Dec. 13, 1960 P. A. GUENTHER 2,964,063

ORIFICE FITTING

Filed Dec. 29, 1958 3 Sheets-Sheet 1

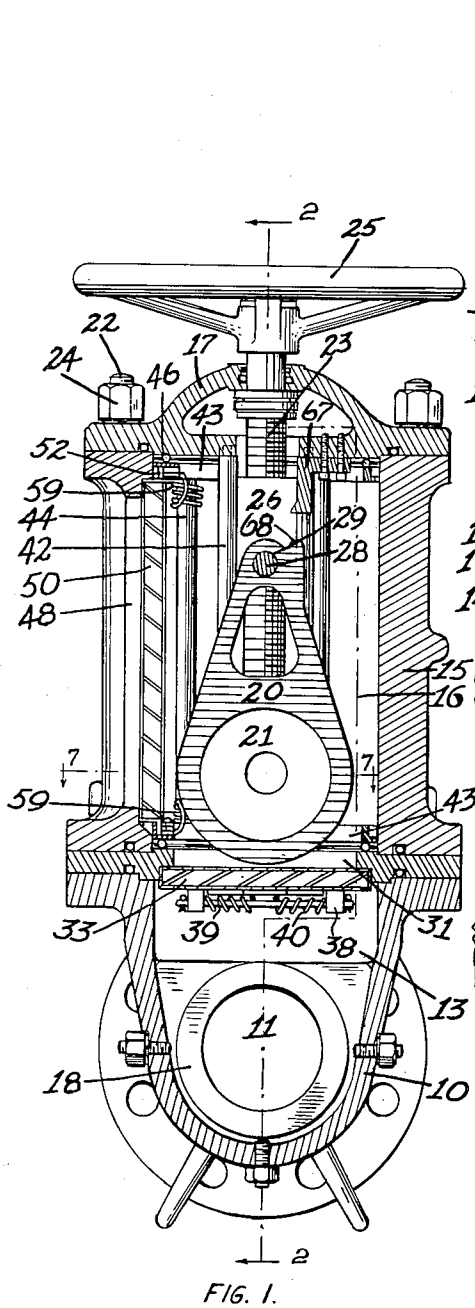


FIG. 1.

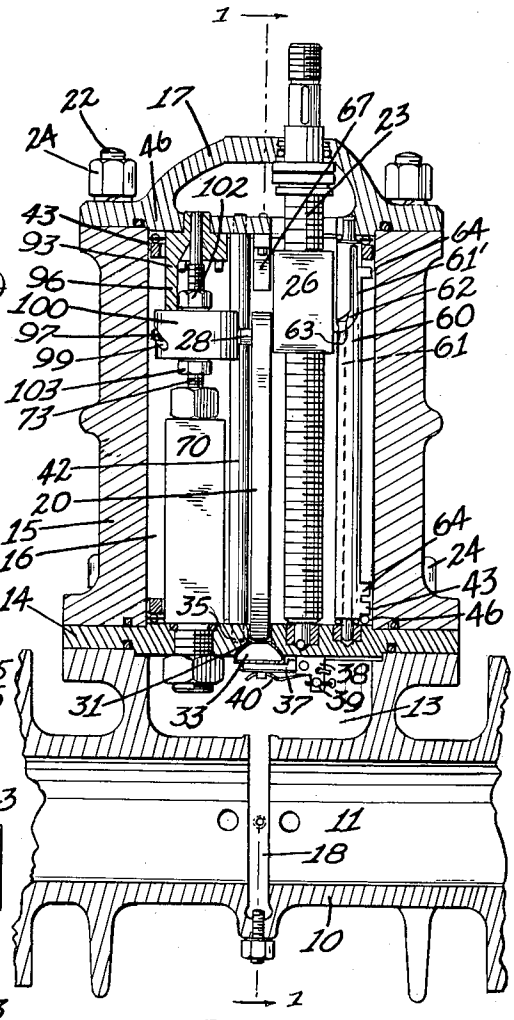


FIG. 2.

