THROTTLE VALVE

This valve is of the hydraulic type and is operated by oil (or other suitable fluid). In a description, it can be divided conveniently into two parts; namely, the main steam valve and the operating mechanism. To avoid confusion, the mechanism is described below with oil as the operating medium. Figure 1 shows the valve and steam strainer while Figure 2 shows the valve operating mechanism.

Steam Valve

The steam valve is a simple arrangement, commonly called the "Double Plug Type". It consists of two single seated plug valves (item "11" and one formed by the lower end of the stem "1"), the one placed within the other. When in the closed position as shown in Figure 1, full steam pressure acting above the valve "11" and the operating mechanism spring load hold it tightly on its seat. The lower end of the valve stem "1" forms the by-pass (or inner) valve. Consequently, as the stem is lifted to open the valve, this small by-pass valve is opened first. When the by-pass valve has been lifted through its full travel, it engages the valve cover plate "10" and any further movement of the stem then lifts the main valve "11". The size and lift of the by-pass valve are proportioned to pass sufficient steam to bring the turbine up to full speed with no load. When full speed is reached, the governing (steam inlet) valves close sufficiently to practically balance the steam force above and below the main valve "11". Very little force is required, therefore, to lift it through its entire travel.

When starting a non-condensing turbine, it should be brought up to full speed with atmospheric exhaust pressure, which can be done on the by-pass valve. The main valve should then be opened wide before higher exhaust pressure is established. With any turbine, the main valve should be opened wide before the unit is synchronized.

The valve stem packing consists of four short, closely fitting bushings "2" with suitable leak-off openings. On valves built for 600 pounds pressure, two leak-offs are provided while the valves built for 400 pounds pressure have only one leak-off. When two leak-offs are used the upper one should be led to a point at atmospheric pressure where a small amount of escaping steam is not objectionable. The lower one should be piped with suitable valves so that it can be connected to a zone of intermediate pressure when operating, and to atmosphere when the turbine is shut down. It is important to by-pass this leak-off to atmosphere when the turbine is shut down, otherwise the steam leakage entering the turbine cylinder may cause excessive distortion. It should be opened to atmosphere as soon as the throttle valve is closed and switched back to the intermediate pressure zone as soon as the throttle is opened to start up again. When only one leak-off is used, it should be open to a point at atmospheric pressure at all times.

As shown in Figure 1, the steam strainer, Item No. "9", is of the cylindrical, wire mesh type and is placed around the main valve.

The following points should be noted in connection with re-seating these valves. The seating surfaces of the outer valve "11" and the seat "13" are machined spherically and then lapped a very small amount which gives a narrow, continuous surface of contact. If the valve and seat are in good condition but leaking slightly, they can be made tight by additional lapping provided the width of the contacting surfaces does not exceed 1/16".

If the width of these contacting surfaces exceeds 1/16", both the valve and seat must be remachined, using the same radii as on the original pieces. When machining the seat "13", after finding the correct radius, the center should be moved downward (as viewed in the illustration) in a line parallel with the axis of the seat so as to take the cut off the top and not increase the diameter of the opening through the seat. After this machining, the parts should be lapped just enough to make them tight. It should also be noted that there is no gasket between the seat "13" and the valve body. These surfaces must be gound to a steam tight joint. The seating surface of the inner valve is bevelled and can be ground to a tight seat in the usual manner.

Operating Mechanism

The principal parts of the operating mechanism shown on Figure 2 are: the operating piston "32", the closing spring "31", the oil by-pass valve "29" and valve plate "46", the handwheel "25", and the handwheel stem "28" which is threaded in the nut "26".

The operating piston "32" is attached to the Steam Valve Stem by the coupling nuts "42", and "43", so that the operating piston and steam valve move as a single piece. The handwheel is attached to the handwheel stem so that rotation of the handwheel gives positive movement to the valve stem, and to the oil by-pass valve "29" which is loosely attached to the stem.

The oil by-pass valve consists of a plate type valve seat by means of which movements of the handwheel control the oil pressure acting below the operating piston. It will be noted that the valve plate "46" has two seating surfaces; the seat "X"between the valve plate and the oil by-pass valve, and the seat "Y" between the plate and the piston cover "47". This plate has approximately 1/8" vertical movement, and normally is held in its upper position by the spring "45". High pressure oil is supplied to the space below the operating piston "32" by either the auxiliary or main oil pump through an orifice to restrict the flow to the proper amount.

