. Cooling systems using anti-aeration baffles restrict visual observation of the true coolant level. Although the coolant can be seen, the system may not be full. To gain a true fill, add water slowly up to the bottom of the fill neck and allow a 30 second settling period. Remember to compensate for the loss of anti-freeze when adding water.

⚠ WARNING

Never remove the radiator cap if the engine is hot. The coolant will be under pressure and could flash to steam with explosive force, causing severe burns. Remove the radiator cap only when the engine is cool.

NOTE: If the engine is hot, the coolant level will be higher than when it is cold.

Inspect the radiator daily for restriction caused by leaves, paper or bent fins. Inspect the radiator cap, hoses, and connectors for any signs of leakage or damage.

Air Cleaner

The air cleaner is a cyclonic-type, dry air filter. A service indicator shows the condition of the filter. The indicator will show in the green zone when the filter is clean. The indicator will show red when the filter is restricted. If red appears in the indicator window, clean or change the element and press the reset button on the indicator.

The air cleaner is also equipped with a pre-cleaner dust cup. It should be emptied daily. Never allow the dust level to come within 1/2 inch of the pre-cleaner tubes. Be sure that the dust cup seals are in place and in good condition. Complete sealing here is essential.

Engine Belts

Check the tension of the drive belts by pressing with the thumb halfway between the pulleys. The belts should not deflect more than the values shown in the table (Fig. 2). If any belt is loose or worn, report to maintenance for corrective action.

Engine	Belt Deflection Inches (mm)
Cummins	3/8 to 5/8 (9.5 to 15.9)
Cat	
Detroit	1/2 to 3/4 (13 to 19)

Fig. 2 Engine Belt Deflection

Air Tank Drain Valves

Visually inspect the valves and connections for damage or leaks. There should be signs of water being ejected from the drain hoses. If not, report the condition to maintenance.

Wheels and Tires

Visually inspect the tires for low air pressure and damage. Also check the wheel assemblies for cracks, loose or missing lug nuts, broken studs, etc. Report any problems to maintenance.

Hydraulic Brake Fluid

Check the fluid level in each of the two brake reservoirs. Each reservoir must be full. Clean the area around the filler cap before removing. Fill the reservoirs with transmission fluid. Do not use automotive brake fluid.

After starting engine:

Engine

After starting, check that the engine runs and sounds normal. It should come up to operating temperature within a few minutes after starting. If you notice unusual noises or excessive smoke, have maintenance check it out.

Instruments

Check all instruments for normal readings immediately after starting the engine. Make sure that pressures and temperatures are within acceptable limits. Also, check that all controls function properly. They should be smooth and responsive.

Air Intake System

Inspect all connections for damage and air leaks. Look for damaged fittings and loose connections. Do not operate the machine if leaks are present. Dirt could enter the engine intake and cause severe damage.

Exhaust System

Check for exhaust leaks. Make sure that exhaust gases are not entering the operator's cab. Mounting brackets must be in place and all connections tight. Check for excessive smoke.

Transmission Oil Level

The level should be checked after engine warm-up, with 180° to 200° showing on the transmission temperature gauge. The dipstick and fill tubes can be reached through an access opening on the chassis deck, directly above the transmission. Check the level with the engine running at idle, at operating temperature, and with the transmission in neutral. The level should be between the "H" (high) and "L" (low) marks. Fill with approved fluid only. See Lubricant Specifications Chart. Do not overfill. Inspect for leaks.

Operator Troubleshooting

The following table lists the most common problems that may be encountered by operators. If the problem cannot be solved using the corrective actions listed in this table, notify maintenance personnel.

Engine *

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Engine turns over but fails to start	Emergency shutdown control pulled out.	Push control in.
	Fuel tank empty	Fill tank
	Fuel shutoff valve at tank closed	Open valve
	Fuel filter blocked	Replace filter
Engine fails to turn over	Battery disconnect switches open	Close switches
	Transmission not in neutral	Place lever in neutral
	Battery low	Have charging system checked
	Battery terminals corroded or loose	Clean and tighten terminals
Engine runs unsteadily and power output low	Insufficient fuel supply	Clean fuel strainers, replace filter, fill tank, tighten fuel lines
	Contaminated fuel	Drain tank, lines, clean strainers, and replace fuel
	Wrong fuel	Drain tank and fill with proper fuel
	Air intake restricted	Remove restriction
Exhaust smokes badly	Too much oil in sump	Drain to proper level
	Air intake restricted	Remove restriction
Engine overheats	Radiator fins restricted	Clean fins
	Low coolant level	Check coolant level
Engine oil pressure low	Low oil level	Check oil level
	Oil leaks	Tighten connections
	Contaminated oil	Change oil and filters

* Also see manufacturer's Operation and Maintenance Manual for additional information

Transmission/Converter *

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Transmission or converter overheats	Low oil level	Fill to proper level
	Oil cooler restricted	Remove restriction
Lack of power	Low engine rpm at converter stall	Have engine checked (governor)

Air & Brake Systems

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Brakes won't release	Low air system pressure	Allow system pressure to build to 120 psi
Loss of braking efficiency	Air in hydraulic brake system	Check fluid level Bleed system
	Low air system pressure	Have maintenance check air system