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ORIFICE FITTING

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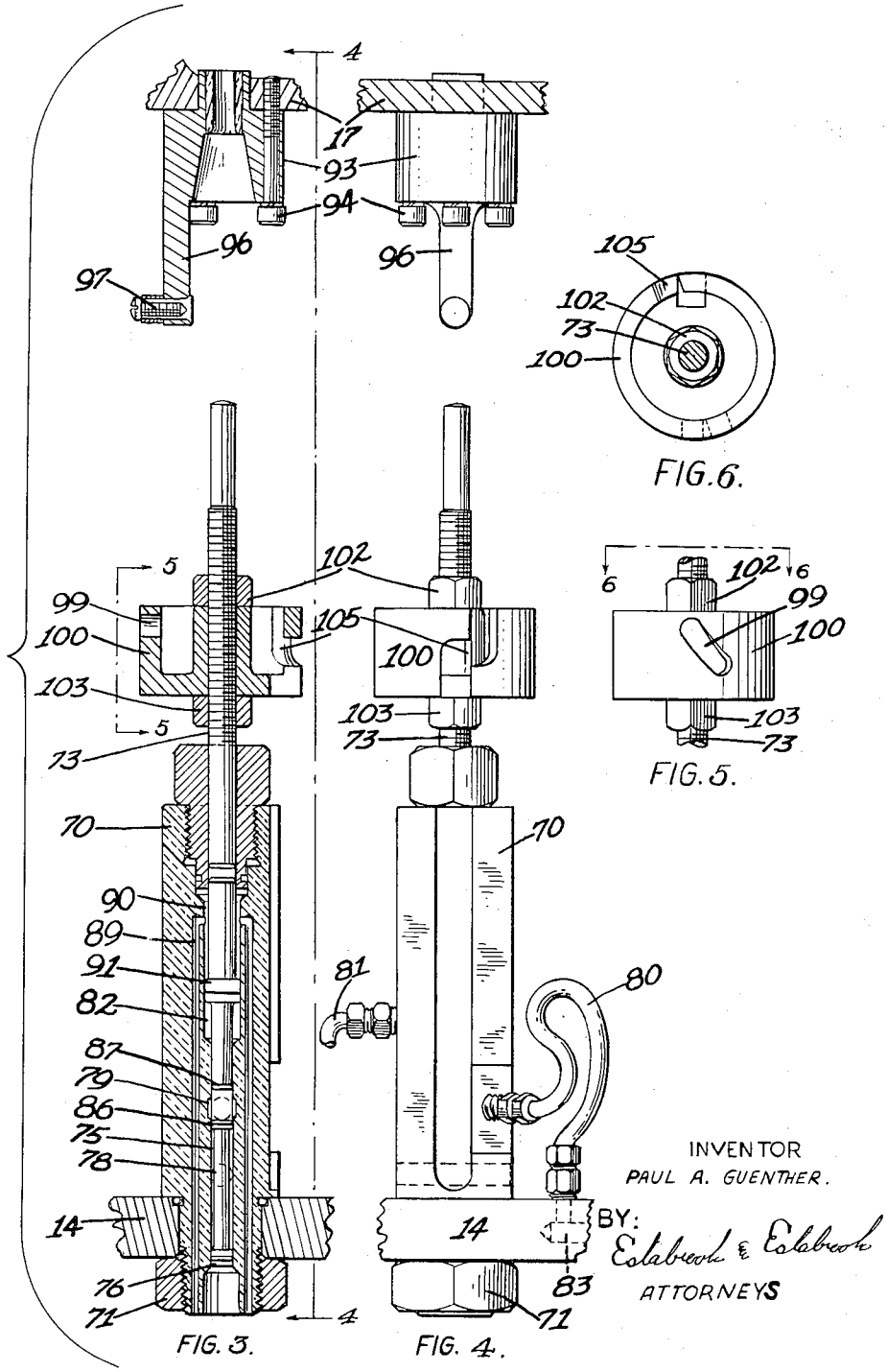


FIG. 6.

