Kapka Yellow Set

[redacted]

CONTENTS


| | Page |
|---|---|
| List of Attached Drawings | 1 |
| List of Attached Accessory Pamphlets | 1 |
| 1. General | 1 |
| 2. Assembly | 2 |
| 3. Installation | 4 |
| 4. Controls | 4 |
| 5. Principle of Oil Operation | 5 |
| 6. Direction for Operation | 5 |
| Case 1. Normal Operation, Water in Penstock, Electric Operation, Diagram | 6A |
| Description | 6 |
| Case 2. Water in Penstock, Manual Operation, Diagram | 8A |
| Description | 8 |
| Case 3. Penstock Unwatered, Electric Operation, Opening Diagram | 9A |
| Description | 9 |
| Case 4. Penstock Unwatered, Electric Operation, Closing Diagram | 10A |
| Description | 10 |
| Case 5. Penstock Unwatered, Manual Operation, Opening Diagram | 11A |
| Description | 11 |
| Case 6. Penstock Unwatered, Manual Operation, Closing Diagram | 12A |
| Description | 12 |
| Case 7. Hydrostatic Test of the Penstock | 13 |
| 7. Filling the Oil System with Oil | 13 |
| 8. Priming the Hand Pump | 13 |
| 9. Operator and Pedestal Assembly | 14 |
| Table I | 14 |
| Table II | 15 |


RECEIVED AUG 31 '55 INTERNATL ENGINEERING CO., INC.

OPERATING INSTRUCTIONS
84" Hollow Jet Valves
for
Morrison-Knudsen Afghanistan, Inc.
Kajakai Project, Afghanistan

List of attached drawings:

| Dwg. No. | |
|---|---|
| SV-1J-171 | General Arrangement |
| SV-1J-170 | Valve Assembly |
| 35-F-142 | Operator Assembly |
| SV-5A-143 | Pumping System |
| C-1010 | Discharge Curves |

List of attached accessory pamphlets:

Cutler-Hammer Publications No. 5489, 8431S, 7473, 817
Cutler-Hammer Drawings No. 84-704, 86-494, B93-51, B70-313
Repair Parts List. Roper Oil Pump
Westinghouse Publication I. L. 41-366H, covering type TK Timing Relay
CLA-Valve-Relief Valve
Winslow-Strainer Assembly-Magnetic Dwg. C-7282
Westinghouse Publication I. L. 43-249-A, Synchrotie Position Indicator
Westinghouse Synch. Position Indicating Motor, Dwg. 64-C-700

1. General

The equipment furnished for this order consists of three hydraulically operated 84" Hollow Jet Valves controlled by internal pilot valves. The pilot valve is positioned mechanically by means of an electric driven geared operator.

The following accessories are provided with each valve:

a. Cutler-Hammer electric operator, type TN-3-Y,
b. An oil system consisting of a 25 HP electric-motor driven pump, hand pump, 600 gal. oil tank, oil piping, magnetic strainer, and valves,
c. Electric controls for (a) and (b),
d. Connecting penstock section.

The pilot valve (Item 19, Dwg. SV-1J-170) is provided with a shoulder, A, (Fig. 1C) to restrain the needle from moving upstream under the force of the static oil head and conditions of an unwatered penstock. This feature is intended for this

purpose only. The arrangement is not designed to pull the needle off its seat or through the opening stroke mechanically. (THE EQUIPMENT MUST NOT BE OPERATED TO MOVE THE NEEDLE MECHANICALLY.)

The pilot valve structure is not designed to withstand a heavy internal hydraulic force on the needle with no counter-balancing water force upstream.

These instructions cover methods of operation under all conditions of service and maintenance for both watered and unwatered penstock.

With the penstock unwatered the maximum internal oil pressure developed on the needle is 24 psi. Greater pressure is not necessary. The operator is cautioned to not submit the needle to an internal unbalanced oil pressure in excess of 60 psi.

2. Assembly (Dwg. SV-1J-170)

The weights of the principal parts are given in Table II.

Various parts of the body can be handled by using bolt holes as lifting eyes. If the edges of the holes are crushed during above operation, the faces of the joints should be filed flush before bolting such joints.

The field assembly to proceed in following sequence:

a. Body Inlet Section (Item 1). The body inlet section is split longitudinally into two halves. These two halves are shipped separately. One of the two halves has a sealing groove machined in the face of the longitudinal joint. Set this half with the longitudinal flange facing upward. Using rubber cement install the 1/4" dia. rubber gasket in the sealing groove so as to have one end of the gasket in B (Fig. 2), approximately 1/2" from the blind end of the groove A, the other end to extend beyond the face of the inlet flange C. Fill the end of the groove AB flush with the face of the flange with plastic packing provided for this purpose. By laying a straight edge across the face of the flange, make sure that the rubber will be pre-compressed, but will not fill the groove entirely and be pinched between the faces of the joint (see section E-E, Fig. 2). Use a different size rubber if necessary.

Place the other half of the inlet body section on top of the first one, using the two 3/4" taper dowels to locate. If necessary, use jacks or clamps to bring the dowel holes in line.

Bolt the two halves together. Tighten the bolts so as to stretch the two bolts F nearest to the inlet flange by .010", the other bolts G by .006". Use slugging wrenches provided for this purpose for tightening these bolts. Use 18"-19" micrometers or outside calipers and feelers to measure the stretch. Pins will have to be set thru the holes of the extension nuts in order to reach the ends of the bolts.

Remove jacks and/or clamps used to bring the dowel holes in line.

V-cut off the end of the rubber gasket extending beyond the face of the inlet flange flush with the bottom of the circumferential V-groove.

b. Body Outlet Section (Item 2). Details of the body outlet section are shown on Dwg. SV-1J-168. It is shipped in three parts: the lower half, the upper half, and the inner cylinder assembly. The inner cylinder assembly consists of the inner cylinder, needle skirt, and the mechanism for moving the needle. To assemble these parts, first set the lower half with the longitudinal flange facing upward. Then lift the inner cylinder assembly by means of slings around the end flanges. Place the inner cylinder assembly into the lower half of the body outlet section and bolt them together. Make sure that the packing gland receiving the driving shaft is pointing upward. Next, lay the upper half in place and bolt it to the inner cylinder and to the lower half.

c. Final Assembly. For the final assembly, set all the parts previously assembled and the needle (Item 3) with their axis vertical and inlet upward.

Lift the needle with two 3/4" eye bolts (Item 60) and set it on top of the needle skirt. A man should go inside the needle through the 16" dia. hole on top of it and bolt the needle to the needle skirt. (The two are match marked.)

Install the rubber gasket (Item 63) in the groove of the inlet flange of the outlet section.

The round gasket rubber is shipped in lengths to be sized and formed into rings in the field. The circumferential gaskets should have their ends cemented together to form a ring. The joint should be made at an angle as shown on Fig. 3. In order to cut the ends of the rubber gasket at the required angle a clamp block, shown on Fig. 4, is provided. Insert the end of the gasket thru the hole in the block, then with a razor blade cut the gasket flush with the face AB of the block.

Bolt the inlet section on top of the outlet section so that the longitudinal joints of the two are at right angles. The 3/4" tapped hole for Item 5 should be on top when the valve is in its normal position.