With the operating mechanism in its closed position as shown in the Figure, high pressure oil acts upward on the operating piston "32", the valve plate "46" and the oil by-pass valve "29". However, with the hand-wheel in its fully closed position, the oil by-pass valve "29" seats on the valve plate "46", thus compressing spring "45" and opening the seat "Y". Therefore, oil flows through port openings in the valve plate, and through the seat "Y" to the drain.

As the handwheel is turned counter-clockwise the stem "28" and the by-pass valve "29" move upward. The spring "45" causes the valve plate "46" to follow the by-pass valve, keeping the seat "X" closed, and also closing seat "Y". The oil pressure below, therefore, raises the operating piston, compressing the closing spring "31". During normal opening movement both seats "X" and "Y" remain closed. If the oil pressure should tend to raise the operating piston more rapidly than the oil by-pass valve is being raised the seat "Y" will open, allowing the high pressure oil to flow to the space above the piston, and thence to the drain. Therefore, the piston can rise only as fast as the by-pass valve "29" is being raised. If the oil by-pass valve should be raised at a rate of speed so great that the high pressure oil supplied through the orifice is unable to raise the operating piston at the same rate, the seat "X" will open, which will allow the high pressure oil under the piston to flow to drain. The valve will, therefore, drop to its closed position. If such a case is experienced, the handwheel should be turned to its closed position, and the valve opened again more slowly.

To close the valve by hand, the handwheel is turned in a clockwise direction causing the oil by-pass valve "29" to move downward. This downward movement of the oil by-pass valve moves the valve plate "46" downward, compressing spring "45" and opening the seat "Y". This allows the high pressure oil to flow to the top and thence to the drain. With the pressure below the piston released, the closing spring "31" lowers the operating piston and steam valve. It will be noted that this feature serves also as an automatic stop in case of loss of oil pressure. If for any reason, the oil pressure should drop below a predetermined point, the spring "31" will automatically close the valve, shutting down the turbine. Also, it is impossible to open the valve until oil pressure is established, thus insuring proper lubrication of all bearings.

The closing spring "31" is sufficiently strong to overcome any friction which may be experienced and exerts a closing force on the operating piston at all times. However, in case of necessity the valve can be closed manually without the help of the closing spring. The application of force at the rim of the handwheel results in the development of a greatly increased, positive, downward force in the valve operating mechanism.

It should be noted that it is not practical to take the load off the unit by closing the throttle valve. As the valve approaches its seat the unbalanced steam force across the valve increases and at some point becomes so great that the valve will drop to its seat suddenly, thus dropping the remainder of the load. Due to this same design characteristic, this valve may drop shut if an attempt is made to open it with more than about 10% load on the generator (a condition which might be encountered if the throttle valve trips shut and the generator remains on the line). Consequently, if the throttle trips, it is advisable to open it wide before applying more than approximately 10% load.

The automatic closing is accomplished by releasing the oil pressure below the operating piston "32". As stated before, the high pressure oil supply to the piston is regulated by an orifice. Thus high pressure is established but actual oil flow is restricted. The space below the operating piston is connected to our standard overspeed trip valve, which, under normal operating conditions remains closed and maintains the high pressure oil below the piston. However, if the overspeed trip functions, the valve is opened, releasing the pressure under the operating piston "32". The line connecting the high pressure oil chamber to the drain tank through the overspeed trip valve is of considerably greater capacity than the high pressure inlet line, which fact insures a drop of pressure below the operating piston. The closing spring "31" then closes the valve in the same manner as described above. After the first downward movement of the piston, the seat "X" opens, which provides another outlet for the high pressure oil, thus further reducing the pressure under the piston and insuring a more positive closing force.

As the operating piston approaches its lower limit of travel, a ring turned on the bottom of the piston enters a counterbore in the operating cylinder support. This forms a dashpot which effectively reduces the force with which the valve strikes its seat.

This valve may be furnished with either of two types of handwheels; the dome type as shown in the Figure, or a straight, conventional type wheel. The sole purpose of this difference is to place the handwheel grips at the most convenient height above the operating floor.

The following list has been compiled to facilitate ordering spare or renewal parts by item number and name, together with the serial number of the turbine.

