

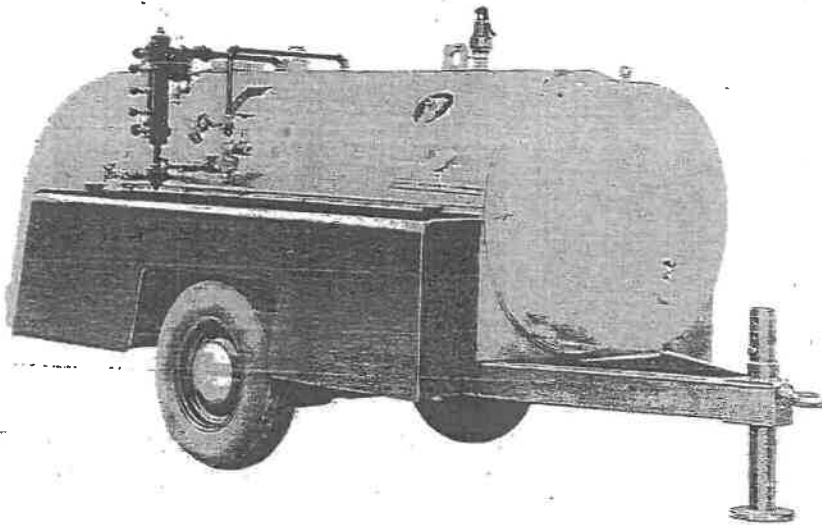
OPERATING INSTRUCTIONS

for

**MODEL PSM-50
PORTABLE STEAMER**

and

**MODEL PS-50
SKID-MOUNTED STEAMER**



Cleaver  **Brooks**

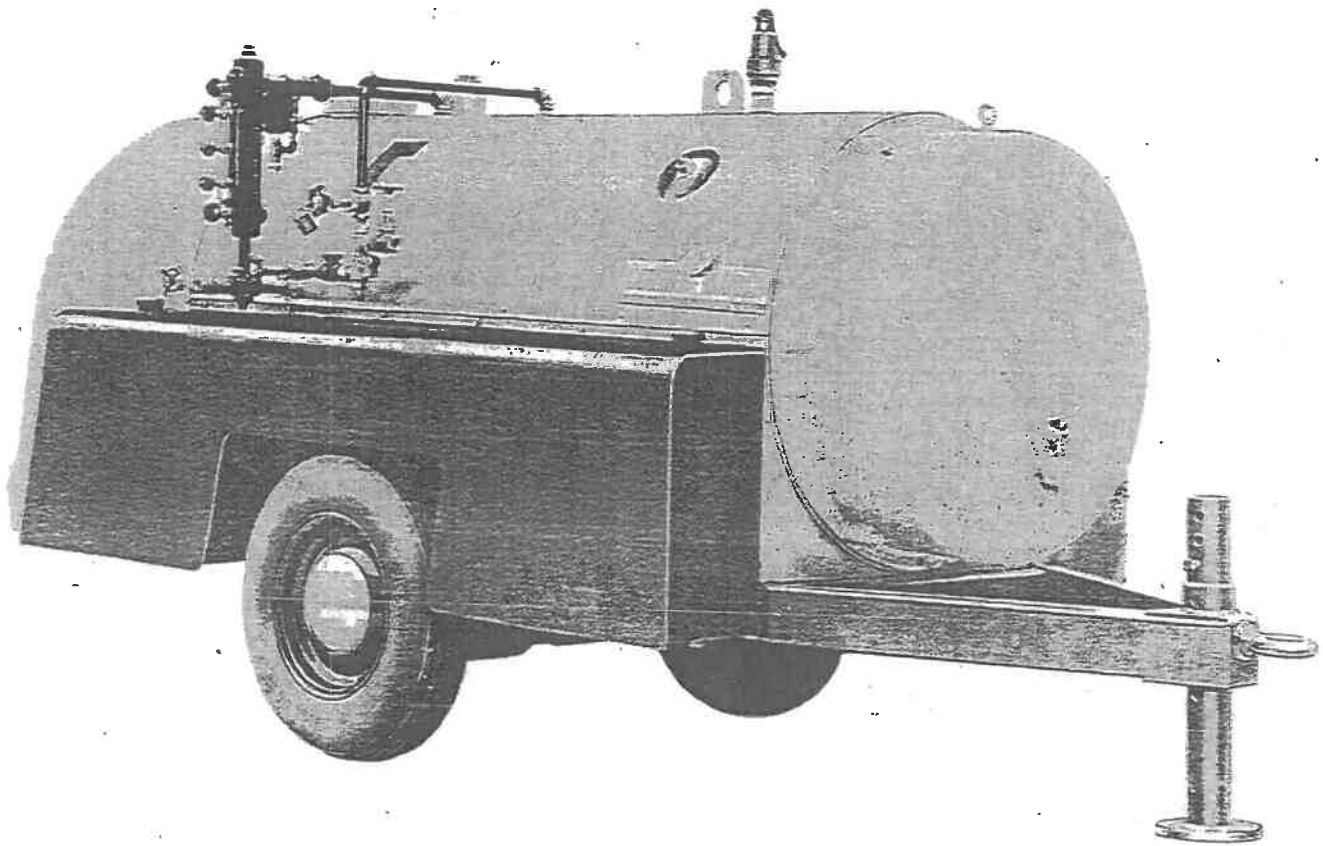
DIVISION OF AQUA-CHEM, INC.
Milwaukee, Wisconsin 53201

Service and Parts Coast to Coast
Boilers and Accessories for the Complete Boiler Room

MANUAL PART NO. 750-58

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TYPICAL PSM-50 UNIT

GENERAL DESCRIPTION

The portable steamer is a compact trailer, boiler and burner assembly designed and equipped for mobile use. The boiler is constructed in accordance with the A. S. M. E. Power Boiler Code. The boiler receives insurance inspection prior to shipment and an inspection certificate is furnished purchaser.

BOILER

The boiler is a four pass horizontal firetube arranged for updraft gas travel. The maximum steam working pressure is 150# sq. in. gauge. The steam producing capacity is 50 Boiler horsepower or 1725# steam per hour. The exposed section of the boiler shell is insulated with 2" fibre glass insulation which is protected by 16 gauge sheet metal lagging.

BURNER

The burner is a 3 nozzle pressure atomizing type with individual nozzle control. The fuel oil required is Commercial Standard #3 or lighter grades. The maximum burning rate is 17 GPH @ 175# atomizing pressure. Combustion air is supplied by a built in centrifugal blower.

TRAILER

The trailer upon which is mounted the boiler, water, fuel oil and gasoline tanks and burner equipment is fitted with a towing hitch and a leveling leg for leveling boiler during operation. The two wheeled trailer has 7:50 x 16, 8 ply grooved implement type tires for inflation to 44 pounds. The trailer is designed for a speed of 20 miles per hour.

In describing equipment and referring to its location in the general assembly, the front of the unit has been taken as the towing hitch end.

- A. Lubricating Fitting (Main Fan Shaft)
 - B. Three Way Valve (Water)
 - C. Priming Cup (Boiler Feed Water Pump)
 - D. Valve, Shut-off (Priming Cup)
 - E. Drain Cock (Boiler Feed Water Piping)
 - F. Engine Hand Crank
 - H. Engine Crankcase Breather
-
- 78. Valve, Main Oil Shut-off
 - 114. Gauge, Pressure, Steam
 - 120. Damper, Secondary Air
 - 127. Gauge, Pressure, Feed Water Pump
 - 139. Pump, Boiler Feed Water
 - 174-1. Nozzle Shut-off Valve
 - 174-2. Nozzle Shut-off Valve
 - 174-3. Nozzle Shut-off Valve
 - 176. Gasoline Engine
 - 202. Fuel Oil Unit
 - 806. Water Strainer (Feed Pump)

