

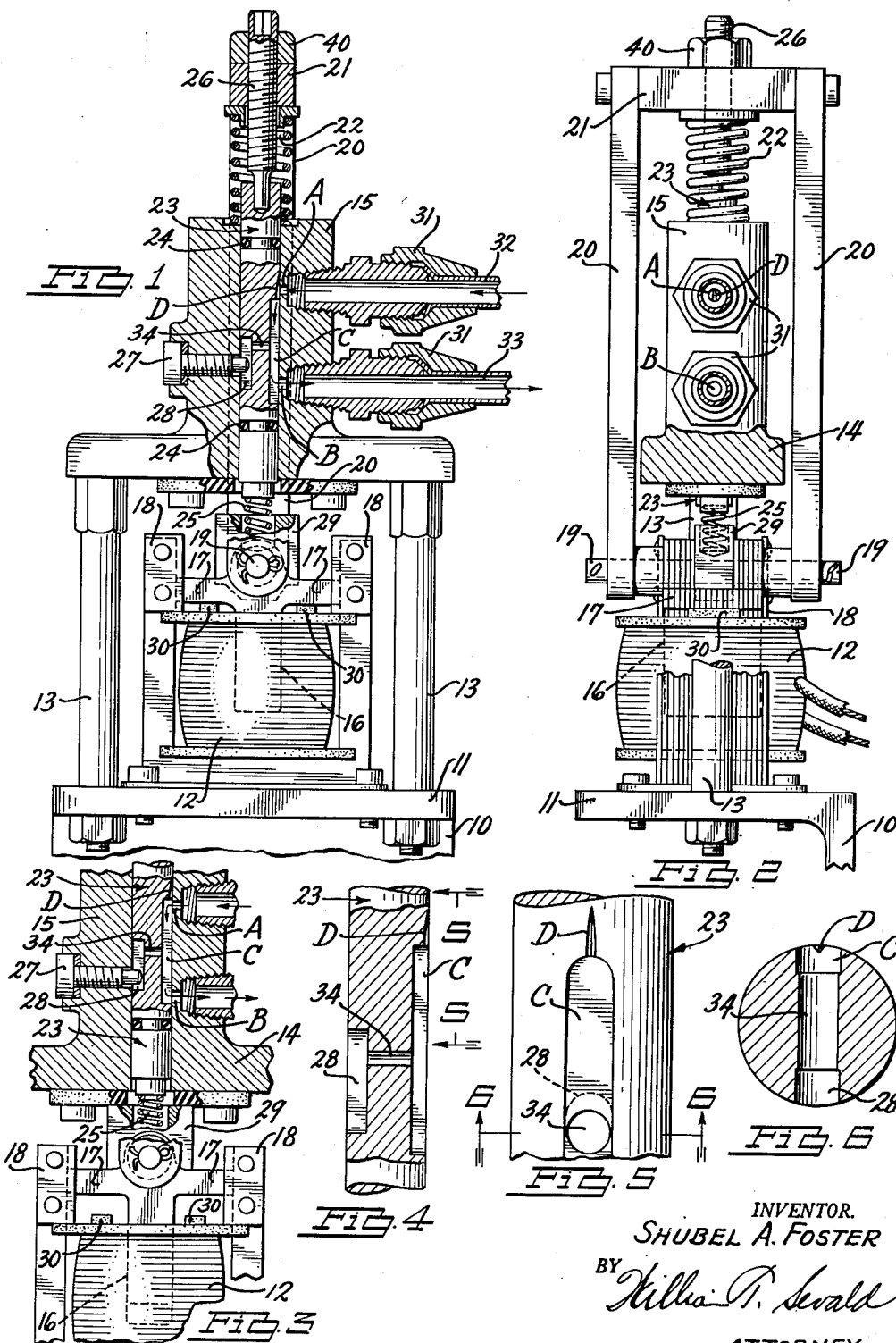
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THROTTLE VALVE

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THROTTLE VALVE

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This invention relates to liquid flow-regulators and throttles and in particular to improvements in a "needle-point channel" throttle for controlling the rate or volume of flow of liquid under pressure.