Item No.	Name
1	Throttle Valve Stem and By-Pass Valve
*2	Throttle Valve Stem Bushing (Inner)
*3	Throttle Valve Stem Bushings (Upper) (Outer)
4	Throttle Valve Body Head Insulation
*5	Throttle Valve Stem Bushings (Lower) (Outer)
6	Operating Mechanism Support
7	Operating Mechanism Support Gasket
8	Throttle Valve Body
9	Steam Strainer
10	Throttle Valve Cover Plate
11	Throttle Valve
12	Steam Strainer Stop Pin
13	Throttle Valve Seat
20	Handwheel Bushing Oil Cup
21	Handwheel Bushing
22	Handwheel Bushing Screw
23	Handwheel Bushing Retainer Screw
24	Handwheel Bushing Retainer
25	Handwheel
26	Handwheel Stem Nut
27	Handwheel Stem Nut Screw
28	Handwheel Stem
29	Operating Mechanism Oil By-Pass Valve
30	Operating Cylinder
31	Operating Piston Spring
32	Operating Piston
33	Operating Piston Ring
34	Gasket
35	Operating Cylinder Cover (Lower)
36	Gasket
37	Operating Cylinder Stud Nut (Special)
38	Operating Cylinder Stud (Long)
39	Operating Piston Oil Seal Sleeve Pin
40	Operating Piston Oil Seal Sleeve
41	Operating Cylinder Cover Oil Seal
42	Valve Stem Coupling Nut (Lower)
43	Valve Stem Coupling Nut (Upper)
44	Valve Stem Coupling Pin
45	Oil By-Pass Valve Spring
46	Oil By-Pass Valve Plate
47	Operating Piston Cover

* Note: Inner bushings must be installed at factory. Therefore, inner and outer bushings are not furnished separately.