Figure 1 – Operating End View

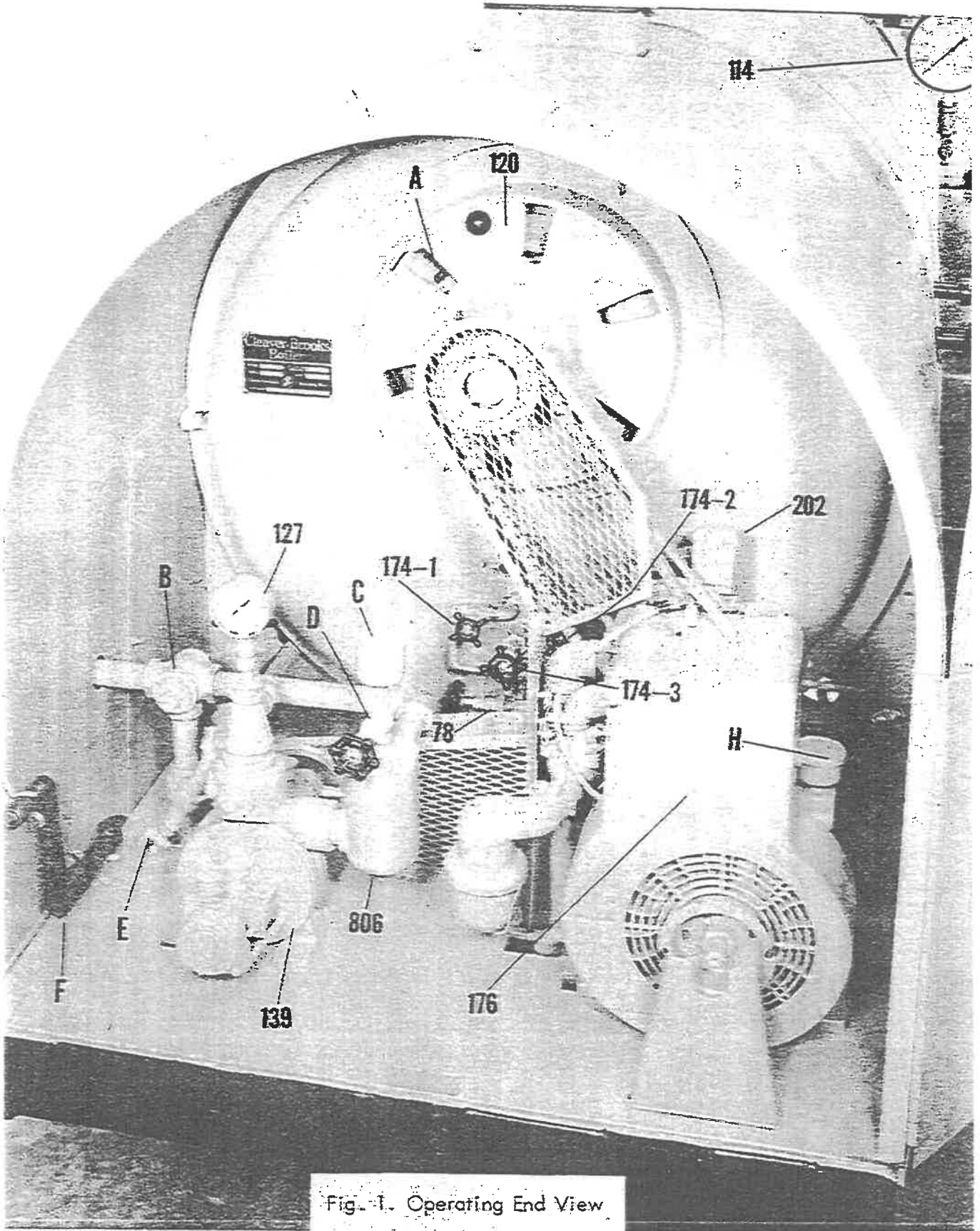


Fig. 1. Operating End View.

- B. Three-Way Valve (Water)
 - C. Priming Cup (Boiler Feed Water Pump)
 - D. Valve, Shut-off (Priming Cup)
 - E. Drain Cock (Boiler Feed Water Piping)
 - R. Engine Air Cleaner
 - S. Engine Stop Switch
 - T. Lighter Hole
-
- 78. Valve, Main Oil Shut-off
 - 112. Gauge, Pressure, Burner Fuel Oil
 - 127. Gauge, Pressure, Feed Water Pump
 - 139. Boiler Feed Water Pump
 - 174-1. Nozzle Shut-off Valve
 - 174-2. Nozzle Shut-off Valve
 - 174-3. Nozzle Shut-off Valve
 - 176. Gasoline Engine

Figure 2 – Operating End Details

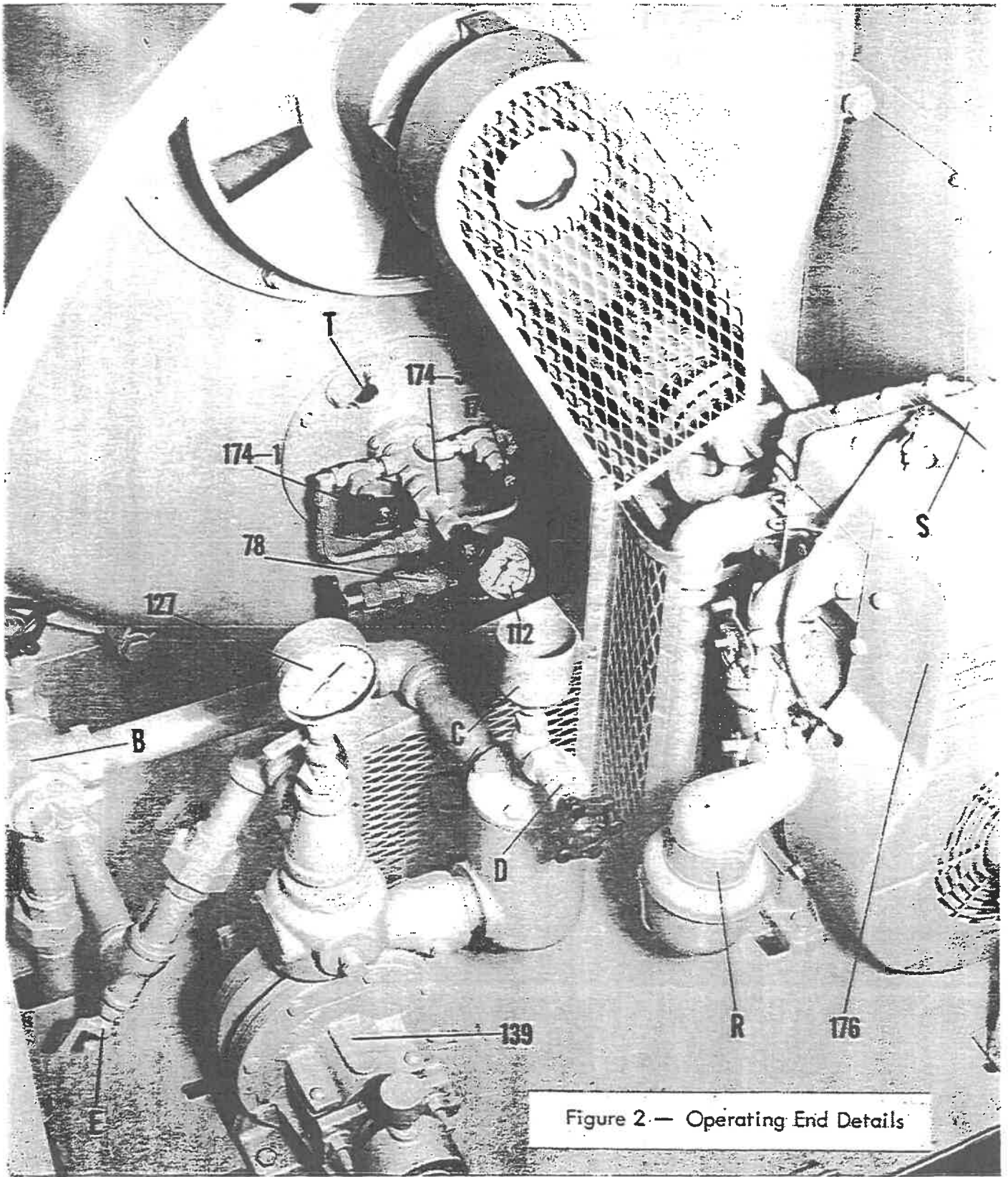


Figure 2 — Operating End Details

- 86. Valve, Pop Safety
- 96. Valve, Blowdown, Glass Gauge
- 97. Valve, Blowdown, Water Column
- 106. Cock, Gauge Glass Shut-off
- 114. Gauge, Pressure, Steam
- 116. Gauge, Water Level
- 128. Column, Water
- 129. Try-Cocks
- 130. Injector
- 159. Valve, Injector Water Supply
- 162. Valve, Discharge Injector
- 164. Valve, Injector, Steam Supply
- 258. Valve, Check, Injector