FIG. 5.

FIG. 3.

FIG. 4.

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ORIFICE FITTING

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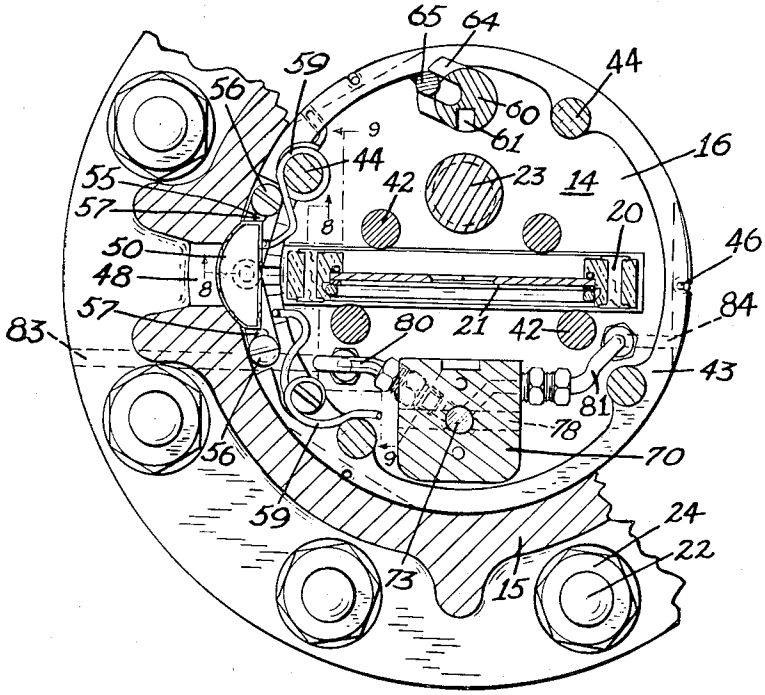


FIG. 7.

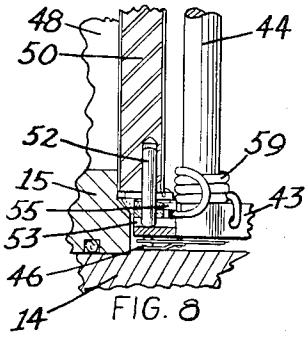


FIG. 8

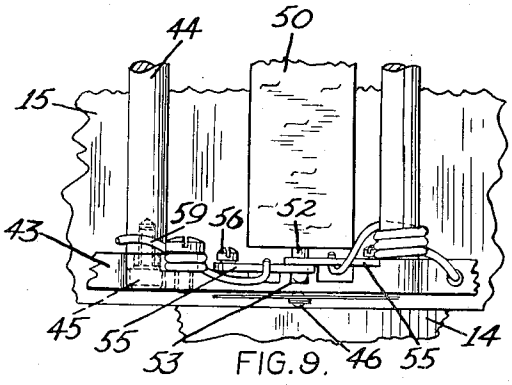


FIG. 9.

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ORIFICE FITTING

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6 Claims. (Cl. 138—44)

This invention relates to an improvement in an orifice fitting which is installed in a pipe line to provide a means for creating or establishing a differential pressure in the line of flow. This differential pressure will be measured or recorded by an orifice meter which is connected to the orifice fitting; however, the orifice meter is not a part of this invention.

In this invention the fitting is provided with upper and lower chambers, in which the pressure is equalized when the orifice plate is located in the pipe line, and an object of the invention is to provide means for exhausting the pressure in the upper chamber by the mechanism employed when elevating the orifice plate within the upper chamber; said mechanism to open a door in the upper chamber when the pressure is exhausted; then to move said orifice plate through the door opening; and when the orifice plate is to be returned to the line of flow the cycle of operation is reversed.