Hydraulic System

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
No response to controls	Closed tank shutoff valve	Open valve
	Low oil level	Fill tank to proper level
Sluggish operation or response to controls	Hydraulic oil cold	Allow adequate warm-up time
	Low oil level	Fill tank to proper level
	Suction leak	Correct suction leak
	Plugged tank breather	Replace breather
	Restriction in circuit	Remove restriction, check filters
	Pump speed too slow	Check engine speed
Excessive noise	Cavitation	Eliminate restriction in suction line Replace tank breather
	Aeration	Fill tank to proper level Correct suction leak
	Tubing vibrating	Tighten mounting clamps
Hydraulic system overheating	Low oil level	Fill tank to proper level
	Operating over pressure reliefs	Correct operating procedure

* Also see manufacturer's Operation and Maintenance Manual for additional information

Electrical System

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
Engine fails to turn over	Battery disconnect switch(es) open	Close switches
	Neutral start switch open	Place transmission shift lever in neutral
	Battery low	Have start/charge system tested
	Battery terminals corroded or loose	Clean and tighten terminals
	Other connections loose	Tighten connections
Voltmeter indicates discharge	Alternator drive belt slipping	Tighten or replace belt
	Loose or corroded battery connections	Clean and tighten terminals

Lubricant Specifications

	MANUFACTURER & SPECIFICATIONS	RECOMMENDED VISCOSITY	PREVAILING AMBEINT TEMPERATURES (FAHRENHEIT)	(CELSIUS)
ENGINE	CUMMINS MIL-L-2104D (API CE)	SAE 10W-30 SAE 15W-40 SAE 20W-40	-13 ° F to 95 ° F 14 ° F and Above (Normal) 32 ° F and Above	-25 ° C to 35 ° C -10 ° C and Above (Normal) 0 ° C and Above
	DETROIT DIESEL MIL-L-46152 (API CD II)	SAE 30 SAE 40 NOTE: Multi-Grade oils are not recommended in Detroit Diesel Engines	Below 32° F Above 32° F	Below 0° C Above 0° C
	CATERPILLAR MIL-L-2104D (API CE)	SAE 5W-20 SAE 10W-30 SAE 15W-40	-13°F to 50° F -4°F to 104° F 5°F to 122° F(Normal)	-25°C to 10° C -20°C to 40° C -15°C to 50° C (Normal)
TRANSMISSION	CLARK MIL-L-2104D (API SE) TYPE C-3	MIL-L-46167 SAE 10W SAE 30	-65 ° F to 0 ° F -10 ° F to 140 ° F (Normal) 30 ° F to 140 ° F	-54 ° C to -18 ° C -23 ° C to 60 ° C (Normal) - 1 ° C to 60 ° C
	ALLISON MIL-L-2104D (API SE) TYPE C-3	SAE 5W-20 SAE 10W SAE 15W-40 SAE 30	Below -10° F Below 10° F(Normal) Below 30° F Below 35° F	Below -23° C Below -12° C (Normal) Below - 1° C Below 2° C
		NOTE: Preheat transmission fluid to indicated minimum temperature before operating transmission...or if preheating equipment is not available, operate transmission in NEUTRAL for minimum of 20 minutes prior to engaging FORWARD or REVERSE ranges		
	TWIN-DISC MIL-L-2104D (API SE) TYPE C-3	SAE 5W-20 SAE 10W SAE 30	-60° F to 0° F -10° F to 140° F(Normal) 30° F to 140° F	-51° C to -18° C -23° C to 60° C -1° C to 60° C
AXLE	CLARK MIL-L-2105C (API GL-5)	SAE 75W SAE 75W-80 SAE 80W-90 SAE 85W-140	-40 ° F to -10 ° F -40 ° F to -0 ° F -13 ° F to 100 ° F (Normal) Above 10 ° F	-40 ° C to -23 ° C -40 ° C to -18 ° C -27 ° C to 37 ° C (Normal) Above -12 ° C
	RIMPULL/BRYAN MIL-L-2105C (API GL-5)	SAE 75W-90 SAE 80W-90 SAE 120	-65° F to 20° F -20° F and Above(Normal) -90° F to 120° F	-54° C to -29° C -29° C and Above(Normal) -32° C to 49° C
HYDRAULIC	WAGNER Premium Grade Anti-wear Hydraulic Oil (Mobil DTE 13M)	NOTE: Mobil DTE 13M is recommended for use in Allied Wager hydraulic systems operating at very low to widely varying ambient temperatures. It provides a high viscosity index with a low pour point and improved fluidity at sub-zero temperatures. IMPORTANT: As a condition of new machine warranty, Mobil DTE 13M must be used in hydraulic system during warranty period.		
CHASSIS	WAGNER Multipurpose Chassis Grease w/EP & MoS_2	NLGI-1 NLGI-2	Below 10 ° F Above 10 ° F	Below -12 ° C Above -12 ° C

WAGNER

LUBRICATION

L-90

LUBRICATION CHART
L-90 with ALLISON TRANSMISSION and FABRICATED AXLE

SYMBOL

○ ZERK
△ OIL
⬡ GREASE
□ NO LUBRICATION

INTERVALS

A-40 HOURS/WEEKLY
B-100 HOURS
C-250 HOURS
D-500 HOURS
E-1000 HOURS
F-8 HOURS/DAILY
G-CONSULT MANUAL
H-AS CONDITIONS REQUIRE
J-REPLACEMENT REPACK