Figure 3 – Water Column and Injector Details

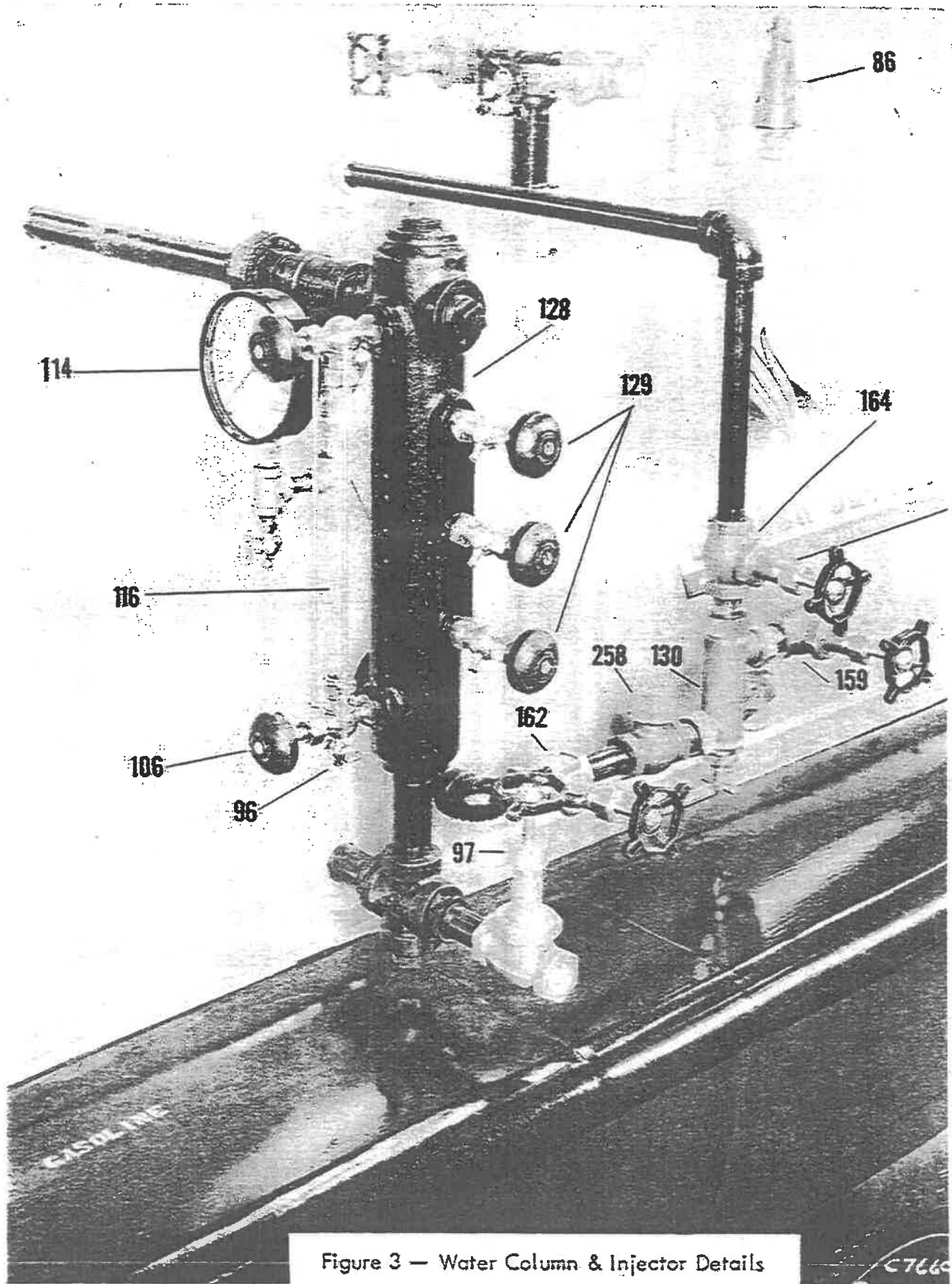


Figure 3 — Water Column & Injector Details

OPERATING INSTRUCTIONS

Refer to identification photographs, schematic flow diagrams and engine instruction manual.

PREPARATION FOR OPERATION

In preparing the steamer for operation these points must be given attention:

1. Tires must be inflated to 44 lb air pressure. The heater unit is designed for towing speeds of 20 mph with boiler drained.
2. Level heater through adjustment of front support leg.
3. Fill the boiler, tanks and accessories with liquids as follows. Close valves as required;

Boiler - clean water - approximate capacity to normal water line
168 gallons 1415 pounds.

On initial fill with cold water, fill to lower trycock which will give 1" of water in gauge glass. This water will expand when heated to normal operating water line which is 2-1/2" in gauge glass.

Water Supply Tank - (in right fender) - clean water - approximate capacity 45 gallons.

Fuel Oil Tank - (in left fender - front) - No. 3 Commercial Standard Fuel Oil or lighter - approximate capacity 45 gallons.

Gasoline Tank - (in left fender - rear) - regular grade gasoline - approximate capacity 8 gallons.

Engine Crankcase - SAE-20 for 32° F and above - approximate capacity 2-1/2 quarts. Fill to top of filler cap opening.

4. Make the necessary steam hose or piping connections to the heating or process load.

OPERATING INSTRUCTIONS

OPERATION

1. Open vent cap at exhaust gas outlet.
2. Close main oil shutoff valve (78) and nozzle shutoff valves 174-1, 2, & 3. Open shutoff cock in fuel oil suction line near tank outlet under trailer frame.
3. Open valve on gasoline filter assembly at gasoline tank outlet.
4. Refer to engine instruction book and start engine with hand crank. Engine will operate at factory governor setting of approximately 2550 R.P.M. This engine speed will drive air fan at approximately 3650 R.P.M.
5. Operate engine until thoroughly warmed. During this period fuel oil will flow to fuel unit (202) which will establish operating oil pressure of 100-110 P.S.I. indicated on oil pressure gauge (112). If pressure is not established pump is air bound. Relieve air by loosening air vent valve in pressure section of fuel unit. Use 1/4" Allen wrench (1/8" across flats) and open valve until a clear stream of fuel oil is visible at vent fitting. Close vent valve.
6. Check water level in boiler. With engine running at reduced speed close air damper (120) tightly. Soak lighter torch in fuel oil, ignite and insert through lighter hole (T). Open main oil shutoff valve (78) and nozzle shutoff valve (174-1). Burner now ignites at minimum firing rate. Remove lighter torch and raise engine speed to normal. Open air damper (120) just enough to clear vent pipe of smoke.
7. Operate burner at this minimum rate until vapor is visible at top trycock.
8. Increase burner firing rate by opening valves 174-2 and 174-3. Open one valve at a time and readjust air damper (120) with each valve opening to clear vent.
9. With normal operation established and boiler thoroughly warmed tighten all head bolts and handhole gaskets.

DESCRIPTION OF FUEL OIL SYSTEM

During normal operation the belt driven Fuel Unit (202) takes oil from the fuel oil tank, and delivers it to the nozzle assembly at the pressure indicated on the Burner Fuel Oil Gauge (112).

Principle parts of the system are, the tank, the fuel oil unit and the burner assembly. The tank holds 45 gallons of fuel oil. It is fitted with a vented fill cap and a drain cock; and is built into the fender of the unit.

Since the two stage fuel oil unit is connected for one pipe operation and runs whenever the engine does, its pump is equipped with an internal bypass to pump oil not used by burner back into the suction line. As pump capacity is greater than burner capacity there is always some oil by passed.

This fuel unit pumps in two stages; in the first stage oil is transferred from the tank to the unit and in the second stage the pressure is raised to that required for atomization. The fuel unit also contains a strainer assembly in the suction side and a pressure regulator and nozzle assembly in the discharge side. An air vent valve is furnished in the discharge chamber of pump to bleed pressure from suction line if necessary. (See (A) in Figure 4). The pump discharge pressure is controlled by the built in pressure regulating valve. Port (P) and Port (O) are plugged. Port (O) can be used for connecting a vacuum gauge for test purposes.

The oil burner assembly is a three nozzle pressure atomizing burner with a shut off valve (78) and individual nozzle shut off valves for adjusting firing rate. The normal operating oil pressure is 100-110 psi, as indicated on Gauge (112).

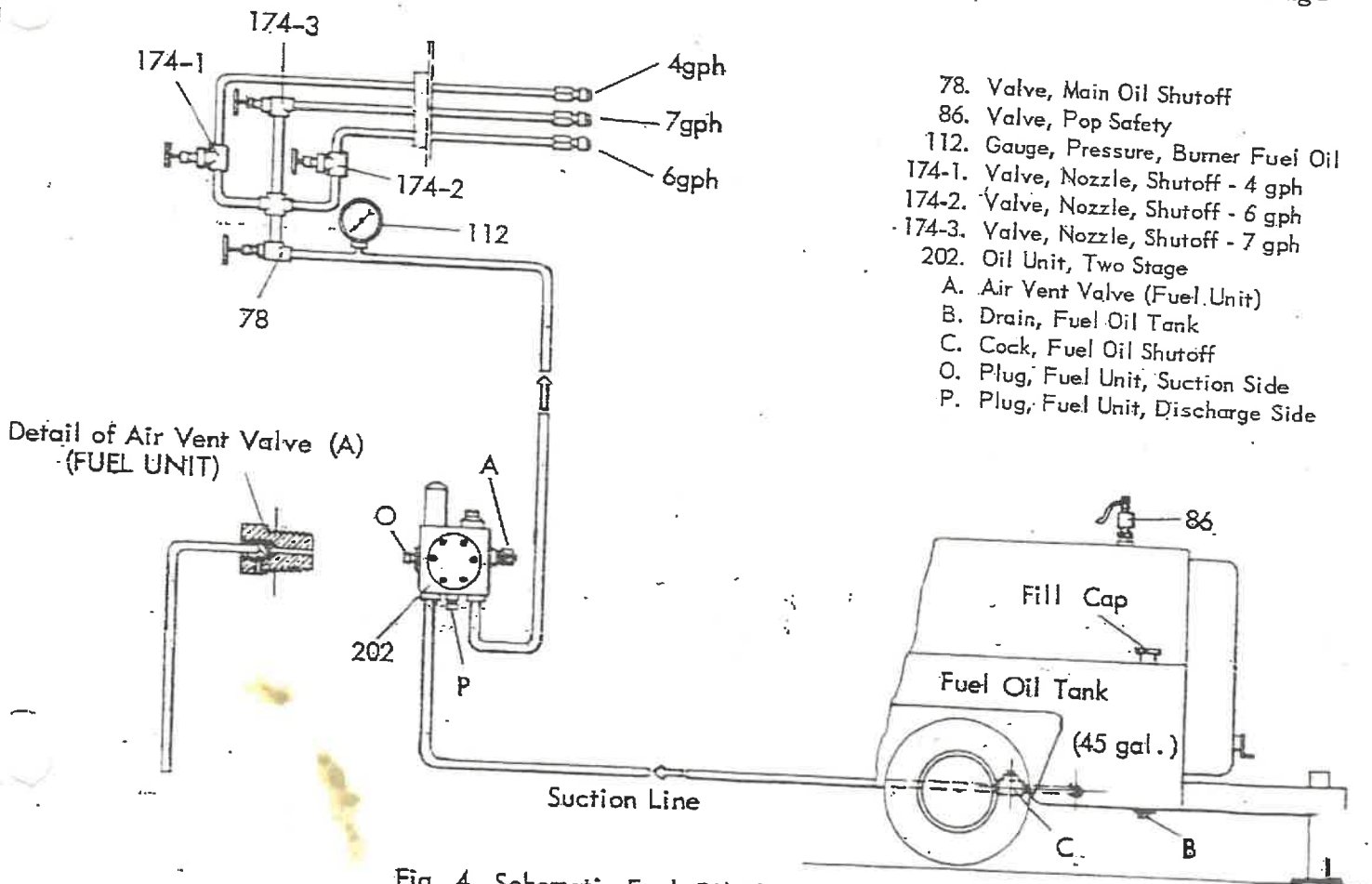


Fig. 4. Schematic Fuel Oil Flow Diagram

DESCRIPTION OF STEAM AND BOILER WATER SYSTEM

The Boiler Feed Water Pump (139) withdraws water from the source and delivers it at the pressure indicated by Gauge (127) into the boiler when Feed Water Shut-off Valve (158) is open. The pump is driven continuously by belt drive from the gasoline engine.