In the accompanying drawings,

Fig. 1 is a vertical sectional view taken on the line 1—1 of Fig. 2;

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a disassembled view in section of valve mechanism;

Fig. 4 is a disassembled view of the valve mechanism in elevation taken along line 4—4 of Fig. 3;

Fig. 5 is a detailed view in elevation taken along the lines 5—5 of Fig. 3;

Fig. 6 is a top plan view taken along the lines 6—6 of Fig. 5;

Fig. 7 is a horizontal sectional view taken along lines 7—7 of Fig. 1;

Fig. 8 is a vertical sectional view partly in elevation taken along the lines 8—8 of Fig. 7; and

Fig. 9 is a similar view along the lines 9—9 of Fig. 7.

The orifice fitting comprises a base casting 10 provided with a longitudinal passageway 11 for the flow of gas or other fluid. This casting is inserted into a main through which gas or fluid flows and is connected thereto in a conventional manner. Located above this passage 11 is a lower chamber 13 and a plate or partition 14 is mounted on the casting 10 over the chamber for forming a cover therefor. Mounted on the partition plate 14 is a cylindrical housing 15 providing an upper chamber 16. A cover 17 is mounted on the cylinder housing to form a closure for the upper chamber 16. The base 10, plate 14, housing 15 and top 17 are all connected together by bolts 22 and nuts 24 to provide fluid tight chambers 13 and 16.

The base 10 is provided with a recess 18 which extends transversely of the passage 11 and provides communication between the passage 11 and the lower chamber 13. An orifice plate carrier 20 having an orifice plate 21 is adapted to be seated in the recess so that the orifice plate 21 thereof is in the line of flow of the fluid through the passage 11. The orifice plate 21 is intended to be calibrated and the calibration of said plate may be established by machining the inside diameter of said plate to a desired dimension within ±0.0002 of one inch.

A lead screw shaft 23 is eccentrically mounted in the housing 15 and has one end thereof journalled in the partition plate 14 and its upper end in the top or cover 17. The screw shaft 23 is rotated by a hand wheel 25 and mounted on the shaft is a non-rotatable nut 26 having screw threaded engagement with the shaft for longitudinal movement of the nut upon the rotation of the shaft.

The orifice plate carrier 20 is pivotally mounted on the nut 26 by means of a pin 28 which extends laterally from one side of the nut 26 through an opening 29 in the orifice plate carrier. Upon the rotation of the screw shaft 23, the nut 26 is moved longitudinally of the shaft 23 and in so doing the orifice plate carrier 20 is moved into and from the upper chamber 16. The partition plate 14 is provided with an elongated slot 31 through which the orifice plate carrier 20 passes in its movement from the chamber 16 and into the recess 18. When the orifice plate carrier is drawn up into the chamber 16 of the housing 15, this elongated slot 31 is closed by a spring actuated valve door 33. The valve door 33 is preferably convex to fit the concaved seat 35 in the lower side of the plate 14 for the normal closing of the slot 31 when the orifice plate carrier is drawn into the housing 15 and the chamber 16. The valve door 33 is provided with an arm 37 which is pivotally mounted to a bearing block 38. A shaft 39 is supported by the bearing block 38 and coil springs 40 are connected to the shaft and held in engagement with the valve door 33 for urging the door to closed position. As illustrated in Figs. 1 and 2, when the orifice plate carrier has been drawn into the housing 15, the valve door 33 will immediately close the opening and slot 31 and cut off any communication between the chamber 13 and the chamber 16. The fluid pressure in the passageway 11 and chamber 13 will also act upon the door 33 to maintain it in a closed position.

Disposed on each side of the orifice plate carrier 20 are series of posts 42 which posts are mounted and supported between the partition plate 14 and the top 17. These posts act as guides in the travel of the orifice plate carrier 20 and nut 26 within the chamber 16 of the housing 15.