ITEM	DESCRIPTION	LUBE OR CHECK	CHANGE
	REFER TO FIGURE 1		
(1)	PLATE, TAIL POST	A	
(2)	PINS, STEERING CYLINDERS	F	
[3]	FILTER, SECONDARY, ENGINE OIL		C/G
[4]	COOLANT LEVEL & FILL	F	
△5	FILL CAP, ENGINE OIL		C/G
△6	OIL LEVEL, ENGINE	F	
[7]	BREATHER, HYDRAULIC TANK		C
[8]	SIGHT GAUGE, FUEL	F	
[9]	SCREEN, HYDRAULIC TANK (FIGURE 2)	D	
[10]	FILL CAP, FUEL	F	
[11]	DIPSTICK, HYDRAULIC OIL LEVEL	F	
[12]	BREATHER, ENGINE CRANKCASE	B	G
[13]	FILL CAP, HYDRAULIC OIL	F	
△14	FILL CAP & OIL LEVEL	B	G
[15]	FILTER, TRANSMISSION		D
(16)	DRIVELINES (FIGURES 1 & 3)	B	
(17)	SLIP YOKE, DRIVELINE (FIGURES 1 & 3)	B	
[18]	FILTERS, HYDRAULIC OIL		D

LUBRICATION CHART

ITEM	DESCRIPTION	LUBE OR CHECK	CHANGE
19	AIR DRYER	F	
20	FLANGE BEARING, DRIVELINE	B	
21	PLANETARIES	A	D
22	OIL LEVEL, DIFFERENTIAL	A	
	REFER TO FIGURE 3		
23	BEARINGS, TAILWHEELS	F	J
24	BEARINGS, TAILWHEELS	D	
25	BEARING, TAILPOST	A	
26	FILTER, ENGINE FUEL		B/G
27	AIR CLEANER, ENGINE (FARR OR DONALDSON)		H
28	INDICATOR, AIR CLEANER	F	
29	WATER PUMP AND FAN	G	
30	FILTER, FUEL		D/G
31	DRAIN, CRANKCASE		C/G
32	FILTER, COOLANT		G
33	DRAIN, TRANSMISSION		D/G
34	PINS, STABILIZER	A	
35	PINS, HOIST	A	
36	DRAIN, DIFFERENTIAL		D
37	PINS, BOOM TO CARRIAGE	A	
38	PINS, HOLDDOWN & KICKOFF CYLINDERS	A	
39	PINS, HOLDDOWN & KICKOFF	A	
40	PINS, BOOM TO CHASSIS	A	

LUBRICATION CHART			
ITEM	DESCRIPTION	LUBE OR CHECK	CHANGE
	THE FOLLOWING ITEMS ARE NOT ILLUSTRATED:		
△	BATTERY BOX AND DOOR HINGES	H	
⬡	BATTERY TERMINALS FOR CORROSION	A	
□	BATTERY WATER LEVEL	A	

CAUTION:

Due to the extreme height of the upper Lube points, it is essential to personnel safety that safe ladders and/or scaffolding be used while servicing. These areas can be dangerously slick under conditions of rain, frost and oil smears.

NOTE:

Due to variations in engine type and models the indicated location of engine filters (fuel - oil - coolant) are general. Consult your specific engine Service Manual for exact location.