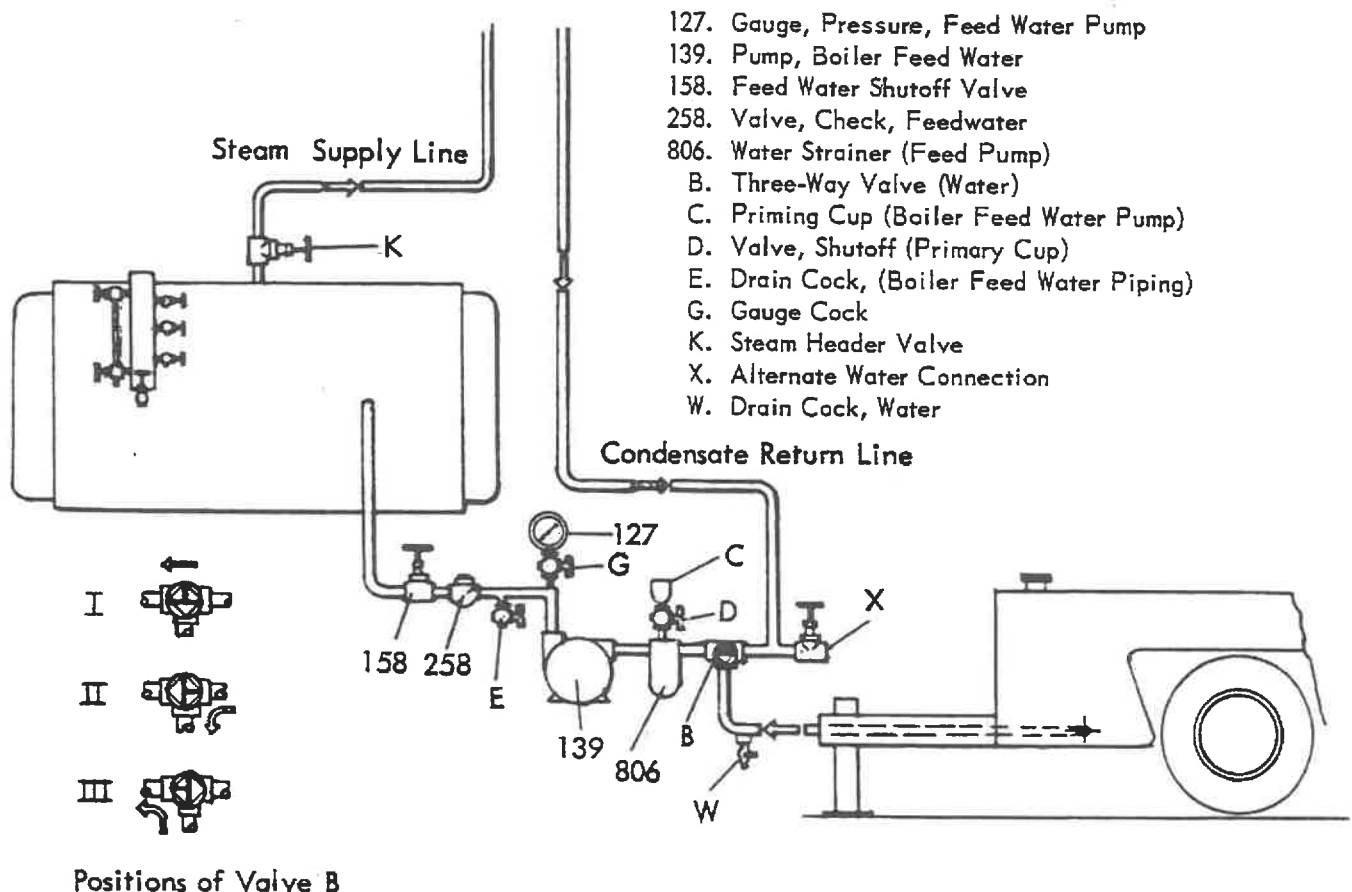


Fig. 5. Schematic Flow Diagram - Steam and Boiler Water

INITIAL FILLING OF BOILER WITH WATER - Fill fender tank with water, turn Three-Way Valve (B) to position #III, and open Drain Cock (E) until a stream of water is visible and then close. Now open Feed Water Shut-off Valve (158). The Priming Cup (C) is not used as tank water level is above pump center line. Start engine and continue pumping water into boiler until proper level is observed in gauge glass. Another method is to connect water source at Alternate Water Connection (X), turn Valve (B) to position #I and open Pet Cock (E) until water is discharged. If source is above center line of pump or pressurized no priming of pump is necessary. However, a valve must be installed in the condensate return line to prevent the flow of water in this line and the admission of air to pump suction.

SUCTION TYPE WATER FEED - When necessary to lift water from a source below center line of pump, priming is necessary. To prime open Cock (E) and Valve (D) and pour water into Cup (C) until water appears at (E). Close Cock (E) and Valve (D) and start engine. It is important that suction line to water source be tight and free of air leaks.

NORMAL OPERATION - During normal operation steam generated by boiler flows through Header Valve (K) and supply line to load where it is condensed and the resulting hot water is returned through condensate line. During this operation Valve (B) must be turned to position I so that condensate can be pumped into boiler. When boiler water line falls below normal operating level through loss of water in external heating system make-up water must be added to the system by turning Valve (B) to position III to shut off condensate system and draw water from the fender tank. As soon as operating water level is re-established, Valve (B) is again turned to position I to allow for normal return of condensate. Tank may be filled from a pressurized water system by connecting to (X) and turning Valve (B) to position II. **IMPORTANT:** Water tank Fill Cap must be removed to provide venting or tank will be damaged.

CAUTION!! Make sure that condensate does not contain oil or other foreign matter which will damage boiler. If contaminated, condensate must be discharged to waste. If portable steamer is subject to freezing temperatures it must be drained by opening all drain cocks.

BURNER MAINTENANCE INSTRUCTIONS

To remove the burner drawer assembly the following steps should be taken:

1. REMOVE BELT GUARD (Refer to Figure 6)
 - (a) Loosen top and left hand bolt holding top of belt guard to air damper. Because of close clearance a box wrench will facilitate loosening.
 - (b) Remove the two capscrews holding lower part of belt guard to base.
 - (c) The entire belt guard can now be twisted to the left and removed as a unit.
2. REMOVE BURNER DRAWER (Refer to Figure 7)
 - (a) Loosen 1/2" flare nut just to the right and below the burner oil pressure gauge (Item 112 Figure 2).
 - (b) Loosen and remove the six nuts and lockwashers which hold burner drawer assembly to front head.
 - (c) Lift up slightly on burner drawer to clear water pump drive belt and withdraw entire burner drawer.
3. ADJUSTMENT OF BURNER NOZZLE POSITION (Refer to Fig. 8 and 9)
 - (a) The nozzles must be mounted in the burner drawer in definite relationship to air diffuser. (Figure 9 shows the diffuser in place in the boiler furnace) In assembly at the factory the initial setting before fire testing is as indicated in Figure 9 i. e. , the distance from the tip of the nozzle to the burner drawer plate is 12-3/4". To adjust, loosen the three set screws (A Fig. 8) and slide the nozzles to the desired position. Lock in that position by tightening the three set screws.
4. DIFFUSER ADJUSTMENT (Refer to Figure 9)
 - (a) The diffuser is held in place in the firetube by means of three Allen head setscrews with locking nuts. In the event of replacement or cleaning of the diffuser it must be relocated in a definite position.
 - (b) To remove the diffuser, loosen the three locknuts and use an Allen wrench to loosen the three setscrews. The entire diffuser assembly can then be withdrawn.
 - (c) In reassembly position the diffuser by measuring from the front of the burner tube to the center of the diffuser. This distance must be 7-1/2" as indicated in Figure 9.