Place the valve into normal position on its foundation. Remove the 3/4" set screws (Item 5) from the body inlet section (Item 1) and needle cap (Item 4). Set 3/4" eye bolts (Item 60) in their place and by use of these eye bolts install the needle cap (Item 4).

d. Connecting Penstock Section (Item 7, Dwg. SV-1J-171). Using rubber cement install the gasket (Item 17) in its groove. Lift the penstock section by means of a sling. Bolt it to the inlet body.

e. The Limit Switches and the Positions Indicators both mechanical and electrical shall be adjusted before the system is put into service. Adjustments to be made in accordance with the instructions in the Cutler-Hammer publication, No. 8431-S

f. Filling with Oil is explained in Paragraph 7.

g. The Pilot Valve Adjustment. In order to obtain 1/16" clearance between the pilot valve (Item 19) and the nuts (Item 17), with the needle bearing against the shoulder B of the screw (Item 24) (see Fig. 1B), the nuts must be adjusted so as to have the lip of the pilot valve 3/16" from the face of the needle (Item 10) before the cover plate (Item 14) is installed. Since the cover plate has a 1/4" shoulder, the pilot valve is pushed 1/16" away from the nuts when the cover plate (Item 14) is installed.

3. Installation (Dwg. SV-1J-171)

The completely assembled valve with the attached penstock section (Item 7) can be set on its supports with a temporary jack under the inlet flange. Then the penstock section (Item 7) can be field welded to the rest of the penstock. After this, the temporary jack may be removed.

4. Controls

This installation is arranged to operate the valve electrically under normal conditions, but provision has been made for manual operation in the event of power failure.

A push button control station is provided with push buttons "Open," "Stop," "Close," and red and green indicating lights which show whether the valve is open (red light burning),

closed (green light burning), or in an intermediate position (both lights burning). A remote position indicator is provided. A mechanical position indicator is incorporated in the operator. Both these indicators show the relative opening of the valve.

A selector switch is provided with three positions: "Automatic" (push button control), "Off" (all electric power turned off), and "Manual" (controls the electric motor driven pump only, operator to be manually operated).

5. Principle of Oil Operation

The principle of the oil operation of the needle is shown on Fig. 1A. The oil is circulated by the main pump (electric motor driven) from the compartment D through a series of holes E and through the opening between the pilot valve (Item 19) and cover plate (Item 14) into chamber F. The pressure in D depends on the clearance C and is whatever it takes to force the required flow of oil (the 100 GPM capacity of the main pump plus or minus the flow required to displace the piston at the speed of the screw) through the clearance C between the pilot valve (Item 19) and the cover plate (Item 14). The clearance C is automatically adjusted to maintain a pressure in the compartment D required to overcome the water pressure on the needle and friction. If the pressure in D is higher than is required to balance the above forces, the needle moves upstream (to the left), the clearance C increases until the pressure in D drops to its required value. The reverse happens if the pressure is lower than required. When the screw (Item 24) with the pilot valve (Item 19), spring mounted on its end, move in the closing or opening direction the needle will follow the motion of the screw so as to maintain the proper clearance C and pressure in compartment D. As long as the main pump is running, the screw and the pilot valve are free from the needle in the axial direction. Therefore, the operator has to move the screw only and not the needle, which is moved by the oil.

6. Direction for Operation under different conditions are given below followed by explanations. Oil line valves positions for the different cases are given in Table I. The piping diagram is in the upper left corner of Dwg. SV-1J-171

The operation under normal conditions of water in the penstock and electric power available is described under Case 1. The other five cases deal with the abnormal conditions of dry penstock and electric power failure. Operation with a dry penstock is necessary before the system is put into service.