L-90 LUBE CHART

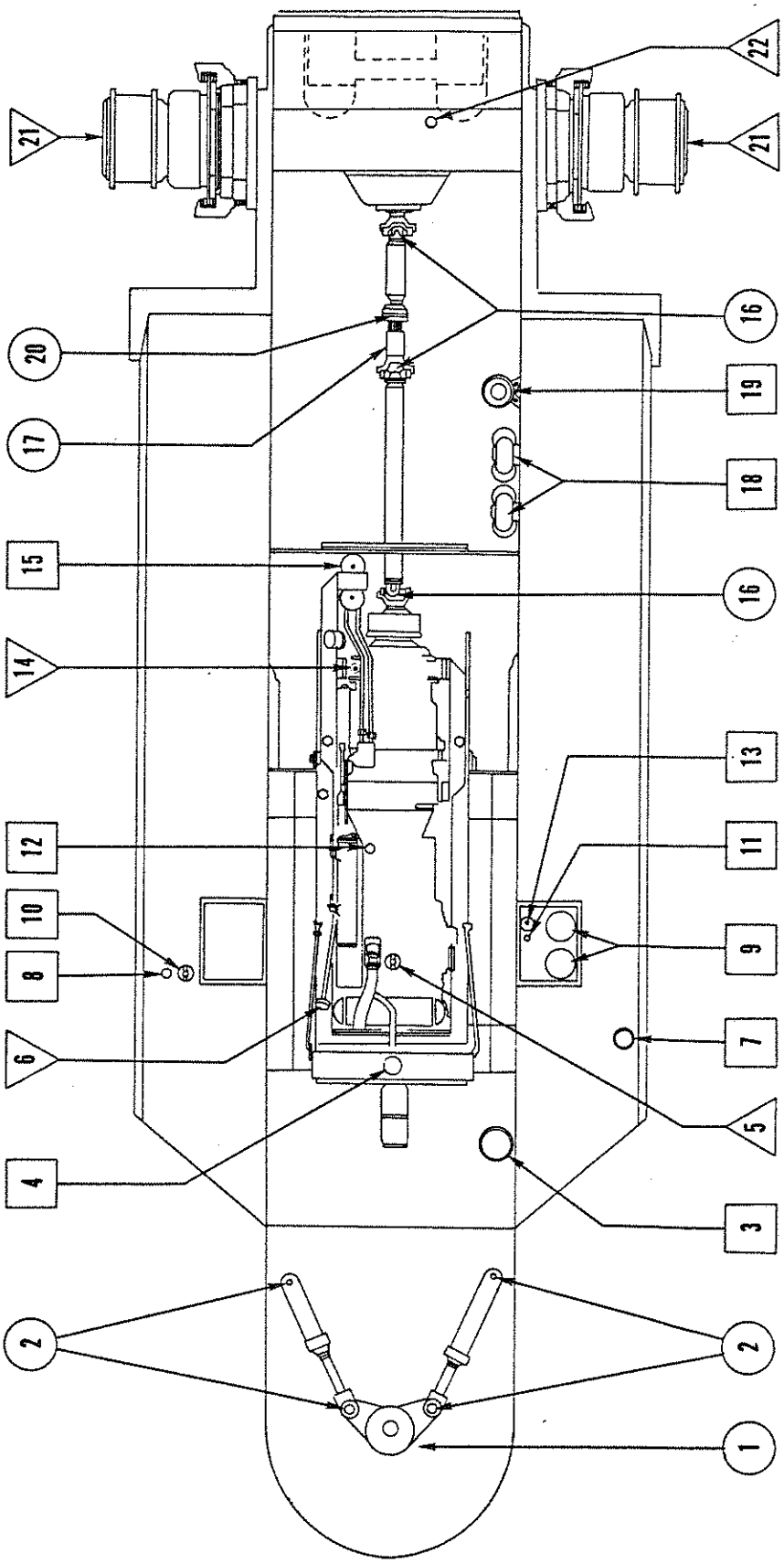
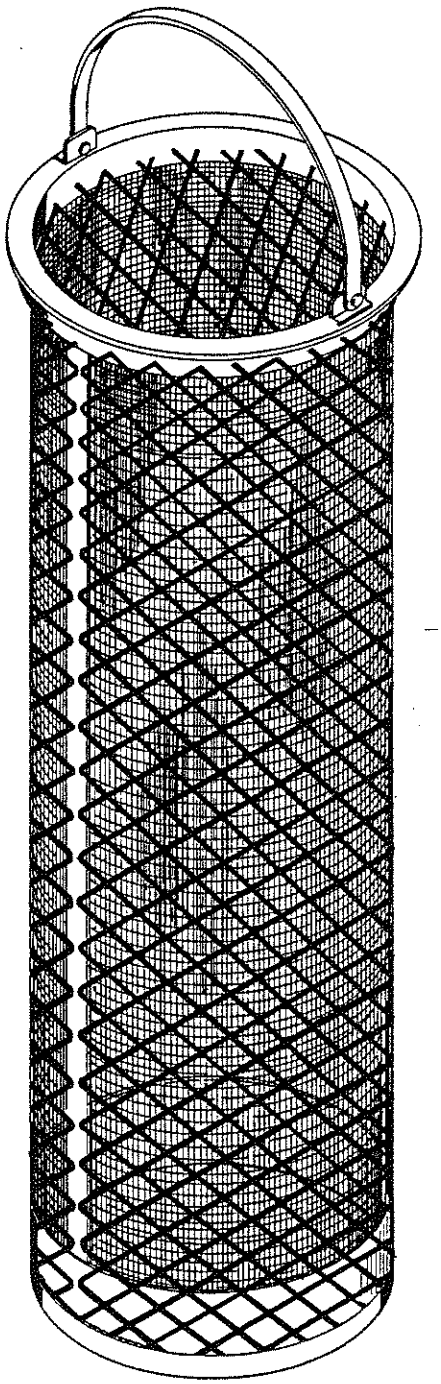


FIGURE 1



9

FIGURE 2

Located under the Hydraulic Tank Inspection Plate, are two return line Hydraulic strainers. These metal screen strainers are approximately 9" x 24" and are to be removed and cleaned on a 500 hour basis.