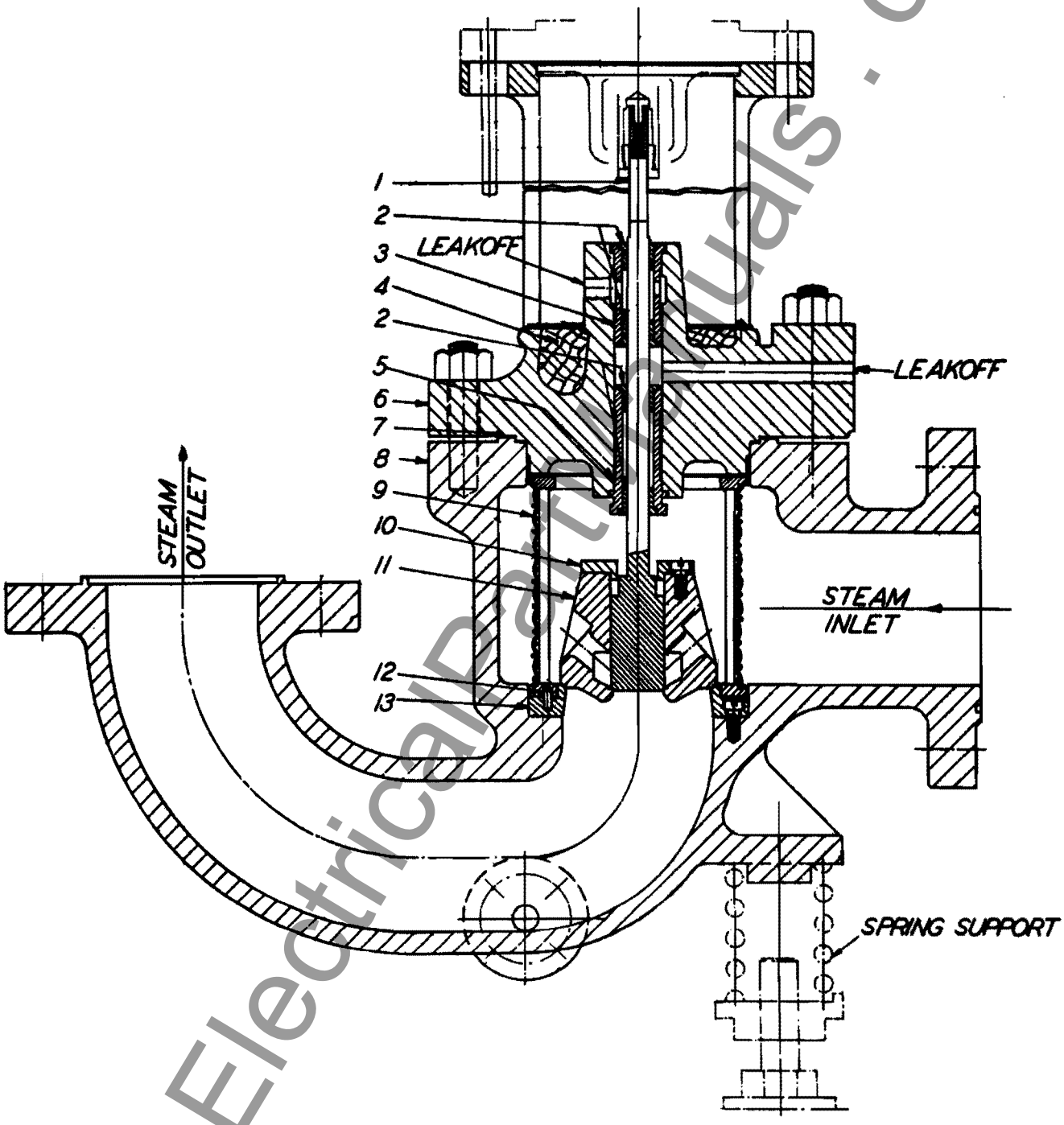

Figure 1

Throttle Valve

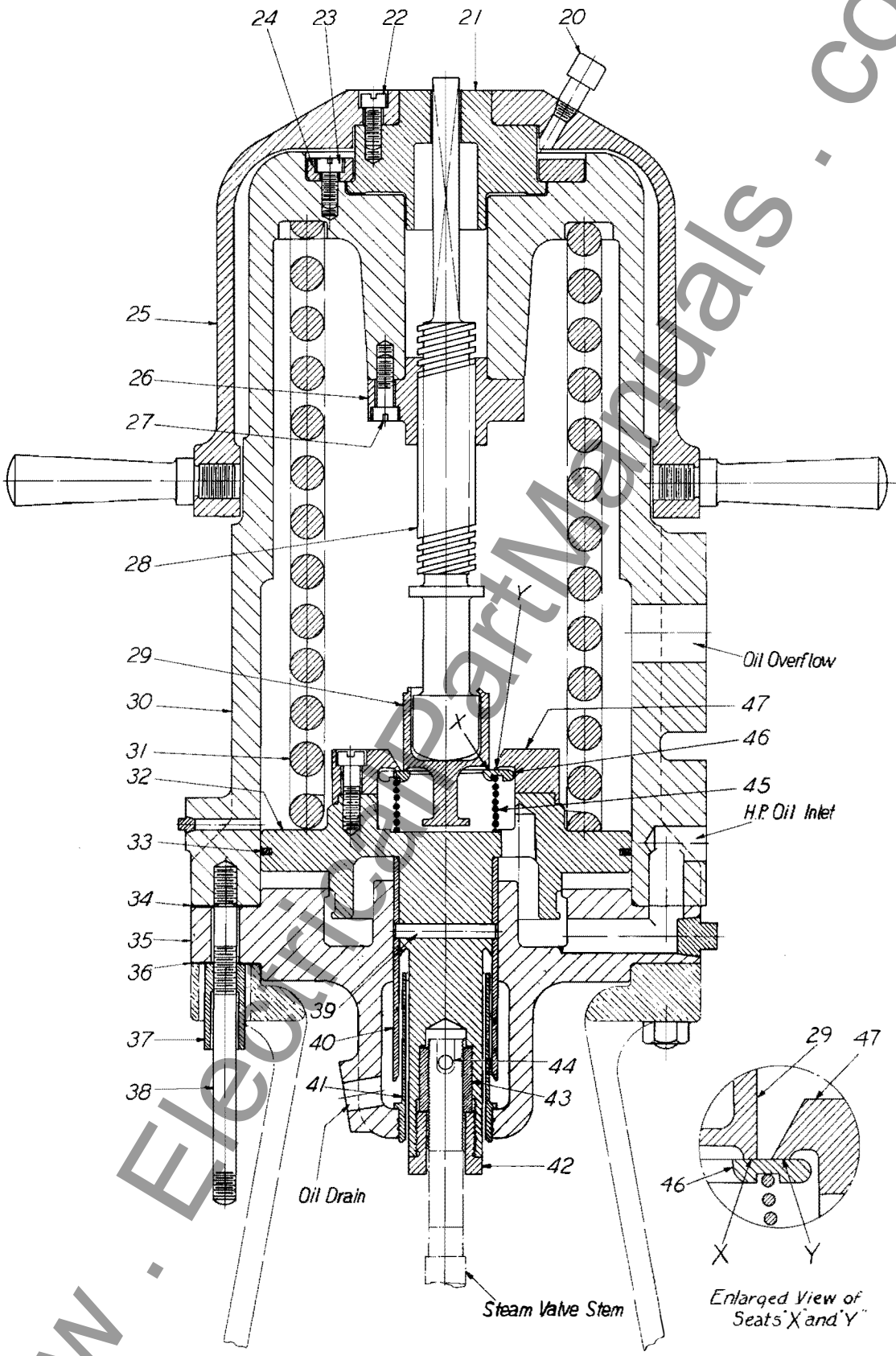

Figure 2