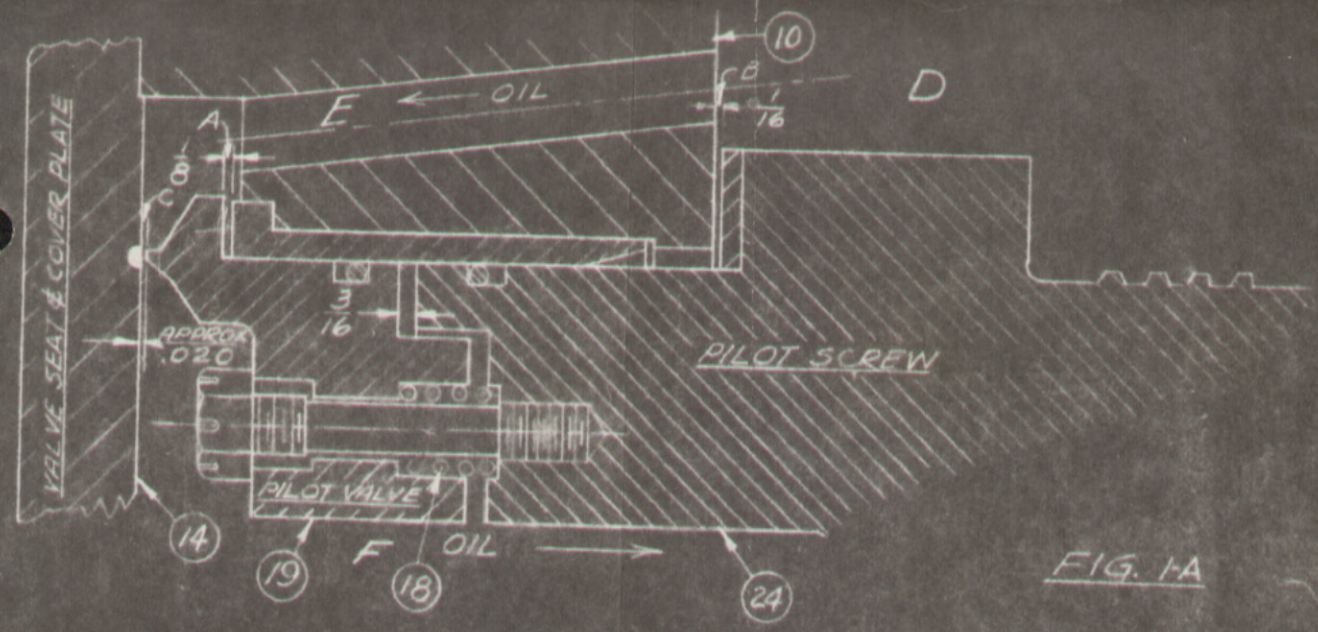


FIG. 1-A

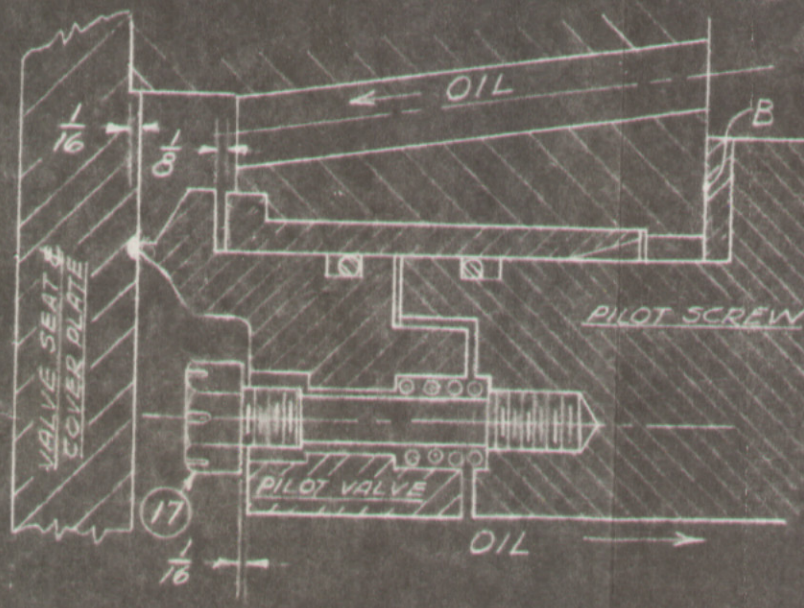


FIG. 1-B

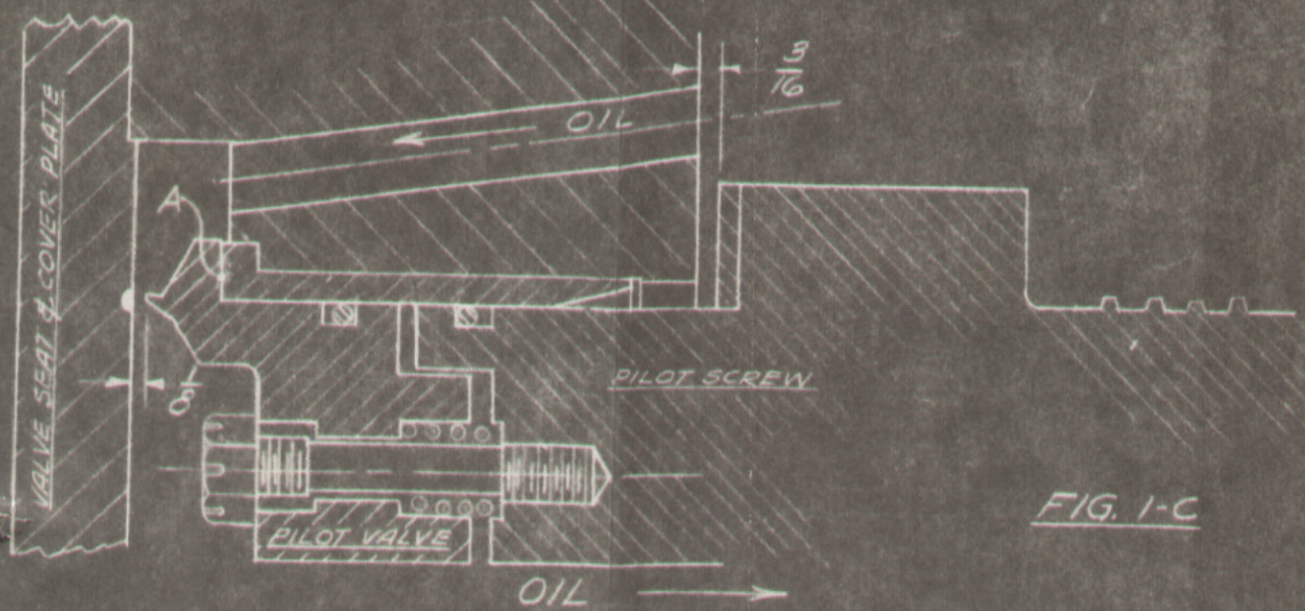


FIG. 1-C

S-1117

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Case 1. Normal Operation - Water in Penstock
Electric Operation

Direction

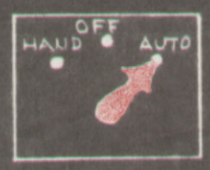
Open valve A, B, D, F and H; close valves C, E, G and J. Set selector switch on "Automatic". Open the valve J. Press the "Open" button on the control station to move the valve in the opening direction, press the "Close" button to move the valve in the closing direction. It is not necessary to hold the button in as these are momentary contact push buttons. As soon as the main pump comes up to speed, close the valve J. When the position indicator indicates that the valve reached the desired position, press the "Stop" button.

To move the valve into completely closed or wide open position it is not necessary to press the "Stop" button. The valve will be stopped at the end of the travel by the thrust switch or by the limit switch.