L-90 LUBE CHART

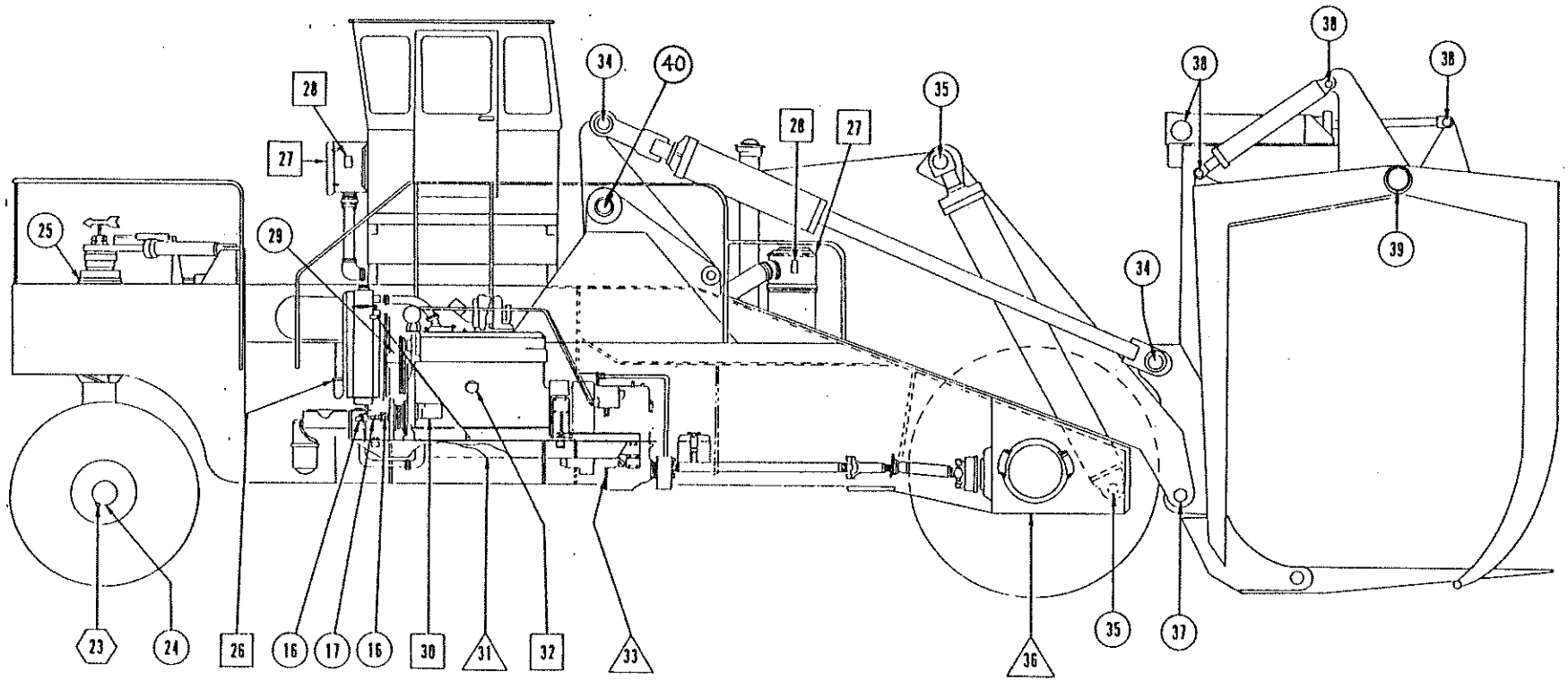


FIGURE 3

Wagner
a division of allied systems company

GENERAL MAINTENANCE TIPS

INTRODUCTION

WAGNER originated and manufactures a wide range of heavy lift equipment. Included among many other models are the LUMBERJACK Log Stacker, the CHIP CARRYDOZER and COAL CARRYDOZER, the PORT PACKER and PIGGY PACKER, and the STEEL WORKER.

Each WAGNER machine owned by your employer represents a substantial capital investment, and your management gave it a great deal of thought before making their decision. The WAGNER was selected for its proven record of high availability and for its productivity in your operation. These two points of availability and productivity depend largely on the maintenance crew, and that means you, a good capable mechanic with sound judgment.

WAGNER machines were designed with the mechanic in mind; they are constructed with standard components we are all familiar with. We know that our machine is simply another tool to help get your job done and the prosperity of your operation depends on it doing that job. Because we also know the responsibility of keeping your WAGNER machines working falls on your shoulders, we have prepared this guide to help you meet the challenge.

First, we have to realize that even though these machines are especialy designed for their different jobs, they all share certain systems and needs for basic maintenance, so we are going to take a few minutes to explain some of the basic maintenance procedures common to all these heavy lift machines.

PARTS AND SERVICE DATA

Your best friends in doing basic maintenance are the Parts and Service Manuals that came with your machine, and the Service Bulletins that you receive periodically. These manuals give you the details of each system in your machine including locations of filters, drains and miscellaneous lubrication points. Even though your heavy lift equipment is available with a choice of engines and transmissions, your manual provides the manufacturer's own documents for the exact options you have ordered.

Every machine we produce at WAGNER is treated like it was unique, yet it is a standard production model. The minute it comes off the assembly line, your particular unit becomes the subject of a

complete and running history kept in our files at the factory and at out dealers locations. Every machine has its own file folder describing the entire machine and all its components to help give you fast and accurate parts and service information. To help the dealer give you this special attention, we would like to emphasize that it is vitally important for you to give him the correct model and serial number for your machine when requesting parts or service.

You will find this information in two places; on a plate assembly mounted on the left side of your cab cowl and on the Master Check Sheets of your Parts Manual and Service Manual. Be sure to copy it correctly and keep the information handy to your telephone for ordering from your local dealer. He will provide you with normal and emergency phone numbers.

GENERAL LUBRICATION

Just above the Serial Number Plate you will notice a lubrication plate. It is a handy reminder for the first step of your basic maintenance program: LUBRICATION. And for easy reference we have provided the same information in your Service Manual. When your machine is delivered it has been serviced with top quality lubricants, and any major brand can be depended upon to provide good results. Whatever brand you prefer, be sure that your vendor supplies lubricants with equal specifications. The wrong substitute may cause premature wear throughout your machine.

General lubrication of your WAGNER heavy lift unit is mostly a matter of common sense. Once you become familiar with your unit your good judgment will guide you.

Here are some helpful lubrication tips. First, you should always be safety conscious when lubricating the highest fittings on your machine, such as the Lumberjack's holddown and kickoff arm pivot points. Before lubricating these points, you should lower these high components as close to the ground as they will go. You should also relieve the pressure from these cylinders and the anchor pins by resting the carriage on the ground to allow them to receive adequate grease. When lubing these high points, take care to use the railings provided for you.

You will also notice that several pivot points on your unit may not be equipped with grease fittings such as the throttle linkage ball joints, emergency brake linkage, and so on. To reduce wear, these points should have a drop or two of oil periodically. In all lubrication questions, go back to your lubrication chart in the Service Manual and bulletins for complete details.