Regulators and throttles of the minute vent type and valves of the needle type have been used to control the flow of liquid under pressure, however, the several devices of the prior art have not proven entirely satisfactory inasmuch as the vents and needles are neither subject to variable adjustment nor are they conducive to compensation for wear; they also plug easily and are difficult to clean without damaging the parts and have no integral construction or means suitable to prevent plugging or to dislodge a plug in the event of plugging.

With the foregoing in view, the primary object of the invention is to provide a "needle-point channel" or groove throttling device which is variably adjustable as to the rate or volume of liquid flow and compensatable for wear to maintain a definite rate of liquid flow.

An object of the invention is to provide a liquid flow regulator which is easily positioned in a line to throttle the flow of liquid therethrough.

An object of the invention is to provide a liquid flow throttle which has integral construction or means to prevent plugging.

An object of the invention is to provide a liquid flow throttle which has integral construction or means to clear itself if it should become plugged at each cycle of the device or at each time the device is moved from throttling to non-throttling position.

An object of the invention is to provide a liquid flow throttle which is easily incorporated with either manual or automatic controls.

An object of the invention is to provide a liquid flow throttle which is not conducive to damage in the event cleaning is necessary.

Other objects of the invention will become apparent by reference to the following description of a "needle-point-channel" throttle or regulator embodying the invention taken in connection with the accompanying drawing, in which:

Fig. 1 is a side elevational view of the inventive device with a portion thereof shown in cross-section to illustrate internal parts and construction showing the device in throttling condition.

Fig. 2 is a side elevational view of the inventive device 90 degrees removed from the position shown in Fig. 1.

Fig. 3 is a partial view of the inventive device as seen in Fig. 1 showing the device in non-throttling condition.

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Fig. 4 is an enlarged view of the central portion of the piston showing the "needle-point-channel or groove" in longitudinal cross-section.

Fig. 5 is greatly enlarged view of the central portion of the piston showing the "needle-point-channel or groove" in elevation; and

Fig. 6 is a cross-sectional view of Fig. 5 taken on the line 6-6 thereof showing the "needle-point-channel or groove" in end elevation.

Referring now to the drawing wherein like numerals refer to like and corresponding parts throughout the several views, the liquid regulator or throttle shown therein to illustrate the invention comprises an attaching bracket 10, a base 11 integral with the bracket 10, a solenoid coil 12 mounted on the base 11, posts 13 seated in the base 11 extending above the coil 12, a bar 14 mounted on and spanning the posts 13, a block or housing 15 mounted on the bar 14 preferably integral therewith and having a chamber axially disposed over the coil 12, a solenoid core 16 disposed within the solenoid coil 12, a guide arm 17 on the core 16, guides 18 channeling the core 16 via the arm 17 in the guides 18, a wrist pin 19 positioned transversely in the arm 17, connecting rods or links 20 on the pin 19 extending above the block 15, a truss or arm 21 disposed between the upper ends of the links 20, a spring 22 disposed under compression between the block 15 and the truss or arm 21 normally lifting the core 16 out of the coil 12 via the links 20, the pin 19, and the arm 17; a piston 23 endwise movably disposed in the chamber of the block 15, O rings 24 disposed in annular grooves in the piston 23 endwise sealing the piston 23 in the chamber of the block 15, a spring 25 disposed under compression between the lower end of the piston 23 and the arm 17 or core 16 normally urging the piston 23 upwardly in the block 15, a set-screw 26 threaded in the truss or arm 21 relatively rotatably disposed on the upper end of the piston 23 for adjusting the piston 23 endwise relative to the block 15 against the spring 25, a key 27 in the block 15 disposed in the keyway 28 of the piston 23 preventing relative rotation between the piston 23 and the block 15 but permitting limited endwise relative movement therebetween, a lock-nut 29 for securing the set-screw 26 in adjusted position, a collar 29 housing the spring 25 adapted to contact the bottom of the bar 14 to limit the upward travel of the piston 23 via the arm 17, links 20, truss 21 and set-screw 26; stops 30 on the core 12 for limiting the downward travel of the piston 23 via the arm 17, links 20, truss 21, and set-screw 26; liquid line fittings 31 threaded in the block 15, an intake oil line 32 leading from the cylinder