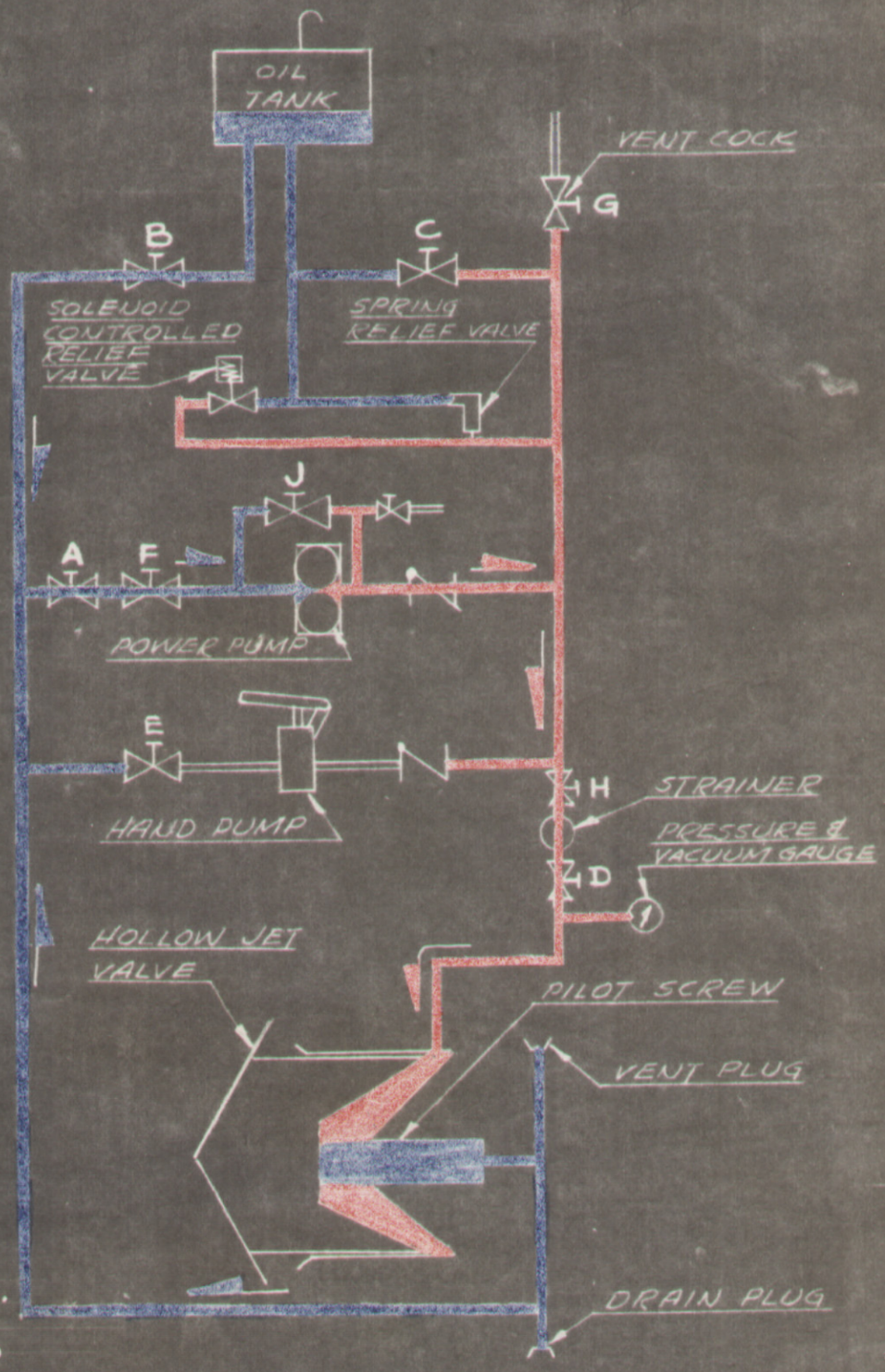
Explanation

In the absence of oil pressure, when the main pump is not running (except for the static head of oil) the water pressure forces the needle against the shoulder B of the screw. (See Fig. 1B). The resulting friction greatly exceeds the capacity of the operator. Therefore, the screw should be released from the load of the needle before the screw can be moved. Pressing the "Close" or "Open" button starts the main pump. Opening the valve J in the bypass of the main pump relieves the load off this pump and permits starting the pump with reduced voltage and, therefore, reduced starting current. Reduction of starting current is required because of the limitation of electric power supply. Closing the valve J after the pump comes up to speed results in the build-up of pressure. As the pilot valve (Item 19) is seated against the cover plate (Item 14) by the springs (Item 18), the oil has no where to go and moves the needle 1/16" from the screw so as to take up the end play between the pilot valve and the nuts (Item 17). After this the cover plate moves away from the pilot valve to form a proper clearance C. The parts assume the relative positions shown on Fig. 1A and the screw can freely move in either direction. A time delay relay starts the operator several seconds after the main pump in order to allow sufficient time for the main pump to come up to speed and for the valve J to be closed. The purpose of the springs (Item 18) is to prevent the pilot valve from taking the load of the needle in the absence of oil pressure and to allow the screw shoulder to take this load. When the needle is forced against the seat and can move no further, the screw continues to move until first the

6 A




SELECTOR SWITCH SETTING AUTOMATIC




## VALVING

A OPEN
B OPEN
C CLOSED
D OPEN
E CLOSED
F OPEN
G CLOSED
H OPEN
* J CLOSED

* OPEN VALVE "J" BEFORE STARTING PUMP MOTOR. AFTER PUMP MOTOR COMES UP TO SPEED, CLOSE VALVE.

## LEGEND

OIL UNDER PRESSURE
OIL - DRAIN OR ATMOSPHERIC
VACUUM

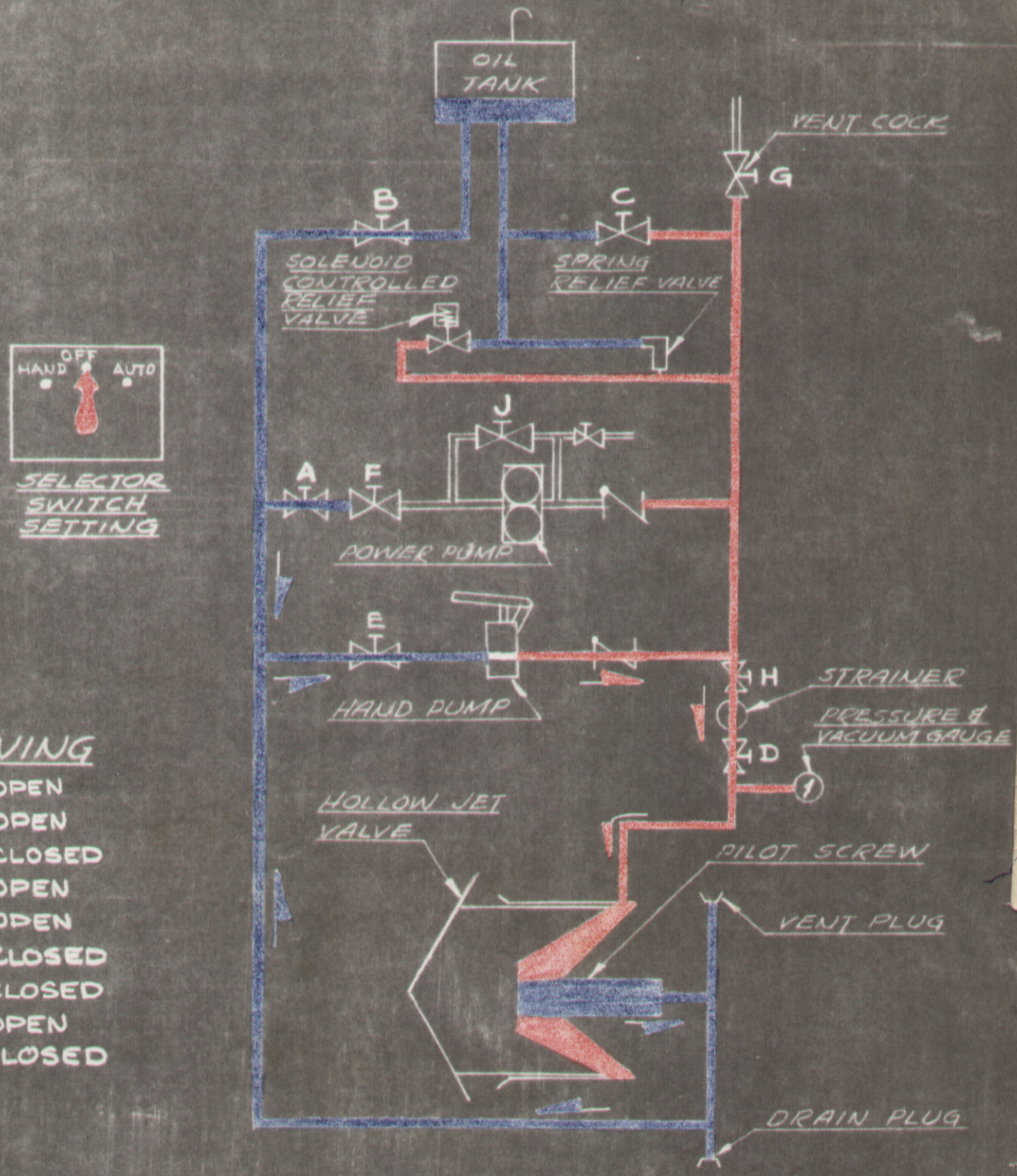
# OPERATING DIAGRAM

## CASE I - OPENING OR CLOSING WATER IN PENSTOCK - ELECTRIC OPERATION

pilot valve comes in contact with the cover plate and next the shoulder of the screw B comes in contact with the needle, as the screw can move no further the thrust switch stops the operator and the pump. In the interval of time between the moment the pilot valve touches the cover plate and the moment the screw touches the needle, the oil pressure increases to the relief valve setting of 270 psig. 265 psig. is required to overcome the water pressure at the maximum head of 263 ft.

The oil pressure required to release the screw prior to opening the valve when the valve is completely closed will be higher than the pressure used to close the valve. This difference is notable if the water head increases after the valve is closed. Two relief valves are provided to meet the above requirement; one set at 270 psig., the other at 325 psig. The 270 psig., valve is solenoid controlled, to function when the operator is energized in the closing direction, but remains closed otherwise. The setting of this valve should be reduced to 220 psig. when closing against a water head below 200 ft., in order to leave enough margin to open the valve with 325 psig. in case the head increased after the valve was closed.