Arranged within the housing 15 are annular rings 43, the lower ring being supported upon the partition plate 14 and the upper ring being disposed adjacent the top 17. The two rings 43 are held in spaced relation by means of a plurality of rods 44 interposed at intervals between the rings and are connected thereto by means of screw bolts 45, as illustrated in Fig. 9, so that the rings and rods function as a cage and are adapted to be rotated within the housing. Anti-friction means 46 are provided between the rings 43 and the plate 14 and top 17 of housing 15. The housing 15 is provided with a vertical opening 48 in the wall thereof through which the orifice plate carrier swings for inspection of the orifice plate 21, and this opening 48 is normally closed by an upper door 50 similar to the valve door 33. This door 50 is provided with eccentric trunnions 52 at each end and which are journalled in slots 53 (see Fig. 8) of the rings 43. The trunnions 52 extend through the ends of two overlapping links 55 and these links are connected to the rings 43 by screws 56 extending through elongated slots 57 in the opposite ends of the links. This arrangement permits, on the rotation of the rings 43, for the door 50 to rotate with the rings and to be drawn inwardly into the housing so that the door can be moved past the opening 48. The links 55 will draw the trunnions 52

along the slots 53 inwardly of the housing so that the door can be moved past the opening 48, and upon a reverse rotation of the rings 43 the door 50 will again be seated for closing the opening 48. Each link 55 has an end of a spring 59 connected thereto, and each spring is connected to a post 44 to provide enough tension to cause the door to be urged into the opening 48 for sealing off the opening in the chamber 15.

A rotary shaft 60 has its ends journalled in the top 17 and plate 14 and is arranged parallel to the screw shaft 23 and disposed between the wall of housing 15 and nut 26. The shaft 60 is provided with a groove which extends longitudinally or axially thereof. This axial groove is made in two sections, 61 and 61'. The groove section 61 extends from the lower end of the shaft 60 upwardly throughout the greater portion of the length of said shaft, while the groove section 61' extends from the upper end of the shaft 60 downwardly. The lower end of the groove section 61' is connected to an end of a spiral groove 62 while the upper end of the groove section 61 is connected to the other end of the spiral groove 62, and thus this spiral groove 62 intersects with the upper end of the groove 61 and the lower end of groove 61'. This is possible because groove section 61 and groove section 61' are arranged axially of shaft 60 at approximately 136° apart, so that we have a continuous groove running lengthwise of the shaft 60 by means of the two sectional grooves 61 and 61' and spiral groove 62. A pin 63 on the nut 26 travels in the axial grooves 61 and 61' and spiral groove 62 of the rotary shaft 60 in the up-and-down movement of the nut 26 on the screw shaft 23 in the raising and lowering of the orifice plate carrier 20 into and from the upper chamber 16 of the housing 15.

The rotary shaft 60 is provided adjacent each end thereof with forked bosses 64 which engage a rod 65 connected to the inner circumference of the rings 43. That is, this rod 65 extends from the upper ring to the lower ring 43 and is rigidly connected thereto. The movement of the nut 26 upwardly on the screw shaft 23 and with the pin 63 in engagement with the spiral groove 62 will rotate the shaft 60 and cause the two rings 43 to be rotated to withdraw the door 50 from the opening 48 in the side wall of the housing 15 against the action of the springs 59. When the door 50 has cleared the opening 48 in the housing, the pin 63 will have travelled through the spiral groove 62 and entered the upper groove section 61' as the nut 26 continues its upward movement. The shaft 60 and the rings 43 are now stationary but the continued movement of the nut 26 will cause the upper portion of the orifice plate carrier 20 to engage a depending leg 67 connected to the top 17. The leg 67 will contact a shoulder or abutment 68 on the pivoted end of the orifice plate carrier 20 and cause the orifice plate carrier 20 to be swung laterally through the opening 48 of the housing, so that the orifice plate 21 and orifice thereof may be examined and inspected for any defects which might impair the proper functioning of the orifice plate 21. The orifice plate carrier 20 will be retracted and drawn into the chamber 16 upon the lowering of the nut 26 on the screw shaft 23, and disengaging the leg 67 from the abutment 68.