or machine to be regulated to one fitting 31, an outlet liquid line 33 leading from the other fitting 31 to an oil reservoir or other suitable device, spaced orifices A and B in the housing or block 15 leading to the piston chamber of the block 15, communicating with the intake liquid line 32 and outlet liquid line 33 respectively, a longitudinal groove or slot C in the piston 23 permitting free communication between the orifices A and B allowing free flow between the intake liquid line 32 and the outlet liquid line 33 when the piston 23 is in its upward position with the solenoid coil 12 not energized as urged by the spring 25 against the set-screw 26, as seen in Fig. 3; a diminishing or feathering needle-point-channel or groove D on the piston 23 leading from the piston slot C at the channel D's larger end to termination or extinction on the surface of the piston 23 at a point removed from the slot C with the channel D diminishing in width and depth away from its point of juncture with the slot C; the channel D restricting or throttling free communication between the orifices A and B when the piston 23 is in its downward position when the solenoid coil is energized as seen in Fig. 1 with the relation between the needle-point-channel D and the orifice A being adjustable as to the point of communication on the diminishing cross-section of the channel D with the orifice A to selectively regulate or throttle the liquid flow between the lines 32 and 33 with the point of communication between the needle-point-channel D and the orifice A being adjustable via the spring 25 and the set-screw 26 for selectively adjusting the downward travel of the piston 26 as activated by the energizing of the solenoid coil 12 via the arm 17, pin 19, links 20, truss 21, and set-screw 26 against the spring 25; and a channel 34 connecting the slot C with the keyway 28 for equalizing fluid pressure on either side of the piston 23.

Relative to the action of the device, the spring 22 stations the linkage and solenoid core 16 in the up, inactive position while the spring 25 stations the piston 23 in the up or non-throttling position against the set-screw 26. The solenoid coil 12 draws the core 16 and linkage downwardly against the spring 22 with the set-screw 26 depressing the piston 23 relative to the block 15 against the spring 25, and it is important to note, that, while the spring 25 may be positively abutted, it is preferably variably abutted by the solenoid core 16 so that the spring 25 moves up and down with the piston and associated linkage furnishing the resilient adjustment relative to longitudinal position between the piston 23 and its activating linkage. In other words, in the preferred illustrated embodiment, all the moving parts move up and down together with the spring 25 and set-screw 26 providing means for adjusting the longitudinal position of the piston 23 relative to the linkage and the block 15 so that the "needle-point-channel" D can be adjusted as to longitudinal point of communication in its diminishing cross-section with the supply orifice A for selectively adjusting the rate of regulating or throttling of the liquid flow between the orifices A and B via the slot C.

In operation, the device is installed in exhaust line of a liquid system, such as a hydraulic cylinder, where it is desired to finely throttle the exhaust flow from the system at a certain time or for a set period such as on a hydraulically-fed machine to slowly advance the feed to facilitate finish working. In this instance, the exhaust

flow is unthrottled via the slot C of the inventive device during the initial stages of working, or stock removal, and then, at the finishing stage, the solenoid coil 12 is powered to activate the inventive device so that the piston 23 moves the needle-point-channel D into selected constricting relation with the orifice A thereby throttling the liquid flow from the hydraulic cylinder slowing down the feed in the machine to facilitate finish working. Obviously, many other uses for the device can easily be recognized by those skilled in the art of liquid systems, and it has been found that a needle-point-channel .006" wide and .015" deep in maximum cross-section at the point of juncture with the slot C tapering to extinction or termination in a longitudinal distance of .250" is suitable for throttling and, obviously, these specifications may be varied as desired and water or air can be substituted for oil as the liquid or fluid to be regulated.