8A




## VALVING

- A OPEN
- B OPEN
- C CLOSED
- D OPEN
- E OPEN
- F CLOSED
- G CLOSED
- H OPEN
- J CLOSED

## LEGEND

- OIL UNDER PRESSURE
- OIL - DRAIN OR ATMOSPHERIC
- VACUUM

# OPERATING DIAGRAM

## CASE II - OPENING OR CLOSING

## WATER IN PENSTOCK - MANUAL OPERATION

Case 2. Water in Penstock
Manual Operation

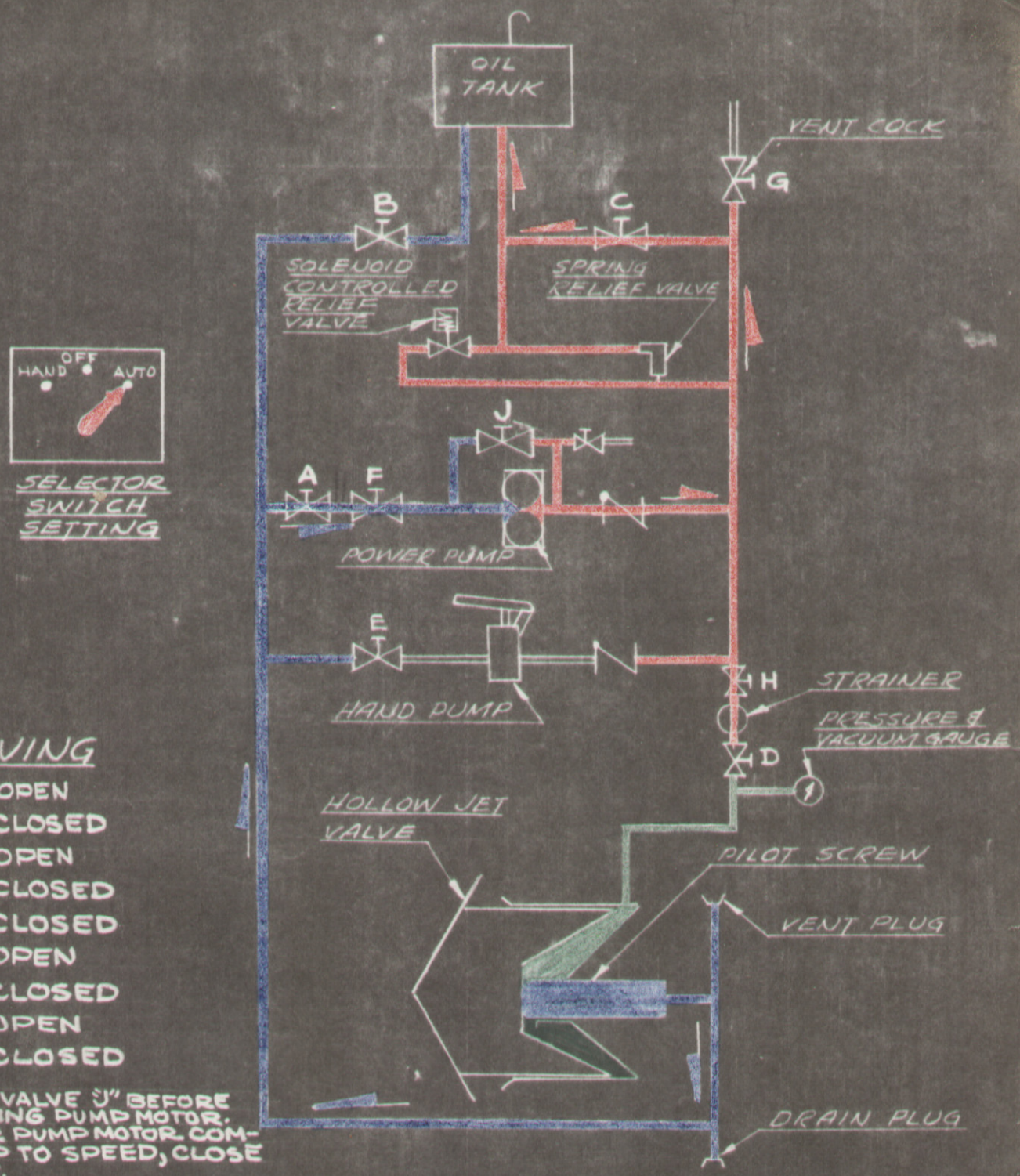
Direction

Open valve A, B, D, E and H; close valves C, F, G and J. Set selector switch at "Off". One man to apply a force on the handwheel in the direction the valve is required to move. Two other men to operate the hand pump until the screw is released and the first man is able to turn the hand wheel. To close the valve continue pumping with the handpump as long as the hand wheel is being turned. To open the valve no pumping is required after the hand wheel starts to turn. 55 turns of hand wheel are required per inch of needle travel.

Explanation

As in Case 1, in the absence of oil pressure, the water pressure forces the needle against the shoulder B of the screw (Fig. 1B) thus effectively locking it. By pumping the oil into compartment D the needle is moved away from the screw, releasing the latter. To close the valve it is necessary to follow the movement of the needle with the screw so that the distance between the needle and the screw does not exceed 1/16" and the pilot valve remains seated against the cover plate. Therefore, the pump is required to supply only the amount of oil to displace the piston plus leakage. No oil is circulated through the pilot valve. To open the valve it is only necessary to pump enough oil to release the screw. After the screw is released it can be moved in the opening direction. The water pressure will force the needle to follow the motion of the screw. A slight clearance will automatically form between the pilot valve and the cover plate to release the oil displaced by the piston.

9A




## VALVING

A OPEN
B CLOSED
C OPEN
D CLOSED
E CLOSED
F OPEN
G CLOSED
H OPEN
* J CLOSED

* OPEN VALVE "J" BEFORE STARTING PUMP MOTOR. AFTER PUMP MOTOR COMES UP TO SPEED, CLOSE VALVE.

## LEGEND

OIL UNDER PRESSURE
OIL-DRAIN OR ATMOSPHERIC
VACUUM

# OPERATING DIAGRAM

## CASE III - OPENING

## PENSTOCK UNWATERED - ELECTRIC OPERATION

Case 3. Penstock Unwatered
Electric Operation
Opening

Direction

Open valves A, B, D, F and H; close valves C, E, G and J. Set selector switch on "Automatic". Open the valve J. Press the "Open" button on the control station to move the valve in the opening direction, press the "Close" button to move the valve in the closing direction. It is not necessary to hold the button in as these are momentary contact push buttons. As soon as the main pump comes up to speed, close the valve J. When the position indicator indicates that the valve reached the desired position, press the "Stop" button.