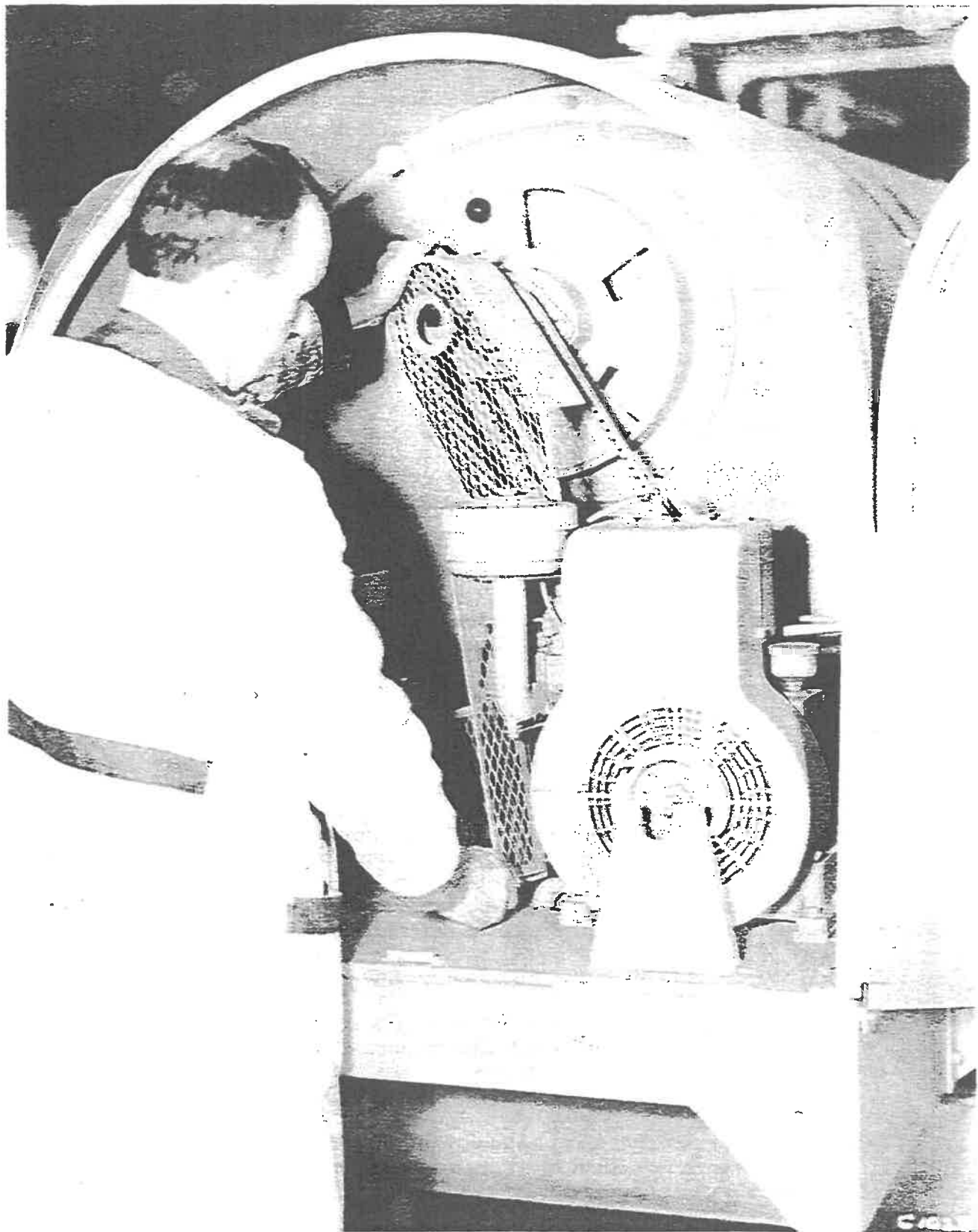
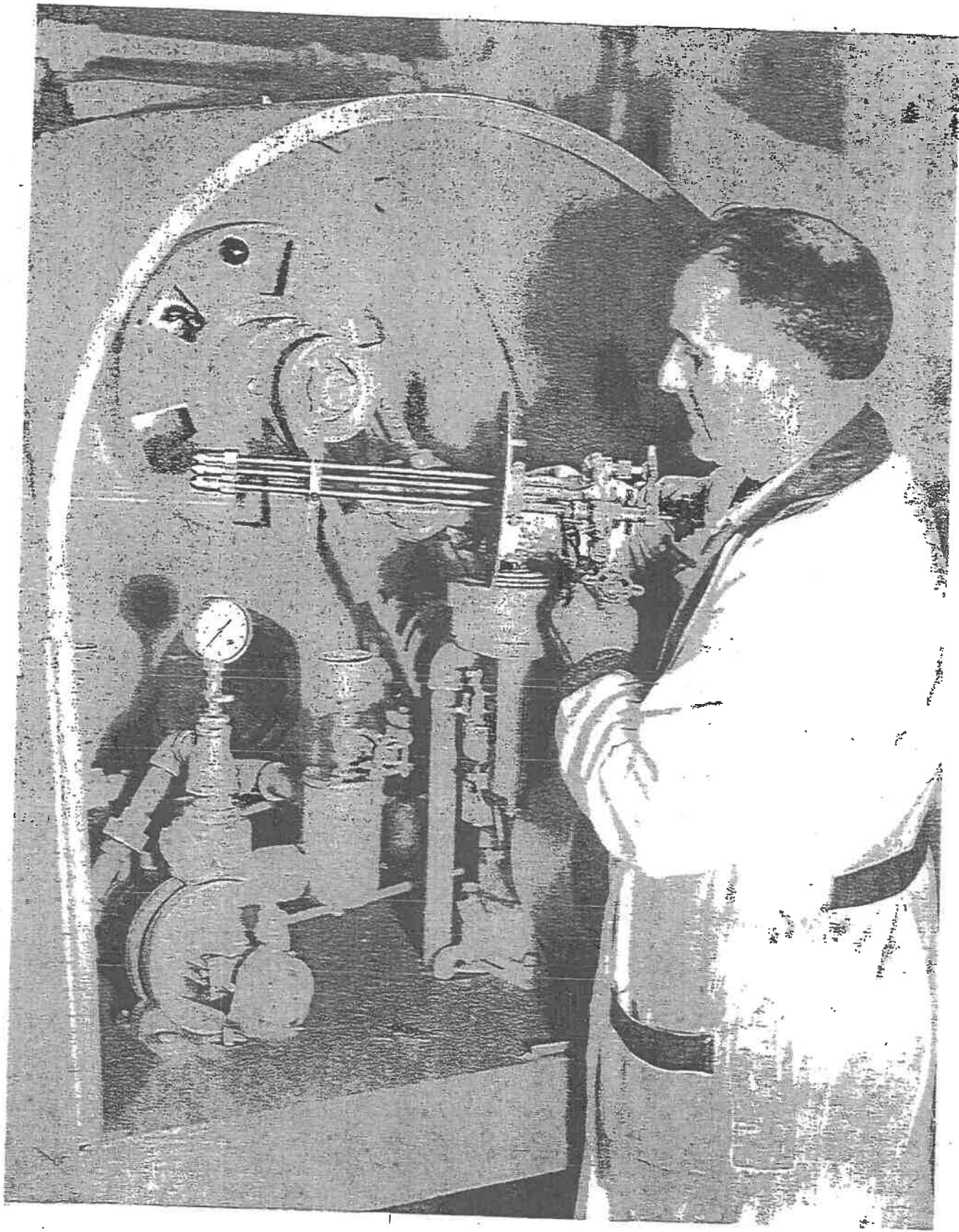


