

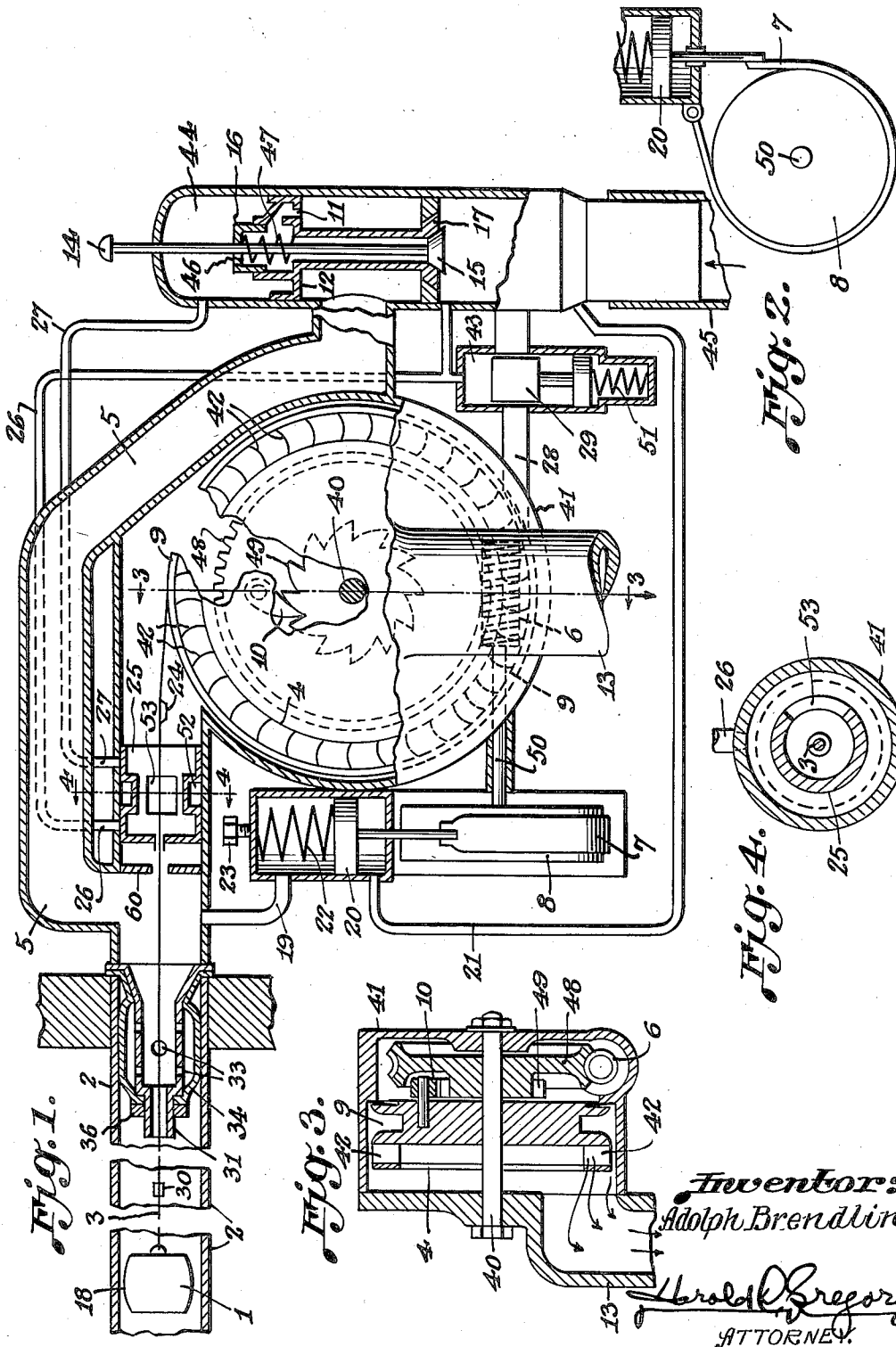
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APPARATUS FOR CLEANING TUBES

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APPARATUS FOR CLEANING TUBES

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My invention relates to improvements in apparatus for cleaning tubes, and more particularly to apparatus of this character which is operated by fluid under pressure and wherein the fluid is fed into the tubes with a strong flushing or washing action.

One of the objects of my invention is to provide improved apparatus of the character referred to which goes through the cleaning cycle in an entirely automatic manner, and which has advantages over the various constructions proposed heretofore in the way of compactness and lightness for easy manipulation, the amount of physical exertion required on the part of the operator, effectiveness of cleaning action, rapidity of operation, and ruggedness of construction.