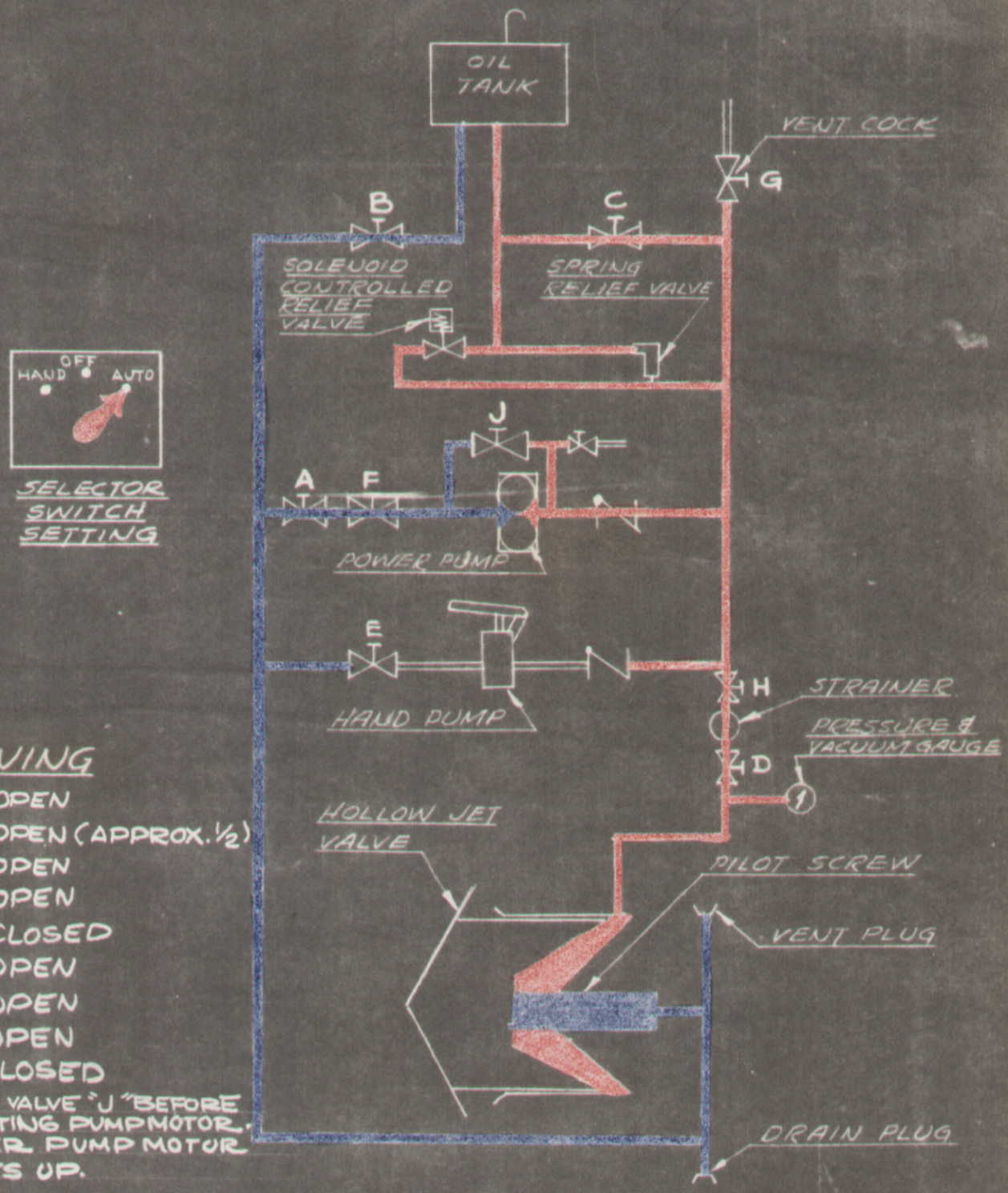
To move the valve into completely closed or wide open position it is not necessary to press the "Stop" button. The valve will be stopped at the end of the travel by the thrust switch or by the limit switch.

Explanation

In the absence of water pressure the static head of oil due to the elevation of the oil tank above the valve is sufficient to move the needle upstream away from the screw and against the shoulder A of the pilot valve (Item 19) as shown on Fig. 1C. To release the screw it is necessary to decrease the oil pressure rather than increase it as in Case 1.

With the oil line set as in Case 1, the main pump circulates through the valve with the oil tank connected to the pump suction. The minimum pressure that can be obtained with this setting in the compartment F is the static head plus the pressure drop in the line from the valve to the pump suction. The pressure in compartment D can never be less than in compartment F, therefore, will always be higher than the static head. With the valves set as shown for Case 3, no oil is admitted to the compartment D. The pump moves the oil from the valve into the oil tank. The needle moves downstream, away from the shoulder A of the pilot valve and takes the position shown on Fig. 1A, releasing the screw and following it when the screw moves in the opening direction. The clearance C automatically adjusts itself to the opening required to pass the oil displaced by the piston from compartment D under pressure required to overcome friction.

10A




## VALVING

A OPEN
B OPEN (APPROX. 1/2)
C OPEN
D OPEN
E CLOSED
F OPEN
G OPEN
H OPEN
* J CLOSED

* OPEN VALVE "J" BEFORE STARTING PUMP MOTOR. AFTER PUMP MOTOR COMES UP.

## LEGEND

OIL UNDER PRESSURE
OIL - DRAIN OR ATMOSPHERIC
VACUUM

# OPERATING DIAGRAM

## CASE IV - CLOSING

## PENSTOCK UNWATERED - ELECTRIC OPERATION

عملیات بسته شدن آب
بستگی به کدام باشد توسط برق



Case 4. Penstock Unwatered
Electric Operation
Closing

Direction

Open valves A, B, C, D, F, G and H. Valve B is to be approximately 1/2 open. Close valves E and J.

To close the valve tight against the seat bring it into contact with the seat with above valve settings. After the thrust switch stops the operator and pump, set the oil valve as for Case 1.

Set the solenoid controlled relief valve at 130 psig. Turn the hand wheel in the opening direction until the mark on the cross arm of the operator comes down in line with the bottom mark and the thrust switch closes. Press the "Close" button. After the dry operation is complete reset the relief valve to 270 psig., as discussed in Case 1 before the penstock is filled with water.