FILTER MAINTENANCE

While there is nothing very complicated about general lubrication, filters in particular, tend to be "out of sight, out of mind", and are often overlooked with resulting serious damage. We realize you will not be working under ideal conditions -- so take the precaution of making sure your filters are clear of dirt and possible contamination when changing them. There are five critical filter areas to be concerned with, the hydraulic tank screens, hydraulic return filters, engine oil filters, transmission filters, and finally, the air cleaners. Proper care of all these filters is essential to a good basic maintenance program.

Starting with the hydraulic tank screens, let's see what proper care means. You will find these screens in the hydraulic tank on the right side of your machine under a hinged section of the catwalk. All the oil returning from your unit's hydraulic system passes through these screens and they should be removed and checked every thousand hours.

Maintenance for these screens is done in four steps: First, remove the capscrews from the tank cover. Slide this cover to the rear so you can get at the screens. Second, grasp the lifting bail on the screen and slowly lift it out of the tank. This is the time to visually inspect the screen for contamination or damage to the mesh. Third, clean the screen by removing the inner section, flush it with fuel oil and blow it dry with compressed air. Return the screens to the tank and secure the cover. Make sure you get a tight seal.

Now let's look at the hydraulic return filters. These return filters are the full flow type, located in the return line next to the reservoir. Filter elements should be replaced periodically to prevent clogging. The system itself is designed to protect against the results of clogging, such as pressure build-ups or blowouts that can let all the impurities collected by the filter flow into the reservoir. Even though the bypass valves are meant to protect the system from pressure overloads, they offer no filtration and let all the impurities circulate freely. Therefore, filters should never be allowed to go unchanged beyond their service specifications.

The procedures for changing these filters are: First, place a suitable container under the filter to be changed capable of holding 20 to 25 gallons. Begin by loosening the square head center bolt and allowing the filter shell to drain. Now unscrew the center bolt while holding the filter shell. If you don't hold the shell, gravity will take over when the bolt is loose and

you will get an oil bath. Next, remove the O-ring and top gasket. Set them to one side. Remove and discard the old element. Disassemble the remaining gaskets and spring and thoroughly clean all the parts. Once you have everything clean, begin reassembling the return filter by placing the bottom gasket in position on the center bolt. Then place the center bolt itself in the filter shell. Insert the spring, bottom back-up washer, and bottom gasket, in that order. Insert a dry filter element, place the top gasket and O-ring into place. Carefully position the filter shell into the filter head, and finally, tighten the center bolt with a torque wrench to 20 foot pounds maximum. Before putting the machine back into service again, check the filter can for leaks while the machine is running. Most of the engines in WAGNER machines have a primary lube oil filter. Detroit Diesel engines have their filter mounted on the sidewall next to the engine, and the Cummins and Caterpillar oil filters are mounted on the engines. Procedures for changing all these filters are similar and we will use the Cummins as an example.

First, place a suitable container under the filter shell; remove the drain plug and let the oil flow out. Remove the hex head bolt and pull the shell off. Then remove the old element and discard it. Clean the shell as on other filters, then install a new factory filter element and seals and remount the shell on the engine. Be sure to put the drain plug back in. Finally, torque the hex head bolt to 25 to 35 foot pounds as indicated on the shell.

The Cummins diesel is also equipped with a secondary lube filter element, which is to be changed along with its primary filter. To change this secondary filter, first place a suitable container under the filter shell, remove the drain plug and allow it to drain. Loosen the clamps on top of the filter and remove the top cover. Now, remove the filter tension nut, then the filter element and discard it. Clean the filter shell with fuel oil and wipe it dry. Be sure all foreign material is out of the shell before installing a new element. Now install the new factory element, replace the filter tension nut and install a new gasket where required. Replace the top cover and drain plug and fill the engine with new oil.

It is vitally important to check your oil level twice after changing filter elements. The reason for this is that the new filters will absorb several quarts of oil as soon as you start up the engine and thus lower the oil level. To make sure you have enough oil, start the engine and idle it for 2 to 3 minutes, then shut the engine down and recheck the level. Now go through the check once more, starting the engine and letting it idle and then shutting down to make certain of the oil level. You should also check all oil filters for leaks.

For all engines, check the oil level with the dipstick daily. Drain the crankcase and change the filters every 250 hours for maximum life and efficiency.

The transmission filters on WAGNER machines are full flow with replaceable elements held in the filter shell by a hex head bolt on the bottom. You begin replacement of the elements by placing a suitable container under the filter, removing the hex head bolt and allowing the oil in the shell to drain out. Now remove the filter shell and discard the element. Clean the shell with fuel oil and dry with a cloth or compressed air. Replace the O-ring gaskets in the filter head, install a new element, then press the shell and element assembly into position and tighten the bolt to 55 to 65 foot pounds of torque. Last, start the engine to operate the transmission oil pump so you can check for leaks and check the transmission oil level.

Here are a few general tips for dealing with filters; whenever it is possible, fill the filter shell and new element with clean oil of the proper type to shorten the time it takes to prime the system. When servicing filters, replace any gaskets that show signs of wear. Some gaskets and O-rings can be used only once, due to distortion caused by pressure.

The last type of filter we are going to cover is the air cleaner. If an air cleaner or intake system is clogged and not doing its job, extensive ring and cylinder wear can result under severe conditions in just a few hours. So it is important to see that they are functioning properly. Your own operating schedule and dust conditions will determine how often you should service the air cleaner and intake system. You should make a habit of visually checking the entire intake system for dirt and leaks when servicing the air cleaner. All WAGNER units are equipped with dry type of air cleaners. By using the restriction indicator, sometimes called the service gauge, you can tell at a glance the condition of the filter element. Anytime the service gauge shows red you should investigate the air cleaner. We recommend daily inspections of the air cleaner, but in severe dust conditions, we must emphasize that once a day may not be enough. If you have the Donaldson type air cleaner, the dust cup should be emptied when needed as a normal part of an air filter inspection.