Fig. 6 - Removal of Belt Guard



Removal of Burner Drawer

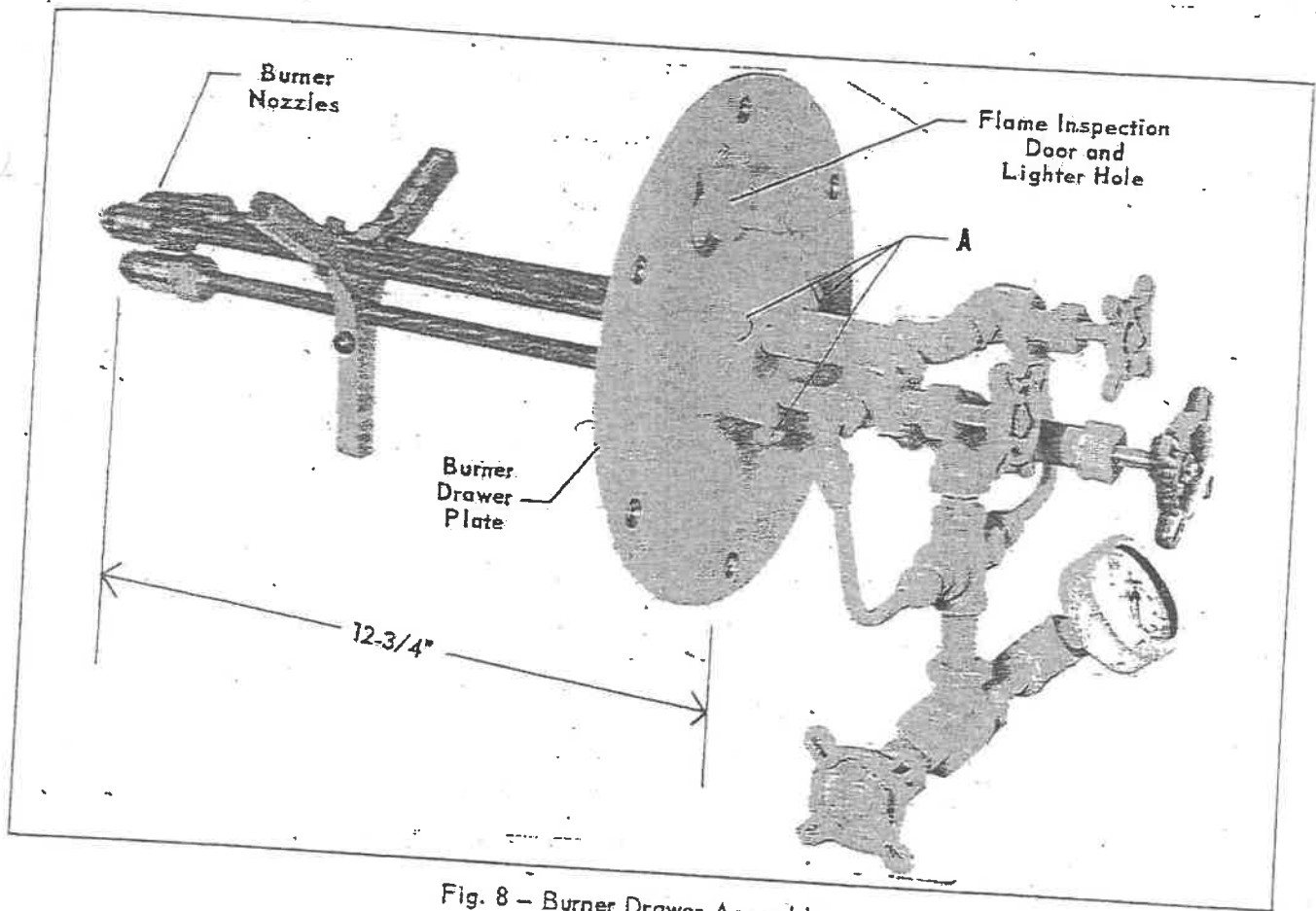
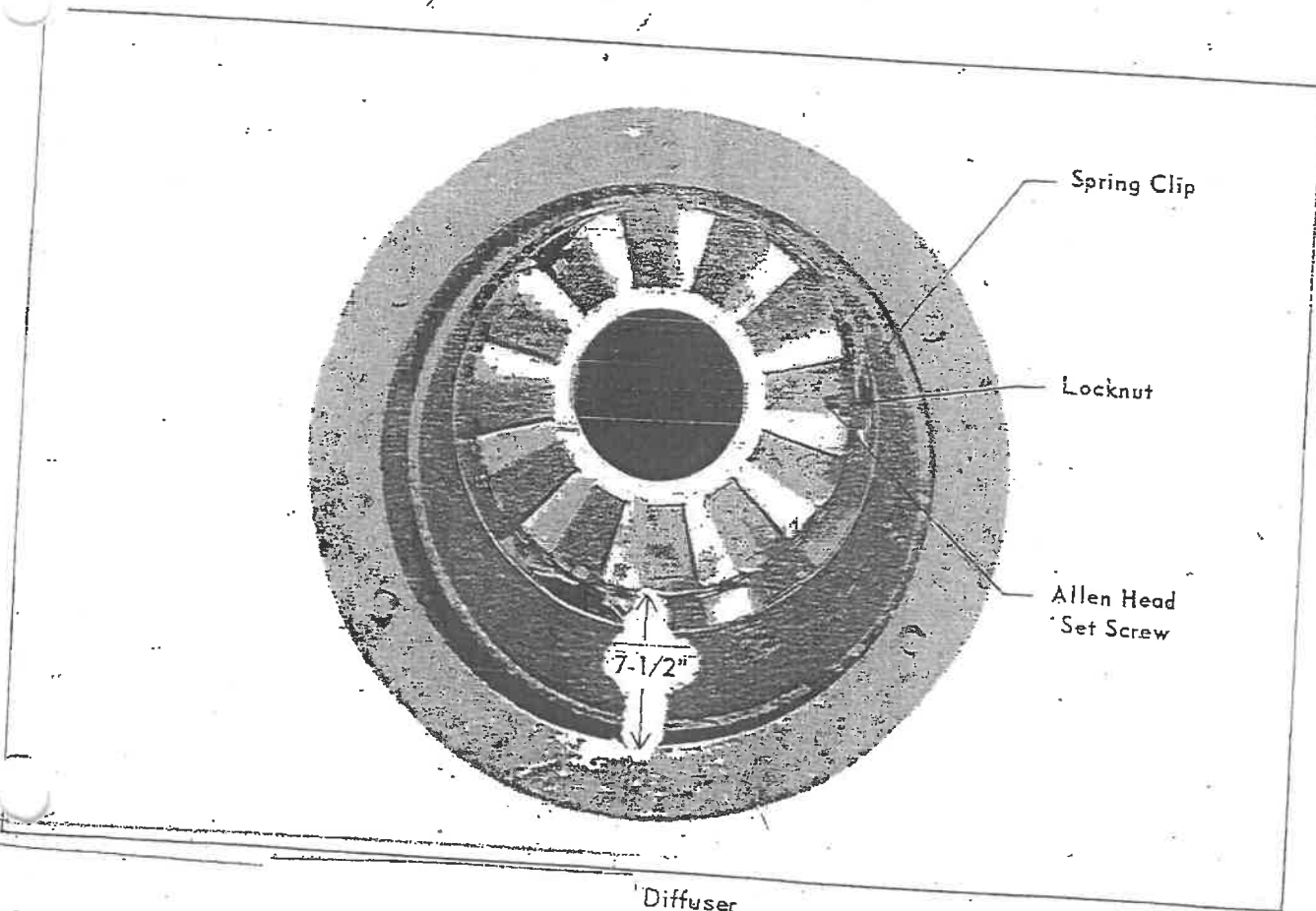


Fig. 8 - Burner Drawer Assembly



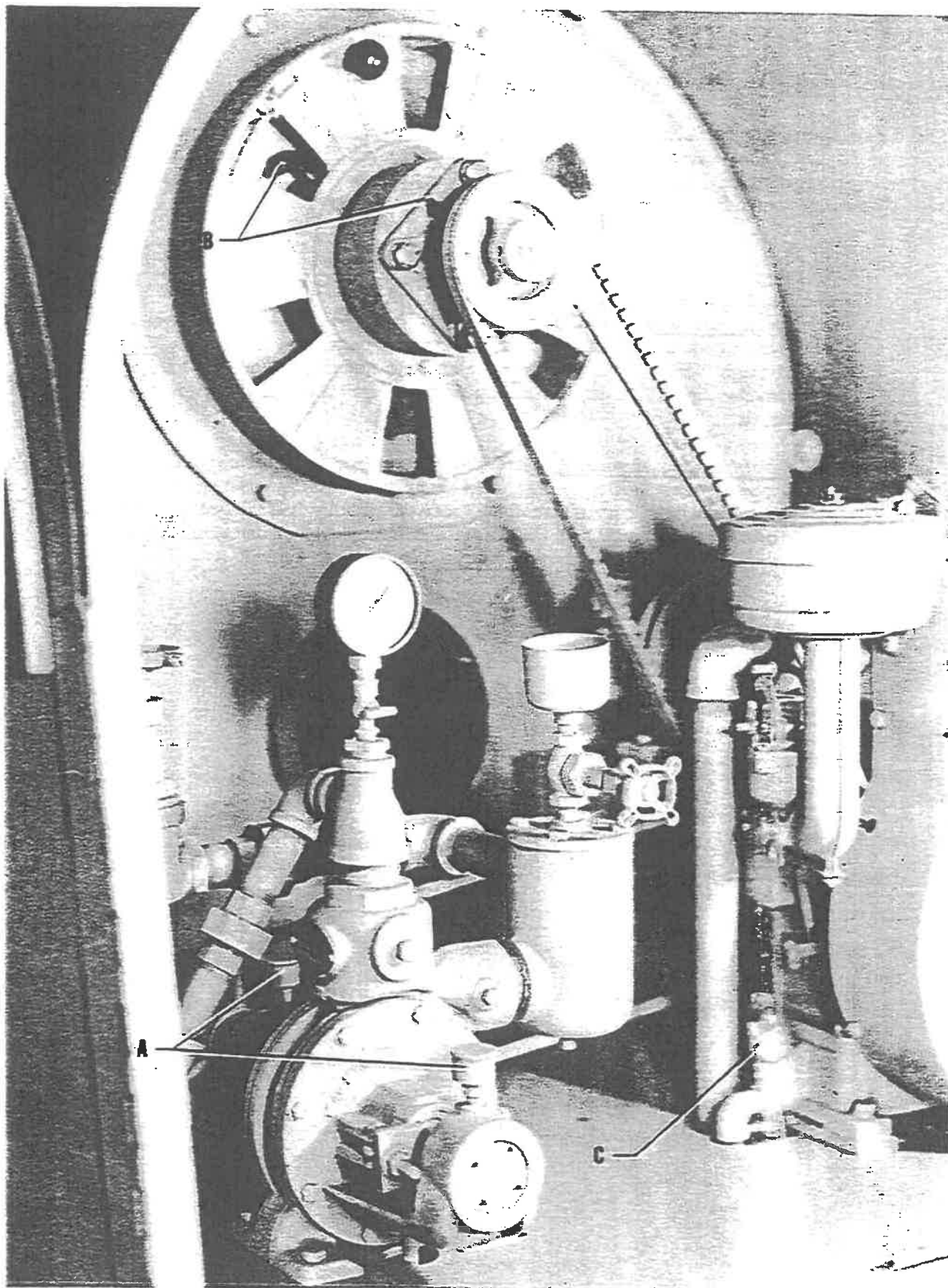


Fig. 10 - Lubrication Points

HOSE COUPLINGS

The hose coupling is illustrated in Fig. 11. Couplings do not require maintenance of any kind except to keep threads clean so that they can be easily closed and tightened. The locking nut is equipped with lugs as illustrated so that a hammer can be used to tighten.