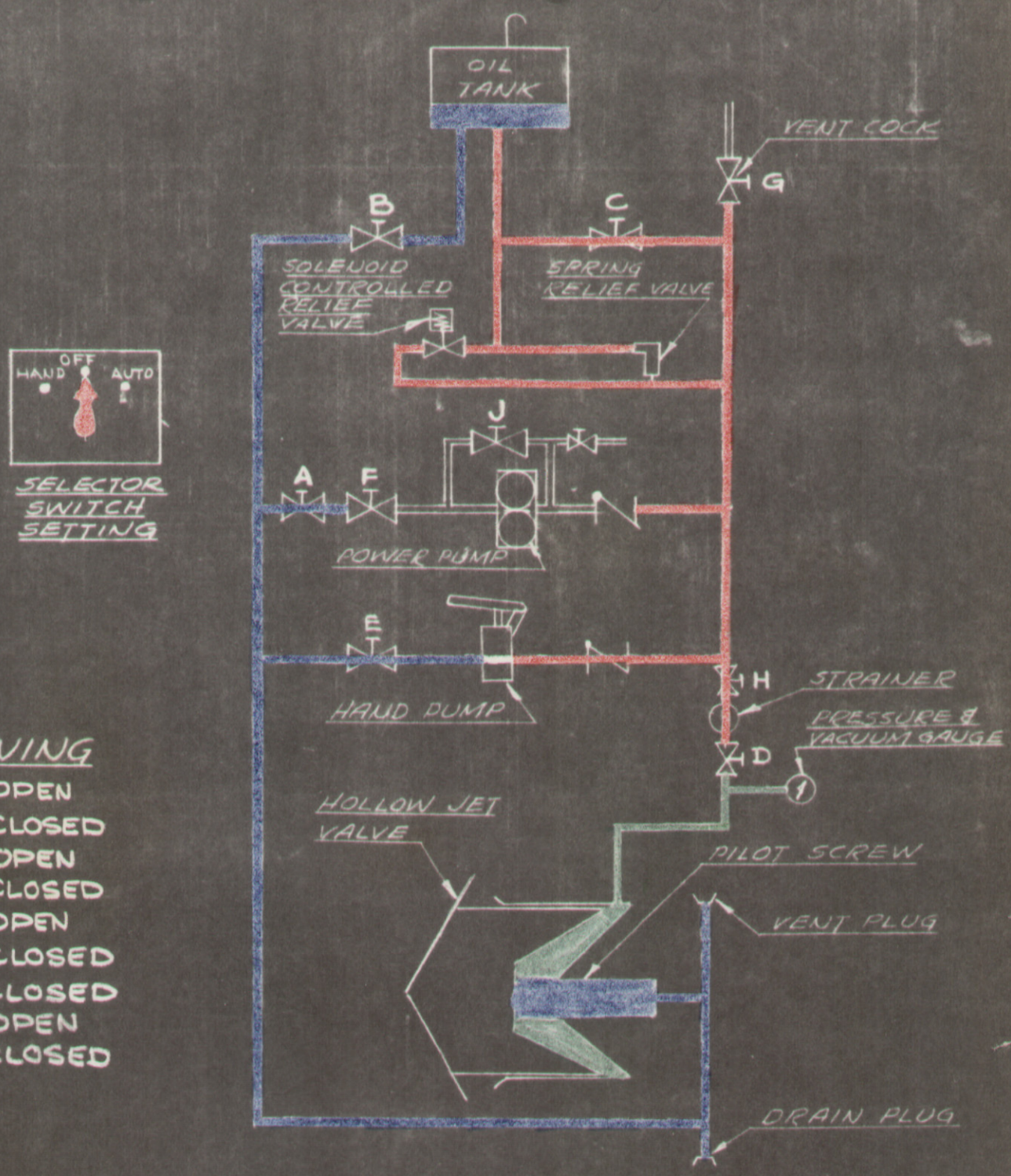
Explanation

As in Case 3 the needle has to be moved away from the shoulder A of the pilot valve.

With valves C, D, F, G, H open, the main pump circulates the oil through the valve with the oil tank connected to the discharge of the pump. The pressure in the compartment D is the static head minus the pressure drop in the line from the oil tank to compartment D. This pressure drop depends on the oil flow and therefore on the clearance C. With the needle against the shoulder A of the pilot valve clearance C is maximum and pressure in compartment D is minimum, causing the needle to move downstream releasing the screw. The maximum pressure available with above valve setting occurs when the pilot valve is seated against the cover and the flow is limited to the one required to displace the piston. This maximum pressure is lower than the static head of oil. It was found insufficient to overcome friction. To increase the pressure valve B should be partly open, thus making a step towards the oil valve setting of Case 1. An ammeter should be connected to the operator motor. The valve B can be set so as to obtain minimum ampere reading. Increase in ampere reading indicates that the oil pressure is insufficient or excessive and the needle is pressed against shoulder B or A.

Closing the valve tight against the seat as discussed in the "Direction" will limit the seating oil pressure to 130 psig. which will keep the valve tight at all water heads, yet leave enough margin to open the valve with 325 psig. oil pressure.

11A




## VALVING

A OPEN
B CLOSED
C OPEN
D CLOSED
E OPEN
F CLOSED
G CLOSED
H OPEN
J CLOSED

## LEGEND

OIL UNDER PRESSURE
OIL-DRAIN OR ATMOSPHERIC
VACUUM

# OPERATING DIAGRAM

## CASE V-OPENING

## PENSTOCK UNWATERED-MANUAL OPERATION

عملیات توسط انرژی دستی



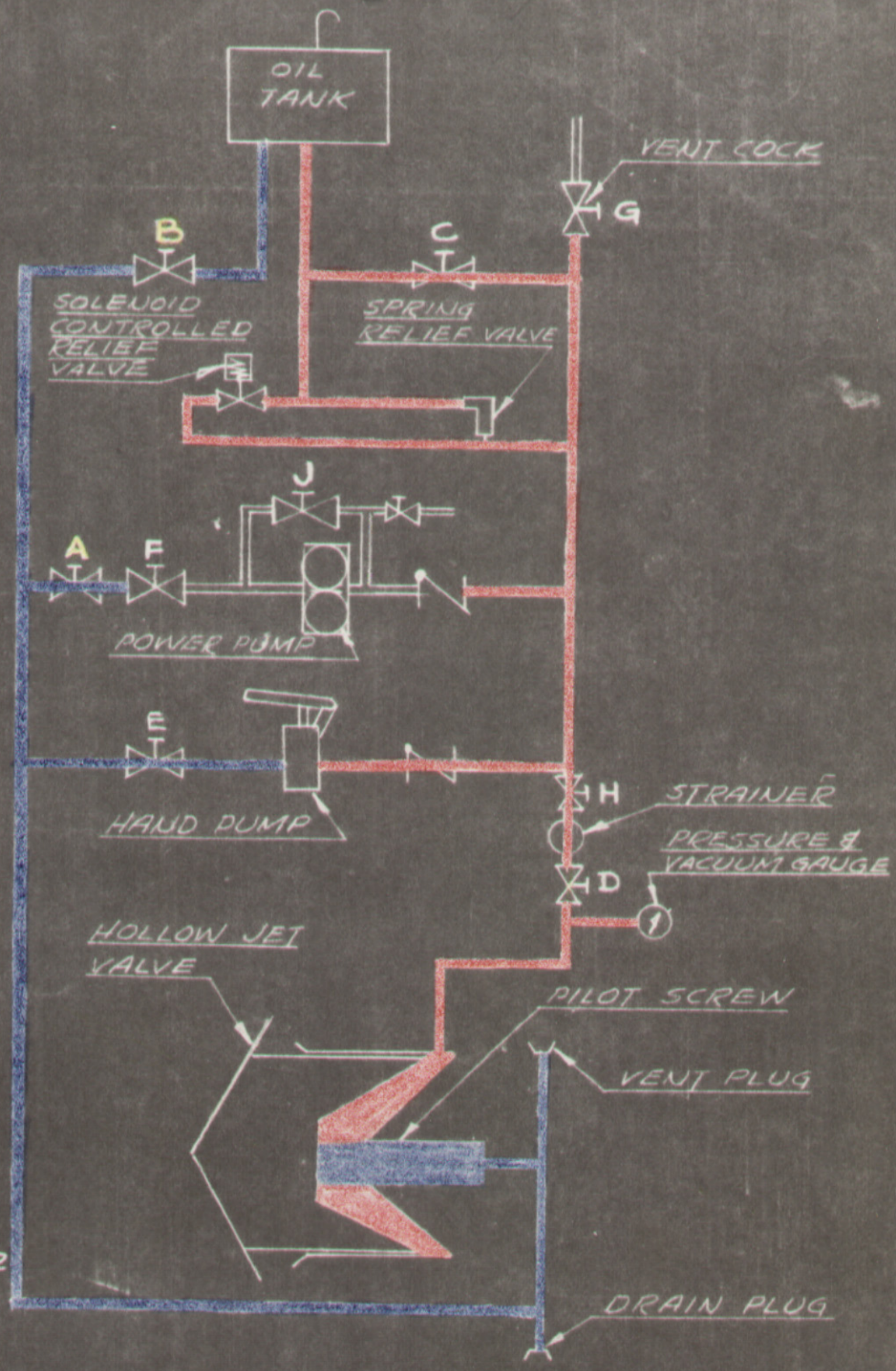
Case 5. Penstock Unwatered
Manual Operation
Opening

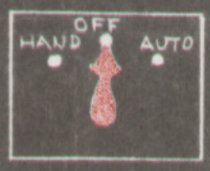
Direction

Open valves A, C, E and H; Close valves B, D, F, G and J. Set selector switch at "Off". One man to apply a force on the hand wheel in the opening direction, one or two other men to operate the hand pump until screw is released and the first man is able to turn the hand wheel. Continue to pump and follow the movement of the needle with the hand wheel until the valve reaches the desired position.