Other objects and advantages will hereinafter appear.

One embodiment of my invention comprises, generally, a casing having a nozzle which is inserted into an open end of a tube or pipe to be cleaned. Journalled in the casing is a drum on which a flexible cable is wound, the cable passing freely through the nozzle and carrying at its outer end a plunger or cleaning element. A worm wheel is connected for rotation in one direction with the cable drum, and drives a worm to which a brake drum is fixed. A brake band disposed about the brake drum is released or tightened in accordance with occurring variations in the fluid pressure ahead of the cleaning element. In using the apparatus, the nozzle and the cleaning element projecting therefrom are inserted into the open end of the tube, and the water or other operating fluid under pressure is supplied to the nozzle. The nozzle is so designed that it expands under the fluid pressure and grips the inner wall of the tube so that no exertion on the part of the operator is required to hold the apparatus in place against the fluid pressure. The fluid, acting on the cleaning element drives the same through the tube, while the brake referred to automatically retards the movement so that the velocity of movement of the element is maintained substantially constant, as well as a relatively large pressure difference on opposite sides of the element. This substantially constant large pressure difference causes the fluid to flow between the tube wall and the cleaning element at very high velocity at all times, and to impinge upon any foreign deposits with a strong flushing or washing action. When the cleaning element reaches the end of its stroke, a control valve is automatically actuated to effect a reversal of the apparatus, whereupon the operating fluid acts

as the impelling force to rewind the cable on the drum and withdraw the cleaning element from the tube, back to its initial position at the nozzle, at which time the control valve is automatically reset to its former position. The apparatus is then inserted as before into another tube and, at the touch of a small control button by the operator, again goes through the complete operating cycle, traveling through the tube and then back in an entirely automatic manner.

For the purpose of illustrating my invention, a particular embodiment thereof is shown in the drawing, wherein

Figure 1 is a simplified elevational view, partly in section and partly diagrammatic of a tube-cleaning device constructed and operating in accordance with my invention, some of the parts being broken away to more clearly illustrate the relative positions of the various parts; and

Fig. 2 is a detail, elevational view looking toward the right in Fig. 1;

Fig. 3 is a reduced, sectional view, the section being taken on the line 3—3 in Fig. 1; and

Fig. 4 is an enlarged sectional view, the section being taken on the line 4—4 in Fig. 1.

With reference to Fig. 1, the particular disclosed embodiment of my invention comprises a cleaning element or plunger 1 secured to the end of a flexible cable 3 for which a drum 9 is provided. The drum is mounted for free rotation on a shaft 40 extending through the casing 41 and fixed at its ends in the side walls of the casing. The drum 9 carries suitable blades 42 to form, in effect, a Pelton water wheel 4.

The cable 3 passes through a sleeve valve 25 and an expansible holding nozzle 31 hereinafter more fully described.

When the apparatus starts its operating cycle, the valve 25 is in the position shown to close a passage 26 leading to a chamber 43 in front of a piston valve 29 and to close also a passage 27 leading to a chamber 44 above a piston 12.

In operation, the cleaning element 1 and the nozzle 31 are inserted into the open end of the tube 2 and the apparatus pushed home. The water under pressure from a supply connection 45 passes through the holes 33 in the rigid muzzle part of the nozzle and forces the flexible sleeve part 34 of the nozzle into firm gripping and sealing engagement with the tube, during which action an end collar 36 attached to the sleeve slides to the right on the reduced end of the muzzle to press the end of the sleeve between itself and the shoulder shown.

In initiating operating action of the apparatus,

the operator need only push down the button 14 to open a starting valve 15 and depress the piston 16 to simultaneously close a vent passage 11 in the piston 12. Water under pressure from the supply connection shown 45 then flows around the valve 15, through an opening 46 in the piston 16, and forces the piston 12 down to open a main supply valve 17 which is rigid with the piston 12, as represented. The water then flows through the passage 5 and the nozzle 31 to drive the cleaning element 1 through the tube, the drum 9 rotating to let out the cable 3. Since the passage 27 at this time is closed by the valve 25, as shown, the pressure builds up almost instantly in the chamber 44 and above the piston 12, and is entirely static pressure. The effective area above the piston 12 being greater than that below the same, this piston is held down by the pressure difference, and the main valve remains open although the operator may now release the button 14 and permit the small valve 15 to return to its seat against the main valve under the action of the spring 47.