On the downward movement of the nut 26, the pin 63 will travel downwardly in groove 61' and into the spiral groove 62 and rotate the shaft 60. The rotation of shaft 60 will rotate the rings 43 and bring the door 50 onto its seat for closing the opening 48 in the wall of the housing 15. The continued downward movement of the nut 26 will cause the pin 63 to go into the longitudinal groove 61, whereupon the shaft 60 will be held against rotation and the orifice plate carrier 20 will be lowered against the valve door 33 causing it to swing into the chamber 13 and allow the orifice plate carrier 20 to again be seated in the recess 18 in the casting 10.

In most orifice fittings, the fluid pressure in the chambers 13 and 16 is the same when the orifice plate carrier 20 is positioned in the line of flow of the passage 11. When the orifice plate carrier 20 is drawn into the upper chamber 16, and it is desired to have the orifice plate moved through the opening 48 thereof for inspection, it is necessary to evacuate or exhaust the pressure from the upper chamber 16 before the door 50 can be opened, because of the great force or power that would be required to overcome the pressure in operating the door. To overcome this objection, a valve 70 is located in the upper chamber 16 and is connected to the partition plate 14 by a nut 71. A valve stem 73 is reciprocated within the bore 75 of the valve, and the lower end of the valve stem is provided with a lower O-ring packing 76 which has frictional engagement with the bore 75. A hole 78 extends through the valve 70 from the bore 75 to provide communication with the chamber 16 to discharge the fluid from and equalize the pressure in the chambers 13 and 16. A cavity 79 is formed in the bore 75 above the hole 78 into which the fluid would flow, and from which cavity 79 the fluid would be conducted to atmosphere by tube 80. The tube 80 is connected to a port 83 formed in the partition plate 14, Fig. 4. The valve stem 73 is provided with two intermediate O-ring packings 86, 87 arranged in spaced relation and disposed to seal off access of the fluid to the cavity until valve stem 73 is raised and the packing 86 caused to enter the cavity 79 so that the fluid issuing through hole 78 can be discharged to atmosphere outside of the fitting.

The ducts 89 are provided in the valve 70 and arranged parallel to the bore 75 and lead to a well 90 in the bore 75 surrounding the valve stem 73. An upper O-ring packing 91 on the stem 73 is in engagement with the wall of the well 90. Fluid pressure from lower chamber 13 flows through ducts 89 to the well 90. The tube 81 connects port 84 in the partition plate 14, Fig. 7, and is connected to the space 82 of the well 90 beneath the O-ring 91 to provide continuous open communication to the atmosphere and prevents the creation of a vacuum in the space 82.

The upper chamber 16 constitutes the space above the lower chamber door 33. As soon as the lower chamber door is closed, the valve stem 73 will have been raised to a position high enough to permit the prevailing high pressure in the upper chamber 16, which is still existent in both chambers, to deplete to the atmosphere, by way of hole 78 along valve stem 73, and when the middle O-ring 86 has entered into the cavity 79 the chamber 16 is then open to the atmosphere through tube 80. If a pressure up to 2000 p.s.i. is prevalent in the lower chamber 13 and acting on the valve stem 73 near the lower O-ring 76, this pressure is offset or equalized, that is, because the pressure is acting on the bottom of the valve stem 73 and O-ring 76 and the area above O-ring 91 and on O-ring 91, and as a result both areas where the pressure acts on the valve stem 73 are equal and acting in opposing directions, thus keeping valve stem 73 in pressure equilibrium. Therefore, the actuation of the valve stem 73 is only resisted by the friction of the O-rings.