Explanation

Operation is same as in Case 3, except that the oil is pumped out of the valve by the hand pump instead of the main pump and the operator is manually operated.




SELECTOR SWITCH SETTING

## VALVING

A OPEN
B CLOSED
C OPEN
* D CLOSES
E OPEN
F CLOSED
G CLOSED
H OPEN
J CLOSED

* OPEN ONE TURN AFTER RELEASING PILOT SCREW.

## LEGEND

OIL UNDER PRESSURE (STATIC HEAD OF TANK)
OIL-DRAIN OR ATMOSPHERIC
VACUUM

# OPERATING DIAGRAM

## CASE VI-CLOSING

## PENSTOCK UNWATERED-MANUAL OPERATION

عمیا - مجب دشتی و راه آهن



Case 6. Penstock Unwatered
Manual Operation
Closing

Direction

Open oil valves A, C, E, and H. Close valves B, F, G and J. Set selector switch at "Off". One man to apply a force on the hand wheel in the closing direction. One or two other men to operate the hand pump until screw is released and the first man is able to turn the hand wheel. Turn the hand wheel as far as it will go (about 12 turns). Stop pumping. Open valve D one turn. The needle will move in the closing direction by itself. Follow its movement with the hand wheel.

Explanation

The static head of oil is sufficient to move the valve in the closing direction. Pumping the oil out of the valve is necessary only to release the screw. After the screw is released turning the hand wheel as far as it will go brings the shoulder B in contact with the needle (total motion of 3/16"). Opening the valve D one turn admits the oil to compartment D at moderate rate, so that the motion of the needle could be easily followed with the screw. If the needle moves faster than the screw it will come against the shoulder A of the pilot valve locking the screw, then the operation has to be started all over.

7. Hydrostatic Test of the Penstock

Direction

Seat the needle with the solenoid controlled relief valve set at 130 psig. as directed for Case 4. Fill the penstock with water. Build up the water pressure to 100 psig. Set the solenoid controlled relief valve at 270 psig. and reseat the needle maintaining 100 psig. water pressure. Build up the water pressure to 180 psig. and maintain it as long as required to test the penstock. Reduce the water pressure to 100 psig. Unseat the valve as directed for Case 1 and drain the water out of the penstock.

Explanation

Seating of the needle on its seat to be done in two steps in order to avoid excessive seat load which would occur if the needle was seated with 270 psig. oil pressure and no water pressure.

Reducing the water pressure to 100 psig. before opening the valve is required because the available oil pressure of 325 psig. is insufficient to release the screw with 180 psig., water pressure.

8. Filling the Oil System with Oil

Direction

Fill the oil tank with all oil valves closed. Open valve B. Open the vento cock (Item 36) until all air is vented. Open valves C, D, G, and H. Wait until the movement of air bubbles in the pipes and tank is no longer audible. Add more oil to the tank. The total amount to be 15 barrels.

The oil level to be approximately 6" from top of tank for valve wide open.

Explanation

The vent cock (Item 36) vents the air from the gear case space only, not out of the compartment D. In the absence of pressure in compartment D the needle may be against shoulder B of the screw (Fig. 1B). The pilot valve may be closed and oil may not enter compartment D from the gear case space. Therefore, compartment D has to be filled from the top, the air traveling in the opposite direction through the same pipe.

9. Priming the Hand Pump

The hand pump will not pump oil out of the valve as required in Cases 5 and 6 unless it is free of air and vapor pockets. To eliminate such pockets, circulate the oil by operating the

hand pump with valves B, E, and G open.

10. Operator and Pedestal Assembly (Dwg. 35-F-142)

The Cutler-Hammer operator is described in the attached pamphlets No. 8431-S and No. 817 prepared by its manufacturer.

If the resistance to rotation of the torque screw is low and friction in the threads is high due to lack of proper lubrication it may occur that the yoke nut will rotate with the screw without coming down the threads, and therefore without closing the thrust switch. In such cases, in order to enable the valve to move in the closing direction it is necessary to close the thrust switch by turning the hand wheel in the opening direction until the mark on the cross arm comes down in line with the bottom mark.

To avoid such occurence, grease the threads of the torque screw and its supporting ball bearings by means of the Alemite fittings (Item 11).

TABLE I

OIL LINE VALVES POSITIONS

| Case | Penstock | Pump | Operation | Valves Open | Valves Closed |
|---|---|---|---|---|---|
| 1 | Water in Penstock | Electric | Opening or Closing | A.B.D.F.H. | C.E.G.J. |
| 2 | | Manual | Opening or Closing | A.B.D.E.H. | C.F.G.J. |
| 3 | Penstock Unwatered | Electric | Opening | A.C.F.H. | B.D.E.G.J. |
| 4 | | Electric | Closing | A.B. ** C.D.F.G.H. | E.J. |
| 5 | | Manual | Opening | A.C.E.H. | B.D.F.G.J. |
| 6 | | Manual | Closing | A.C.E.D.*H. | B.F.G.J. |

*Open one turn after releasing screw.

**Approximately 1/2 open

## TABLE II

## APPROXIMATE FINISHED WEIGHTS

| | | Wt. In Pounds |
|---|---|---|
| Inner Cylinder, | Dwg. SV-1J-168 | 15,830 |
| Needle Skirt Assembly, | Dwg. SV-5A-125 | 8,720 |
| Cylinder Head, | Dwg. SV-1J-166 | 6,790 |
| Gear Case Assembly, | Dwg. SV-2A-913 | 1,300 |
| Pilot Screw, | Dwg. SV-5A-128 | 400 |
| Pilot Nut, | Dwg. SV-5B-56 | 290 |
| Spline Shaft, | Dwg. SV-5B-53 | 60 |
| Bevel Gear Set, | --- | 220 |
| Pilot Cover Plate, | Dwg. SV-5D-87 | 50 |
| TOTAL WEIGHT - Inner Cylinder Assembly | | 33,660 |

| | | | |
|---|---|---|---|
| Body Inlet Section, | Dwg. SV-1J-167 (2 halves) | 2x6,850 | 13,700 |
| Body Outlet Section, | Dwg. SV-1J-168 (2 halves) | 2x9,460 | 18,920 |
| Needle, | Dwg. SV-5A-126 | | 3,610 |
| Needle Cap, | Dwg. SV-5C-59 | | 360 |