It is to be noted, furthermore, that with the valve 25 in position to close the passage 26, the pressure in the chamber 43 will be relatively high and sufficient to hold the valve 29 down against the action of the spring 51, to close the nozzle 28 from the water supply.

An important feature of my invention resides in the fact that the cleaning element 1 is somewhat less than the diameter of the tube 2, together with the fact that although the pressure of the water may be high, the rate of movement of the cleaning element through the tube is automatically maintained substantially constant to maintain a high pressure difference between opposite sides of the element 1. This pressure difference between the two sides may be as high as 114 pounds gauge. The water therefore always flows at a high velocity through the annular space 13 between the element 1 and the tube, and impinges on the deposits or collected foreign matter with a strong flushing or washing action. To this end, the worm wheel 48 shown, and which is rotatable freely on the shaft 49, is driven by the drum 9 as the cable 3 unwinds during forward movement of the cleaning element through the tube. The driving connection, disposed between the worm wheel 48 and the cable drum 9, is in the form of a pawl 10 carried by the drum and an associated ratchet wheel 49 fixed to the worm wheel. The worm wheel meshes with the worm 6 having a proper pitch to permit the same to be driven by the worm wheel. The worm is supported for free rotation and is fixed on one end of a shaft 50 which carries at its other end a brake drum 8 about which is disposed a band 7 connected to a piston 20. A connection or passage 21 provides that the pressure below the piston 20 is always the same as the pressure in the water supply connection 45. A connection or passage 19 provides that the pressure above the piston 20 varies with the pressure at the outlet end of the passage 5, or, in other words, with the pressure on the high pressure side of the element 1. The piston 20 is urged upward by the fluid pressure in the connection 21 and is urged downward by a compressed spring 22 and the fluid pressure in the passage 5 at the connection 19. The stiffness and adjustment of spring 22 by the screw 23 are such that when the pressure back of the element 1 builds up to a certain value, the downward force on the piston 20 predominates to release the brake and permit the worm 6 to be

driven by the worm wheel. If, however, the pressure back of the element 1 drops below the desired value due to a sudden increase in the rate of forward movement of the element 1, the upward force on the piston will predominate to apply the brake. From the foregoing, it will be seen that the water pressure is utilized to control automatically the rate of forward movement of the cleaning element 1, whereby a high and predetermined pressure difference between opposite sides of the element 1 is maintained, and whereby the rate of movement of the element is maintained substantially constant regardless of the fact that the supply pressure might be very high and might vary. It will also be seen that the rate of forward movement of the cleaning element may be varied by adjusting the screw 23. By the arrangement wherein the worm wheel drives the worm 6, only a relatively small braking action is required on the brake drum 8, so that the speed-control parts are very sensitive to occurring variations in the pressure of the water in passage 5.

When the cleaning element travels through the tube to unwind all of the cable, a member 24 fixed on the cable strikes the valve 25 and moves it to the left against the wall 56, to open the passages 26 and 27. The pressure in these passages then drops immediately, since they then open, through the annular passage 52 and the opening 53 in the valve, into the interior of the casing of the device and to the exhaust pipe 13 which always provides a free outlet for fluid from the casing. The pressure above the piston 12 now being relieved, the main valve 17 closes instantly because of the water pressure in the supply connection. Also, the pressure above the piston valve 29 now being relieved, the spring 51 becomes effective to move the same upwardly to admit water to the nozzle 28 for the Pelton wheel 4. The wheel 4 then rotates the drum 9 in the reverse direction to rewind the cable 3 and withdraw the element 1 from the tube, during which time the pawl 10 rides over the teeth of the associated ratchet wheel 49 which is fixed to the worm wheel 48. The water supplied to the Pelton wheel finds an outlet by way of the pipe 13.

As the cleaning element is withdrawn, the air ahead of it is allowed to escape by way of the opening 46, passage 5, vent 11, passage 27 and through the casing 41 to the exhaust pipe 13.

When the cleaning element has been returned to substantially its initial position, a lug 39 carried by the cable engages the valve 25 to return the same to its righthand position, whereat the valve again closes the passages 26 and 27. Upon the closing of passage 26, the pressure above the piston valve 29 is again permitted to build up to close this valve against the action of the spring 51. The water supply to the Pelton wheel is, accordingly, cut off.

From the foregoing it will be seen that I have provided improved apparatus which, after the operator presses down the button 14 and then releases it, automatically goes through its operating cycle, the cleaning element 1 being driven forward the length of the cable and returned to the starting position at the nozzle 31. It will further be seen that the cleaning action is very effective on account of the high velocity at which the water flows between the tube and the element 1 and impinges on the deposits, this being attributed to the high pressure difference which the automatic brake maintains. Further, the operator is relieved of all unnecessary exertion by the

expansible nozzle 31 which takes all the axial thrust.

