OPERATION OF THE COFFIN BALANCED NEEDLE VALVE.

(F. Teichman 氏ノ設計ニ係ル Needle valve ハ宇治水電及帝釋水電ノ兩株式會社ニテ使用スルコトトナレリ本文ハ其 valve ニ關スル記事ナリトス)

1. In the accompanying print the operating shaft is carried to a chamber in the dam, underneath the conduit. This is, on the whole, more advantageous than to carry the shaft up vertically to the top of dam. Ordinarily the operation of valve is accomplished by turning the handwheel which results in turning the central screw shaft. This shaft has a disc or button at one end and Acme thread at the other end and the nut of this thread is part of the piston. The first rotary motion of the screw shaft will effect an axial motion not of the piston, but of this shaft, which motion will tend to bring the button home against one or the other of the opposing faces.

2. The print shows the piston in its extreme position, valve wide open. The button leaves the entrance to waste pipe wide open and the axial pressure on the upstream end of the piston is that of the water in the waste pipe, having a head of a few feet above the centre line of valve. This pressure is smaller than the pressures on the downstream end of piston, viz., (a) the axial pressure exerted on the needle face of the piston by the passing water and (b) the axial pressure on the piston owing to the pressure in annular space that surrounds the piston.

3. In closing the valve the rotation of the screw shaft first closes the outlet to the waste pipe. This results in an increase of the pressure back of the piston due to the leakage that passes the bullring from the annular space. Due to this increased pressure and probably before the button has fully closed the waste pipe the piston will begin to move and

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as the rotation of the screw shaft is continued the piston will continue to move with the button in front of the waste pipe inlet, but not in contact therewith, automatically regulating the pressure back of the piston so as to be just able to overcome the opposing hydraulic forces including the friction of motion. The closing motion may be interrupted at any point of the closing process and the amount of opening to waste pipe will automatically adjust itself so as to establish an equilibrium of the opposing hydraulic forces, the friction of motion of piston serving as margin in this adjustment. If, during the process of closing, for some reason the frictional resistance should be excessive (the valve not having been moved for a long period) then the hydraulic forces may be insufficient to accomplish the desired motion of the piston at some point of its travel. In such case the button will go home against the opposing face and the operator, persisting in the turning of the mechanism, adds mechanical force to the hydraulic forces until motion results. The crank (or an additional improvised lever) will serve this purpose and a mechanical axial force of thirty tons or more may thus be brought into action. Such force will never be required if it is made a rule that every valve is opened and closed at least once or twice each season, eventually (if reservoir level are high) with emergency gates closed during this process. In the manner described the valve is brought to any desired partial opening or to final closure. When closure is completed the button closes the waste pipe, no further leakage occurs around the bullring and the piston is held against its seat with the full load of the reservoir water on the area that is represented by the circular line of contact of the piston with the seat ring.

4. For opening the closed valve turn the handwheel in the opposite direction. The pressure back of the piston will be reduced from that of the reservoir to that of the waste pipe and the full reservoir pressure in the annular space will overcome this pressure and the piston will commence to open and from that moment the reaction of the water passing the needle end of the piston will aid in the opening motion. As in the closing process, the amount of opening of inlet

to waste pipe will adjust itself at all times automatically in such manner that under an equilibrium of forces the valve will smoothly open as the operator continues the turning of the handwheel. For very low reservoir heads the hydraulic force may be insufficient to raise the piston from its seat. Then mechanical force will be added to accomplish the desired motion.

5. The only thing required in the closing or opening of the valve is the turning of the handwheel (or the crank). Whatever mechanical force may be required in the process the operator will supply without any intent and exercice of judgement on his part. In this sense the apparatus is fool-proof; any workman may operate the valve like any other small grate valve.

6. The position of the valve is shown at all times by an indicator, positively connected with the operating shaft.

7. The piping shown is: (a) The waste pipe ending with a gate valve at end, submerged in the gutter of operating chamber. (b) Small brass air pipes from highest point of waste pipe and from highest point of cylinder, terminating with valve or cock near roof of operating chamber. (c) Drain pipe from lowest point of cylinder, terminating with gate valve submerged in gutter. (d) Supply pipe or pressure pipe with gate valve at end bringing water of reservoir pressure into the operating chamber.

The uses to which this piping may be put are as follows:

8. During the operation of the needle valve as described the gate valve at end of waste pipe is open, the air pipe from highest point of waste pipe is open, the valve or cock at end of other air pipe is cracked dripping water or discharging air if such should gather inside the apparatus.

9. If it should be found that for low reservoir heads it is necessary to develop mechanical force for the opening of

the valve and if it is considered desirable to avoid this then partial vacuum may be made to assist in the opening of the valve. To prepare the apparatus for this condition close the needle valve and close the gate valve at end of waste pipe, turn the handwheel enough so that the button will just leave its seat, and when the air pipe of waste pipe begins to discharge water close the valve at end of this air pipe. Then open the gate valve and there will be partial vacuum back of the piston. By this means, an additional hydraulic force of from 15,000 to 45,000 lbs. (according to size of valve) is made available in the opening of the needle valve.