COOLING SYSTEM

Now we can go from filters to some other basic maintenance tasks. The cooling system in todays diesel engines requires little maintenance, and you need to follow only three pointers. One, keep the radiator filled. Be sure you remove the cap only after

the engine has stopped and cooled down. The system is pressurized - and loosening a cap with the engine running could result in burns. Second, keep the water pump belt at its correct tension. Third, keep the radiator core clean and make sure that antifreeze has been installed during freezing weather. You can find more information on engine cooling systems in your Service Manual.

AXLES

The axles of your WAGNER machine should be checked periodically for lubrication in the differentials and planetaries. To do this, slowly roll your machine until the planetary oil level plug is in the proper position and check the oil. Then remove the oil level plug in the differential and check its oil level. Your service manual or the lubrication placard will tell you everything you need to know about oil types, time between changes and so forth.

WHEELS AND TIRES

Next is the wheel and tire maintenance, because they are not usually given the recognition they need; lets see just how important they are from the assembly line on out to your service conditions.

Before the wheels are installed all studs and locknuts on the axle are checked for proper torque. The outside diameter of the pilot hub and bounce ring is miked on each hub and the inside diameter is miked on each wheel to insure no more than 10 thousandths tolerance overall. That means it can be out no more than 5 thousandths on both sides of the wheel, not 10 thousandths on each side. This is necessary to carry your machines weight properly and eliminate excessive stress on the mounting studs and nuts. Next, the wheels are mounted on their hubs and the nuts torqued up to specifications (found in Service Manual). During final inspection the stud nuts are rechecked for proper torque. It is extremely important that studs not be overtorqued.

When you receive the new unit, it is important to visually check for loose and missing studs or nuts twice every day for the first four or five days of service. Check these studs and nuts for proper torque every 50 hours for the first two weeks. You should always use a torque wrench on these studs and stud nuts, since an overtorqued nut will stretch the stud and eventually break it, or nuts can become stripped.

A torque wrench can avoid the process of one man checking the nut until it moves, the next man tightening it until it moves some more, and finally, the last man ending up with a broken stud and wondering why. Remember, every time you tighten the nut down, it pulls the stud a little bit tighter and stretches it a little bit farther. A stud only has so much give before it breaks, and a torque wrench is the only tool that will let you know for sure what you are doing.

In the event you ever have to remove a wheel, you should center punch a reference mark on it and the hub, so you can remount it in the original position. Be sure both mounting flanges on the hub and wheel are clean so a positive fit can be obtained when remounting. If you ever have to replace an axle hub or wheel, both should be miked as in the factory, even if this requires the rental of inside-outside micrometers. The cost will be more than justified by longer wheel and stud life. Your Service Manual will give you more information on wheel care and inspection.

The tires on our heavy lift machines are designed to operate with a certain sidewall deflection, or bulge. Proper inflation is very important to tire life. An underinflated tire flexes excessively every time you turn the wheel, which generates high internal heat and causes premature failure. Overinflation causes excessive center tread wear. A correctly inflated tire permits all the tread to contact the ground and insures proper operation and maximum life. All your recommended tire pressures are cold readings. Hot pressures, taken while a tire is in use will not give you the proper reading. Maintenance pressure checks should be taken only when the machine has been idle long enough for the tires to cool down to the surrounding temperature.

HYDRAULICS

Lets examine one of the most important systems in any WAGNER heavy lift machine - HYDRAULICS. Your unit employs the most advanced principles of hydraulic engineering. Instead of using the old single function hydraulic circuits -- ones that use a single pump for each separate function and have no way of contributing their spare power to other functions, our system employs three pumps, each having a primary function and one or more secondary functions.

When any pump is not being used for its primary function a control valve diverts the oil to the secondary function instead of just returning it to the reservoir as in the single function system. When all our functions are operating, the power is divided up like this: On Lumberjacks the hydraulics are divided into three basic systems. Whenever a steering pump's power is

not being used for its primary function, it is diverted to the hydraulic system. It has many advantages over the single function system, one, for example, is greater effeciency. Hoisting can be done much faster with the combined power of three pumps than it could with a larger single pump. Also, because of the multiple relief valves in the "power beyond" system, it provides greater protection for pumps, valves and hoses.

For further protection, your unit is equipped with circuit relief valves in the circuits themselves. These also function when the circuit control valves are not being operated. This advanced hydraulic design is not complicated and will be easy to work with by keeping this one principle in mind: Because the circuits are interconnected, any problem that shows up downstream may be caused by a malfunction upstream. Therefore, solving any problem depends on following your checks and pressure settings in a logical sequence beginning upstream at the highest pressure and going downstream to the lowest pressure. Follow the sequence from upstream to downstream and maintenance is easy. Fail to follow it, and you are asking for problems.

The sequence begins at the steering valve, which is all the way upstream on all machines, and then, using the Lumberjack as an example, goes downstream to the hoist and tilt valve, the farthest downstream and the lowest pressure. You can trace the system on all machines by the schematics in your service manual. Be sure to check your service manual for the proper pressure settings on your unit. Keeping this in mind, gather all the tools you will need to test and adjust pressure settings on your machines.