Although but one embodiment of my invention has been disclosed, various modifications, such as in the size, shape and arrangement of the parts, may be made without departing from the spirit of my invention or the scope of the claims.

The invention claimed is:

1. In tube-cleaning apparatus, an element for insertion into a tube, means for supplying fluid under pressure to the tube and back of said element to impel the same through the tube, a cable to which said element is attached, a rotatable drum for said cable, a worm wheel driven by said drum as said element is impelled through the tube, a worm driven by said wheel, and brake means for controlling the rate of rotation of said drum and connected to said worm whereby a relatively large gear reduction is obtained from said worm wheel to said worm and brake means.

2. In tube-cleaning apparatus of the character described, a casing, an element for insertion into a tube, a flexible cable to which said element is secured, a drum for said cable rotatably mounted in said casing, means for supplying fluid under pressure to said element to impel the same through the tube, a worm wheel connected to said drum for rotation therewith during forward movement of said element through the tube, a worm driven by said worm wheel, a brake drum fixed for rotation with said worm, and means responsive to conditions of fluid pressure on one side of said element and operable in accordance with such conditions to apply a braking force to said brake drum.

3. In tube-cleaning apparatus of the character described, a casing, an element for insertion into a tube, a flexible cable to which said element is secured, a drum for said cable rotatably mounted in said casing, means for supplying fluid under pressure to said element to impel the same through the tube, a fluid-impelled wheel for rotating said drum to wind up said cable, a connection for supplying the fluid under pressure to said wheel, and valve means for cutting off the fluid supply to said wheel during rotation thereof in letting out said cable, said valve means being controlled for such purpose by the pressure of the fluid.

4. In tube-cleaning apparatus of the character described, a casing provided with a nozzle for insertion into a tube and expansible responsive to fluid under pressure flowing through the same, a cable drum rotatably mounted in said casing, a cable secured to said drum and passing through said nozzle, a tube-cleaning element secured to the outer end of said cable, and a connection for supplying fluid under pressure to said nozzle.

5. In tube-cleaning apparatus of the character described, an element for insertion into a tube, a casing, means for supplying fluid under pressure to said element to impel the same through the tube, a flexible cable to which said element is secured, a drum for said cable mounted in said casing for rotation in a given direction to let out

said cable during forward movement of said element through the tube, motor means connected to said drum for effecting reverse rotation thereof to retract said element from the tube, and control means actuated by said cable and operable when so actuated to control operating action of said reversing motor means.

6. In tube-cleaning apparatus of the character described, a flexible cable, an element for insertion into a tube and secured to one end of said cable, a drum for said cable, means for supplying fluid under pressure to said element to impel the same through the tube and to unwind the cable from said drum, a motor for rewinding said cable and connected to the drum for such purpose, valve means for controlling said motor, and means disposed on said cable to actuate said valve means when said cable has been unwound from said drum.

7. In tube-cleaning apparatus of the character described, an element for insertion into a tube, means for supplying fluid under pressure to said element to impel the same through the tube, a device connected to said element for controlling the rate of movement thereof through the tube, and control means for said device responsive to conditions of a change in pressure of the fluid and operable upon occurrence of such conditions to actuate said device to effect a corresponding change in the rate of movement of said element.

8. In tube-cleaning apparatus of the character described, an element for insertion into a tube, means for supplying fluid under pressure to said element to impel the same through the tube, means for retarding the movement of said element through the tube, and means responsive to conditions of a decrease in the fluid-pressure on the high-pressure side of said element and operable upon occurrence of such conditions to effect retarding action of said retarding means.

9. In tube-cleaning apparatus of the character described, an element for insertion into a tube, means for supplying fluid under pressure to said element to impel the same through the tube, a brake for retarding movement of said element, and means operable by the fluid-pressure to effect braking action of said brake.

10. In tube-cleaning apparatus of the character described, a casing, an element for insertion into a tube, means for supplying fluid under pressure to said element to impel the same through the tube, a flexible cable to which said element is secured, a drum for said cable rotatably mounted in said casing, a worm wheel connected to said drum for rotation therewith during forward movement of said element through the tube, a worm driven by said worm wheel, a brake drum fixed for rotation with said worm, and means responsive to conditions of the fluid-pressure on the high-pressure side of said element and operable to apply a braking force to said brake drum which varies inversely proportionally to occurring variations in such conditions.

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