Relative to adjustment of the inventive device to achieve different rates of flow of the liquid or fluid being regulated, the piston 23 is adjustable relative to the block 15 as to its farthest downward position in its stroke via the setscrew and the spring 25 so that at the bottom of the stroke of the piston 25, as activated by the described linkage, the point of communication on the needle-point-channel D which is communicating with the orifice A can be varied so that the diminishing cross-sectional area of the channel D can be adjusted relative to the orifice A to adjustably determine the rate of throttling via the selected point on the diminishing channel D. In other words, the rate of throttling can be varied by varying the bottom position of the piston 23 which in turn positions either a larger cross-section of the needle-point-channel D or a smaller cross-section of the needle-point-channel D at the orifice A to provide adjustable fine throttling of the flow at the orifice A.

In the event one rate of throttling is desired, this rate can be determined and set on the device. However, due to the fact that fluid or liquid under pressure is highly abrasive, the cross-sectional area of the slot D communicating with the orifice A will become worn and enlarged permitting more flow than desired; in this event, the device can then be re-set with a smaller cross-section of the channel D communicating with the orifice A achieving the first desired rate of flow and compensating thereby for the interim wear on the piston 23 due to the abrasive action of the liquids flowing thereon.

If a clot is present in the fluid, it will enter the inventive device at the orifice A and if the clot is small enough to enter the needle-point-channel D, it will immediately be ejected therefrom due to the fact that its point of entry will be the smallest point of the channel containing flow and due to the fact that the walls expand in the direction of the rate or flow, the clot will be ejected from the needle-point-channel D.

However, in the event the clot is larger than the communicating cross-sectional area of the channel D, the clot will not enter the channel D but will position itself over the channel preventing further flow of the liquid or fluid; this clot will be cleared when the piston 23 rises in the block 15 taking the needle-point-channel D out of communication with the orifice A and putting the slot C into full communication with the orifice A, which slot C, being as cross-sectionally large as the orifice A, will easily communicate the

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slot out of the inventive device thereby eliminating clogging.

Should a clot jam in the needle-point-channel D, and should the piston 23 have to be removed from the block 15, the clot can be dislodged from the channel D with an instrument without damaging the slot D due to the fact that the channel D increases in one direction and even in the event that the channel D should become scored or enlarged due to the necessary cleaning, the variable adjustable characteristics of the device will allow the device to be adjusted to compensate for the slight enlargement of the channel D resulting from the cleaning.

Although but a single embodiment of the invention has been shown and described in detail, it is obvious that many changes may be made in the size, detail, shape, and arrangements of the elements of the invention, such as narrowing the needle-point-slot D in depth only or in width only, or providing manual or other controls, within the scope of the appended claims.

I claim:

1. In a liquid volume of flow regulating device for selectively controlling the volume of flow of liquids under pressure, a housing having a piston chamber and two spaced liquid conducting orifices communicating with said chamber, a piston disposed in and normally filling the chamber of said housing to seal said chamber, said housing having a slot permitting communication between the spaced orifices for freely transmitting liquid from one orifice to the other and having a diminishing needle-point-groove communicating with the slot

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at one end thereof; said piston being movable relative to said housing to move the slot out of communication with one of the orifices of said housing and to move the needle-point-groove into communication with said one orifice for restricting the flow of liquid between the orifices, said needle-point-groove diverging in the direction of flow of said fluid when flowing from one orifice to the other whereby said needle-point-groove presents its smallest cross-section to said one orifice and constantly increases in cross-section in a direction toward said other orifice.

2. In a liquid volume of flow regulating device as set forth in claim 1 wherein said piston is provided with adjusting means enabling said needle-point-groove to be adjusted to a desired position for varying the flow of said liquid.

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