You will need two end wrenches each of 9/16ths, 3/4 and 7/8th inch size. You will also need a medium flat head screwdriver, several rags and the pressure gauge provided with the units tool kit. You should have the gauge calibrated from time to time to maintain its accuracy.

Using the Lumberjack again as our example, testing and adjustment of pressure settings begins by starting up your unit and operating several functions to allow the hydraulic oil to warm up to operating temperature. Relief pressures will not be accurate if adjusted and set while the oil is cold.

We will begin pressure relief setting at the farthest point upstream, that is, at the highest pressure, which is the steering valve. You should first notice that it is operated by a slave cylinder that receives oil from the converter pump. Make sure the slave cylinder is operating, then proceed with setting the pressure relief on the steering valve. First, install a pressure gauge supplied in your units tool kit. Install it on the quick

disconnect. Bottom the steering by removing the slave cylinder from the walking beam. Manually push or pull the walking beam until the steering relief bypasses. With the engine at 1500 RPM adjust the steering relief valve to the pressure specified in your units service manual. The manual will give you proper settings and sequences to follow. Adjustment is made by removing the acorn nut, and loosening the jam nut on the relief adjusting screw, turn it clockwise to increase pressure and counterclockwise to decrease pressure. double check relief settings at maximum RPM. Usually override should be only 50 to 100 psi over normal.

Now we go downstream to the Lumberjacks left holddown and kickoff valve. Install the pressure gauge on the quick disconnect located on top of the valve. Move the kickoff arms to their back position and hold until the relief bypasses. Now with the engine at 1500 RPM, set it to the specified pressure in your manual the same way you did the steering valve.

The right holddown and kickoff valve is adjusted in the same manner. Install the pressure gauge and follow the procedure used for the left hand valve.

At the downstream end of the system you will set the hoist and tilt valve. You will notice that it is not equipped with a quick disconnect. Instead, on top of each junction manifold is a hex plug. While raising the boom, shut down the engine and keep the hoist lever open, this will cause the hoist cylinder to partially cavitate, allowing you to remove the hex plug with no oil present. Now, remove the hex plug from the downside hoist manifold and install a 90 degree O-ring adapter, supplied with your units tool kit. Install a quarter inch hose which has a quick disconnect on the other end, and snap on the pressure gauge. Move the hoist control lever to bring the hoist up or down to its highest or lowest position and hold until the relief bypasses. With the engine at 1500 RPM adjust it to the specified pressure just as you did on the other valves. Remove the pressure gauge and adapter in the same manner as you installed it and no oil will be present.

On units without loadlocks, push the hoist lever forward until the cylinders fully retract and shut the engine off. Remove the gauge plug on the stem end manifold block. CAUTION: DO NOT remove the base end manifold gauge plug with hoist cylinders extended on units without loadlocks or be prepared for an oil bath!

On early units with the air assist system you relieve the pressure by moving the control lever in both directions while the engine is off.

Now, lets move on to the circuit relief pressure checks. All reliefs are preset at the factory, however, they can be set on the machine in the following manner. You must raise the main pressure relief higher than the specified circuit relief setting. Install your pressure gauge. Screw the main relief adjustment clockwise several turns without bottoming in the same manner as described for setting the operating pressures. DO NOT BOTTOM any relief at any time or complete destruction of the pump can result!

There are circuit reliefs on each port of the holddown and kickoff valves and one each on the downside of the hoist and tilt. Operate each function until the main relief bypasses either on the stem or anchor end of each cylinder. Slowly raise the main relief until it no longer reads higher than the specified circuit relief setting which should be about 2300 psi on all circuit relief except the tilt on some models that specifies 950 psi and 1050 psi on base end of cylinder.

If the pressure is not right, adjustments can be made by adjusting the circuit relief valves on both ends of each spool of the kickoff and holddown valves, as you did all the other relief valves, clockwise to increase, counterclockwise to decrease. Parker and Commercial valves use shims to control the pressure bypass. Most thin shims raise or lower pressure about 50 psi and thick shims approximately 300 psi. In an emergency a 1/4" flat washer raises the pressure about 600 psi. You have now completed your pressure settings. Remember, the same basic principles apply to all WAGNER heavy lift machines, whether the Lumberjack or most other members of this large family.

Here are a few tips in case you should run into problems completing these pressure settings; If you should find a valve that will not adjust to the recommended relief pressure, either the relief valve assembly or the pump may be malfunctioning and should be corrected before proceeding further downstream. Make sure your control system is functioning properly. Check for loose oil cylinder clevises, pinched oil lines, sticky valve spools or loose valve tie bolts. You will also find pointers in the Service Manual listed under Pump and Mechanical Problems in Hydraulic Systems.

IN CONCLUSION ---

You have just completed a solid basic maintenance routine. Of course there are many more details you will have to work with to keep your machine in top condition, but this coverage of lubrication, filters, wheel and tire care and hydraulic pressure settings was meant to give you the essentials of a sound day to day maintenance program to be used along with common sense items like daily visual inspection of structure for cracks and broken parts, etc.

By now you realize the help your service manual and bulletins can be to you, but when the problems go beyond regular maintenance and you feel like you are in over your head, remember that you didn't just get a machine for your hard earned money, you also have the service of a strong dealer organization and WAGNER at your disposal twenty-four hours a day. We are no further away than your telephone at any time. Dial our number and you will get the fastest nationwide service there is.

We want the WAGNER heavy lift machine you use to be the best machine there is. Your good judgment and these tips we have just presented can make it the best and keep it that way.