LUBRICATION

(Refer to Figure 10)

- (a) Main Fan Shaft - Lubricate with approximately 1/2 ounce of soda soap ball bearing grease once per month. Apply Zerk fittings "B". It is advisable to disassemble the bearings approximately once a year and remove old grease and replace with fresh.
- (b) Water Pump Bearings - The water pump is equipped with two grease cups (See A, Fig. 10.) Approximately every 20 hours of operation the cup should be turned clockwise about 1/4 turn. When empty refill with a soft lime base grease similar to Standard Oil Company Superla No. 18 or equal.

OPERATING INSTRUCTIONS

OPERATING ADJUSTMENTS & CARE

1. Maintaining constant steam pressure.

The burner is a three nozzle unit equipped with a 4.0 gallon, 6.0 gallon and 7.0 gallon nozzle. Each of the three nozzle lines can be opened or closed with a nozzle shutoff valve. By the selection of one or more nozzles the oil burning rate can be adjusted to closely match the steam demand or load on the boiler.

Each time the oil burning rate is changed the air adjustment, damper (120) must be reset to just clear smoke at the vent pipe. Light smoke indicates too much air. Dark smoke indicates a lack of air. Do not open air damper beyond the point where the stack clears as this practice passes excess air through the boiler and wastes fuel with a reduction of steam output.

If fuel oil pressure adjustment is required unscrew slotted plug in pressure section of fuel unit and insert a 1/4" Allen setscrew wrench (1/8" across flats) and adjust for required pressure.

The boiler is a high pressure firetube type and requires the same thorough care as all firetube boilers. The water used must be clean and free of scale producing impurities or water treatment and more frequent waterside cleaning and inspection will be required. The pressure atomizing burner and the combustion air supply furnished is more than adequate for the designed output of the unit. If the air adjustment is neglected and the burner permitted to smoke an abnormal deposit of soot on the heating surfaces will be experienced. The gas velocities through the tubes is high and will keep the heating surfaces clean if the burner is operated at proper air and fuel adjustments. If an abnormal deposit of soot is allowed to accumulate on the heating surfaces it will be necessary to remove the rear head and wire brush the tubes to remove this deposit.

Adhere to boiler blowdown instructions as proper blowdown will reduce the concentration of solids in the boiler water and greatly reduce its scale forming ability.

This list of operating notes will aid the operator in quickly checking operating conditions.

DO

1. Carefully and frequently observe water gauge glass and steam pressure gauge during all periods of operation.
2. Inflate tires to proper pressure and operate unit in level position.
3. Maintain the normal operating water level of 2-1/2" in the gauge glass at all times.
4. Determine the quality and cleanliness of return condensate from heating load before it is fed into system.
5. Adjust burner to closely match steam load. The continuous blowing of the safety valve will cut valve life and waste water and fuel.
6. Keep adequate supplies of water, fuel oil, gasoline and lubricating compounds available at operating site.
7. Blow down boiler shell and drain gauge glass during every 4 hours of operation.
8. Close vent cap during periods when unit is not in operation.
9. Fire boiler at minimum firing rate on cold start until unit is warm and vapor is visible at upper trycock.

DON'T

1. Don't ignite burner unless water in gauge glass is within normal operating range.
2. Don't tow trailer at excessive speeds as this will seriously shorten tire life.
3. Don't dip lighter torch into fuel oil tank. Withdraw a small amount of oil and use open container for saturating lighter torch.
4. Don't open oil valves at burner unless the lighter torch flame is visible at lighter hole.
5. Don't feed contaminated condensate or makeup water into boiler water system. Discharge it to waste.
6. Don't pump liquids into tanks at high flow rates as the fill opening is the only venting source.
7. Don't neglect the operating and maintenance requirements of your equipment. The unit requires operating and maintenance attention to keep it in dependable condition and ready to start and finish your important jobs without interruption.

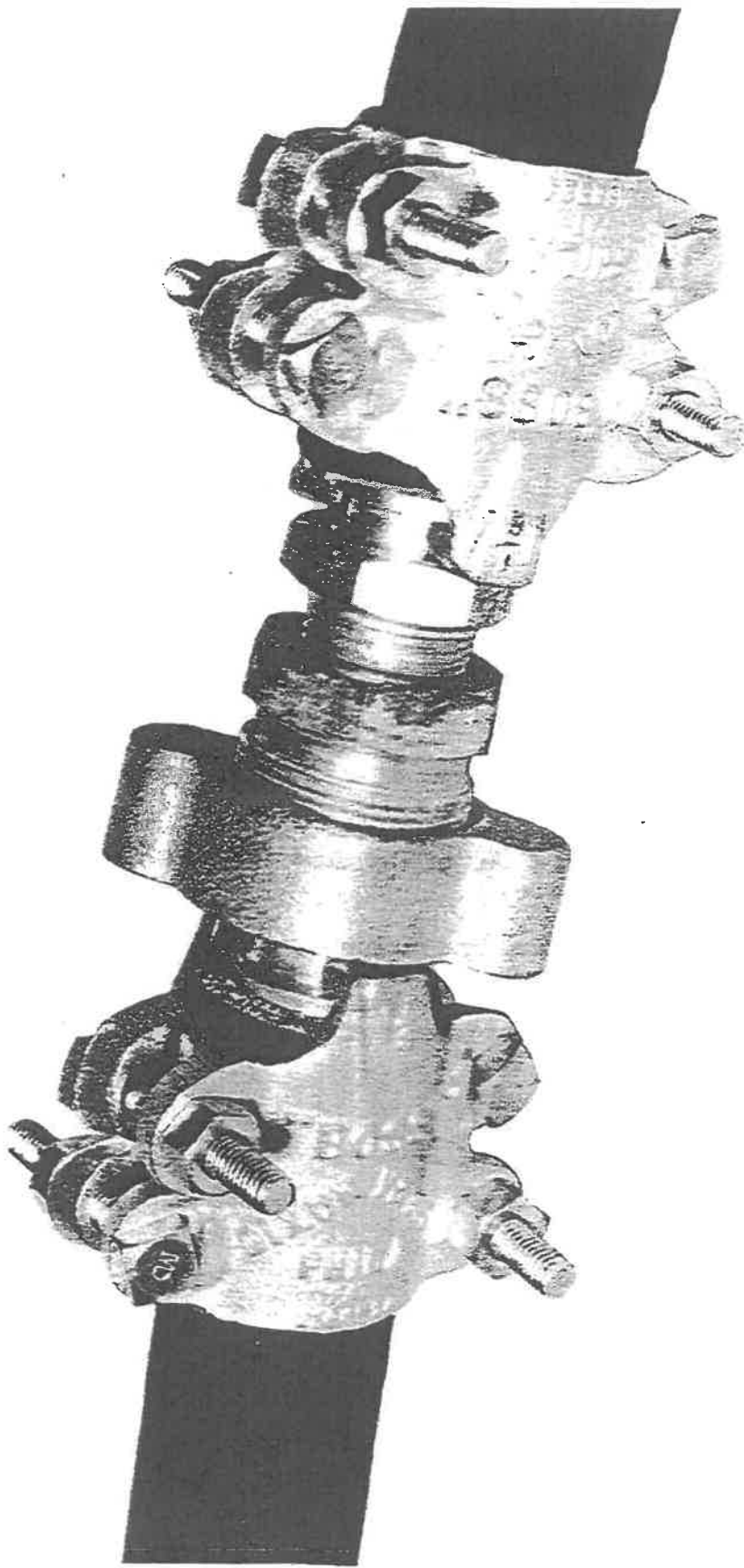


Fig. 11 - Hose Coupling

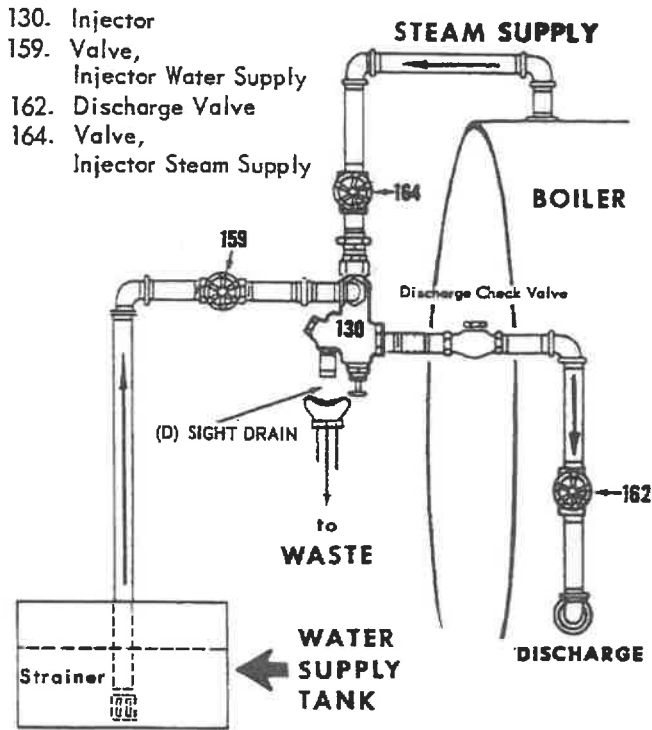
INJECTOR BOILER FEED

GENERAL DESCRIPTION

An injector is used for forcing feedwater into a boiler operating under pressure. To accomplish this it takes steam from the boiler, transforms its energy in such a manner that part of the energy is impacted to the feedwater forcing it into the boiler. The remainder of the energy is returned to the feedwater in the form of heat to raise its temperature. All this the injector accomplishes without the use of any moving parts.