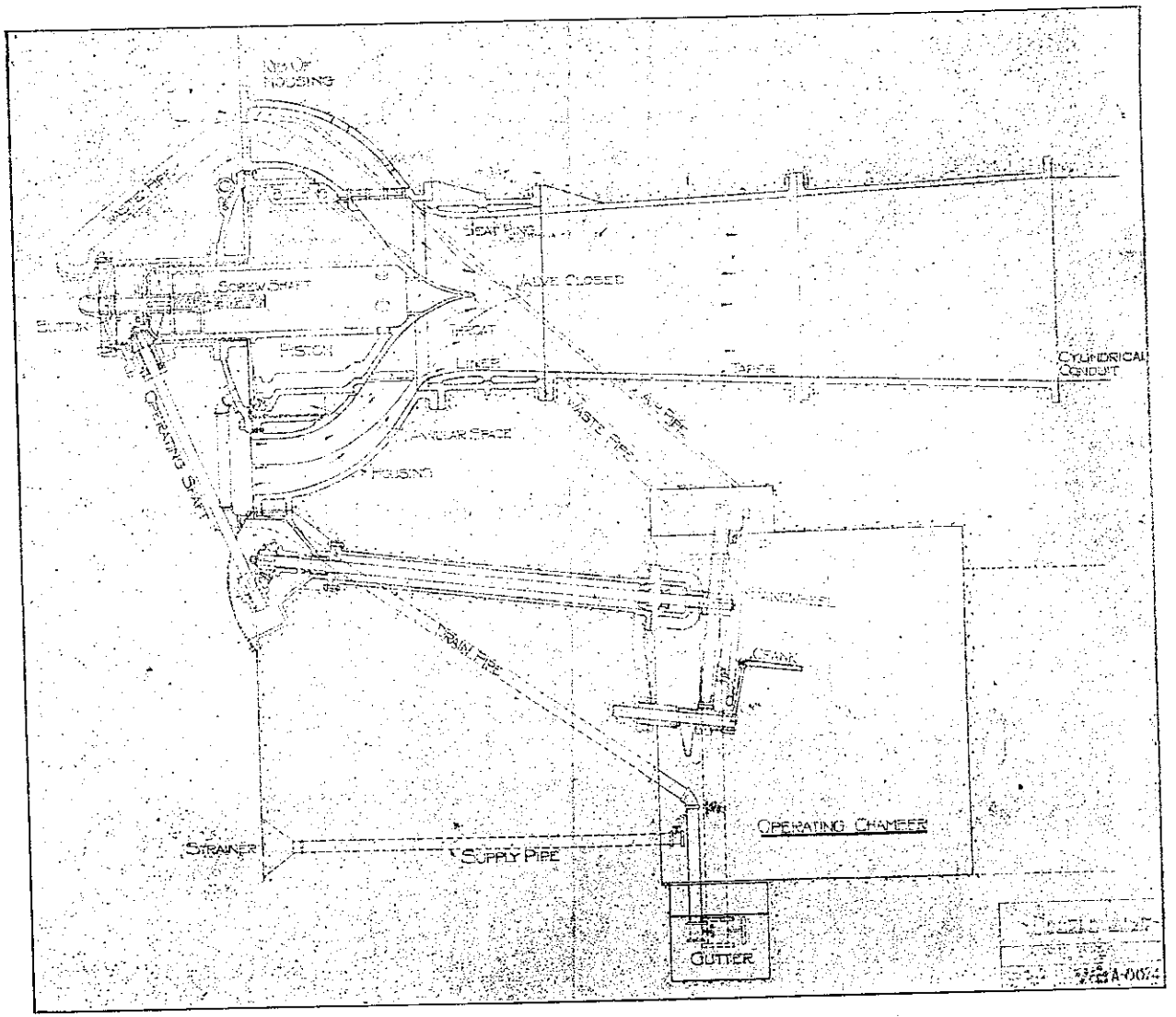
10. If the reservoir bottom holds limestone the water will absorb some carbonate of lime, due to the pressure of CO_2 in this water. As the water passes the bullring its pressure is reduced, the CO_2 is partially liberated and the carbonate of lime partially precipitated. This sediment in time accumulates in the chamber back of piston as muddy substance and should be let out at longer intervals. One way to do this is to remove the piece of flanged drain pipe at front face of needle valve (when occasion offers access to this face) and to wash out the chamber by means of a hose stuck into the tapped hole in upper part of cover. The other way is to perform this process from the operating chamber by opening the valve at lower end of drain pipe and if the waste pipe should be under vacuum by opening the air pipe of waste pipe. This process must be carried out only while the head over the valve is relatively low or harm may be done to the screw shaft, because, while the drain pipe is open, the screw shaft must take the whole load of the reservoir head on the piston pertaining to the annular space and the screw shaft can safely take such load only if reservoir level is sufficiently low above center line of needle valve. Which amount of head is permissible will be stated for each of the various sizes of needle valves.

11. The velocity of opening a needle valve depends merely on the velocity of turning the mechanism, provided the

waste pipe is big enough to take, without much resistance the water of leakage passing the bullring plus that of displacement. It follows then that too much leakage may retard the process of opening the valve. On the other hand the max. rate of closing a needle valve depends on the rate of leakage passing the bullrings. The leakage must fill the space vacated by the piston and for max. rate of closing of needle valve no leakage goes into the waste pipe, i.e. the operator must turn the screw shaft fast enough to always keep the button close to the inlet of waste pipe. In case it should be found that the max. rate of closing the valve is too slow then the deficiency in leakage is corrected by making a connection (1″ to 1-½″) from the supply pipe to the drain pipe and have the valve in this connection set and permanently locked by the engineer. He may change the adjustment of this valve when much higher or much lower reservoir levels are reached.

12. The various gate valves are shown as submerged in the gutter of operating chamber. This is done to avoid air being sucked into the apparatus thro possible leaks at such time when the valve works with partial vacuum.

The End.



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