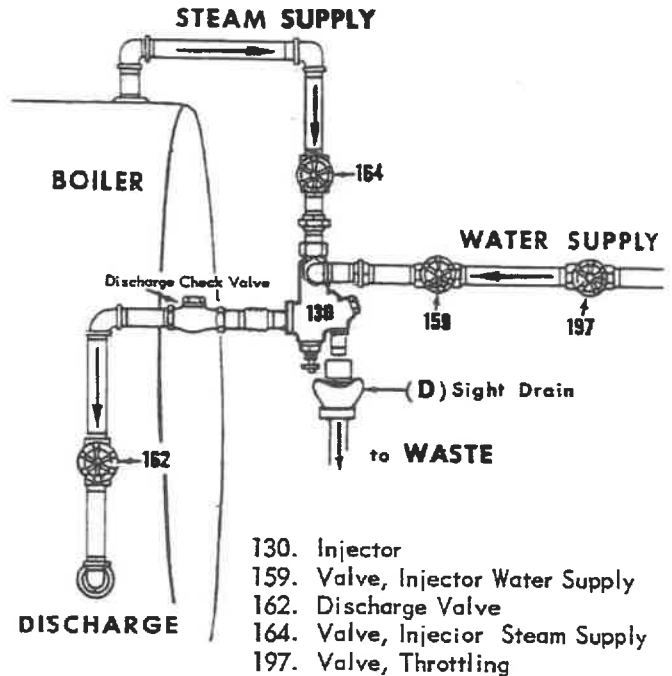
precautionary measure to protect system from any back flow from boiler.

Note: Since the pressurized water system of Application II furnishes a water rate greater than the injector capacities, an additional Throttling Valve (197) is installed as shown; and this valve is permanently adjusted to cut the water supply rate to the injector system. The Throttling Valve (197) provides the additional pressure reduction to bring the water supply rate within the limits of the injector capacity.



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Application 1



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Application 2

OPERATION

Starting – To put injector in service, open first the Discharge Injector Valve (162), next the Water Supply Valve (159); and finally the Steam Supply Valve (164). Automatically water now enters boiler; but to establish correct rate of feed adjust Water Supply Valve (159) as required.

If water is discharging at Sight Drain (D) during normal operation of injector throttle Water Supply Valve (159) until discharge at Drain (D) stops.

Stopping Injector Action – To discontinue water input to boiler, close first Steam Supply Valve (164), then the Water Supply Valve (159), and finally Discharge Valve (162); this is in the reverse order to the starting procedure. The Discharge Valve (162) is closed as a

Performance – Unsatisfactory performance of the injector will be experienced if any of the following conditions exist:

- Leaky suction system: If there are pipe leaks so that air is drawn in at joints or at water supply valve stems the injector will not operate smoothly; and water will be discharged erratically at Drain (D).
- Dirt in injector tubes.
- Water supply or discharge lines choked.

Capacities – Effective capacity is reduced if injector is required to handle water at higher than normal temperature (75° F). An injector loses its ability to condense steam at higher boiler temperatures and pressures.

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THEORY OF OPERATION (Refer to Type I Injector)

When Steam Supply Valve (164) is opened, steam passes through Steam Jet (C), over Ring Valve (F), Suction Jet (E) out to overflow drain.

The high velocity steam entrains air in Suction Chamber (D) and creates a vacuum so that feedwater is drawn in at W from supply line when Water Supply Valve (159) is opened.

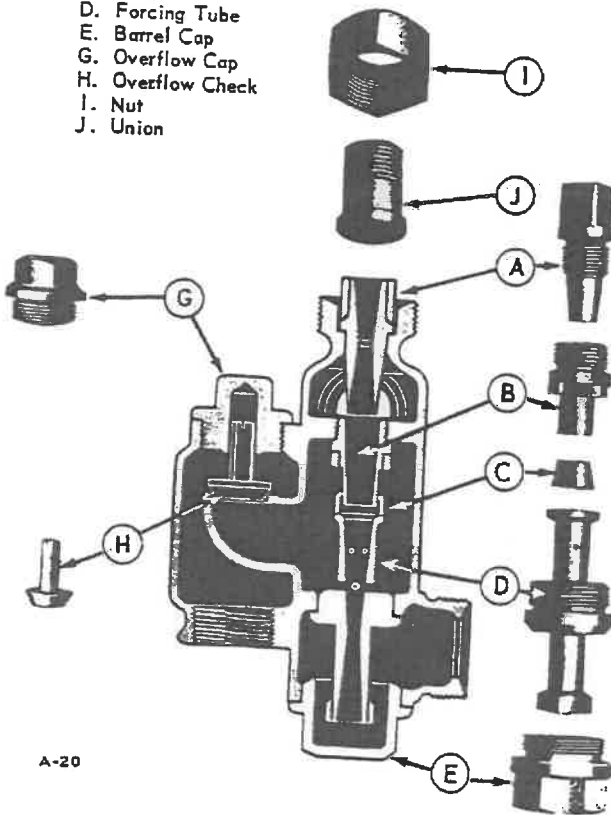
The steam gradually condenses as the mixture advances through the injector; and Ring Valve (F) rises to close. The kinetic energy of the steam is now sufficient to build up a pressure greater than the boiler pressure so that water is forced to flow through discharge check valve into the boiler. When flow into boiler is established the Over Flow Valve (M) closes

automatically and prevents entrance air which would disrupt operation of injector.

Maintenance - To clean injector, unscrew bottom plug; and the removable jet which rests upon it will follow the plug out. Turn on steam pressure (not less than 40 psi) and dirt will be blown out. Examine all passages and drill holes and see that no dirt or scale has lodged in them. Replace jet and screw into place tightly. Be careful not to bruise jets; and use no wrenches on body of injector.

If jets are incrustated with scale ("limed") acid clean with a dilute solution of muratic acid. Manufacturer recommends that solution consist of one part acid to seven parts of water. After parts are clean neutralize acid with a solution of soda in water and rinse thoroughly with water before reassembling.

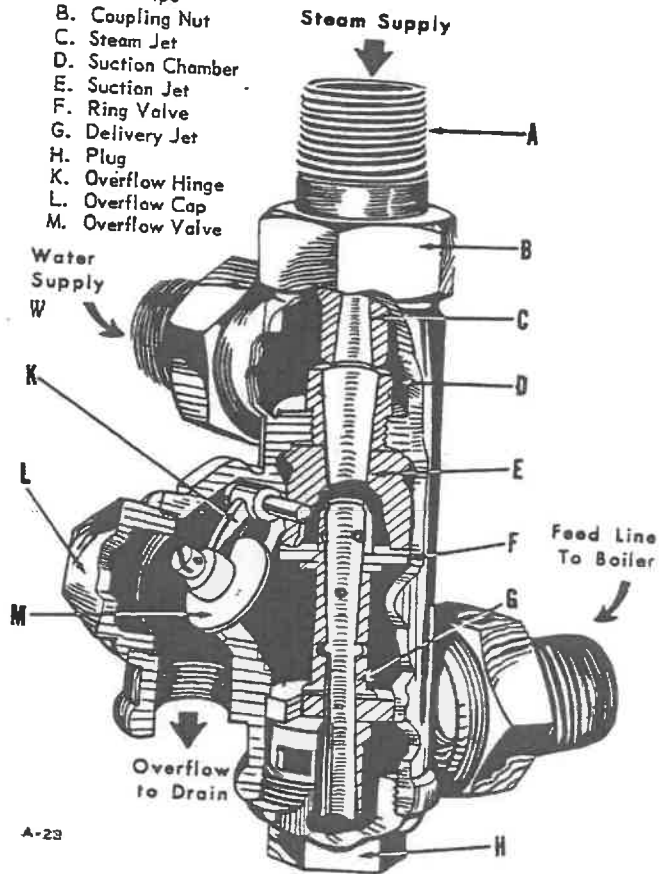
- A. Steam Jet
- B. Lifting Tube
- C. Ring
- D. Forcing Tube
- E. Barrel Cap
- G. Overflow Cap
- H. Overflow Check
- I. Nut
- J. Union



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TYPE 2 - INJECTOR
Sectional View and Parts

- A. Tail Pipe
- B. Coupling Nut
- C. Steam Jet
- D. Suction Chamber
- E. Suction Jet
- F. Ring Valve
- G. Delivery Jet
- H. Plug
- K. Overflow Hinge
- L. Overflow Cap
- M. Overflow Valve



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TYPE 1 - INJECTOR
Sectional View and Parts