A hollow bearing 93 is secured to the top 17 by means of screw bolts 94 and extends into the housing 15 and forms a support and guide for the upper end of the valve stem 73. An arm 96 extends downwardly from the hollow bearing 93 and is provided with a lateral pin 97 which is received in a spiral slot 99 in sleeve 100. Referring to Figs. 2, 3 and 4, the valve stem 73 is shown as having been moved upwardly in the bore 75 but it has not moved sufficiently to cause the O-ring 86 to enter the cavity 79 to establish communication between the bore 75 and cavity 79. A sleeve 100 has screw threaded engagement with the valve stem 73 and is held thereon by nuts 102 and 103 so that the sleeve cannot have any longitudinal movement with respect to the stem but as it is rotated, the valve stem 73 will be rotated and reciprocated. The sleeve 100 is provided opposite

to the spiral slot 99 with a stepped slot 105 in which is received the end of pin 28 of the nut 26. This stepped slot 105 is open at both ends so that on the upward movement of the nut 26 the pin 28 will enter the bottom of the slot 105 and in travelling through the slot the sleeve will be rotated including valve stem 73 and cause the valve stem 73 to move upwardly. Simultaneously, the stationary pin 97 in the spiral slot 99 will cause the rotating sleeve 100 to move the valve stem upwardly sufficiently to cause the O-ring packing 86 to enter the cavity 79 and establish communication between the hole 78, bore 75 of the valve, and the cavity 79, so that the fluid pressure can be evacuated from the upper chamber 16 to atmosphere through the tubing 80. The valve stem 73 will have now moved upwardly to the limit of its travel and further movement thereof being resisted by the several O-rings and slot 99 of sleeve 100.

In the travel of the nut 26 after raising the valve stem 73, the orifice plate carrier 20 will be further elevated into the chamber 16 of the housing 15.

The pin 63 of the screw nut 26 has been travelling in the groove 61 of rotary shaft 60 during the movement of the valve stem 73 and on the completion of the movement of the valve stem, pin 28 has become disengaged from the sleeve 100, but the pin 63 has now moved up and entered the spiral groove 62, and the shaft 60 is rotated. The rotation of shaft 60 will cause the rod 65 and rings 43 to rotate and to move the door 50 away from the opening 48 in the wall of the housing 15. The pin 63 will now have completed its movement through the spiral groove 62 and entered the longitudinal groove 61' so that no further movement is imparted to the rings 43 but the nut 26 will continue its upward movement on the shaft 23 and cause the orifice plate carrier 20 with orifice plate 21 to engage the leg 67 and be swung laterally through the opening 48 where orifice plate 21 may be inspected.

Upon the inspection of the orifice plate 21, the screw shaft 23 will be rotated in the reverse direction from that just described and the nut 26 will be lowered in the chamber 16. This movement will cause the orifice plate carrier 20 to be returned to the chamber 16 and as the nut moves downwardly the pin 63 begins travelling downwardly in the groove 61' until the pin enters the spiral groove 62, whereupon the shaft 60 will be caused to rotate and to move the rings 43 in an opposite direction to return the door 50 to its seat for closing the opening 48 in the wall 15. Upon the door 50 closing the opening 48, the pin 63 will leave the spiral groove 62 and enter the groove 61 of the shaft 60 and the continued downward movement of the nut 26 will lower the orifice plate carrier 20 to operate and open the lower door 33 and continue its downward movement until the orifice plate carrier 20 and orifice plate 21 are seated in the recess 18 of the passage 11 of the fluid main.

As the pin 63 leaves spiral groove 62 and enters the main groove 61 the pin 28 will enter the stepped slot 105 of the sleeve 100 to rotate the sleeve 100 and feed the valve stem 73 downwardly until the nut 103 of the sleeve 100 engages the valve 70, whereupon the pin 28 will become disengaged from the sleeve 100 so that further rotation of the sleeve cannot take place. This downward movement causes the packing ring 86 to be moved below the cavity 79 and closing access thereto, and the packing ring 76 to be moved to a position whereby the fluid pressure in the chamber 13 can re-enter the upper chamber 16 as the O-ring 76 will be moved to a position to allow the fluid pressure from the chamber 13 to enter the bore 75 and equalize the pressure in chambers 13 and 16. Upon the pin 28 of the nut 28 becoming disengaged from the sleeve 100, the orifice plate carrier 20 will open the valve door 33 and allow the orifice plate carrier 20 to continue its downward movement into the recess 18 of the passage 11 of the fluid pressure main.

What is claimed is:

1. In an orifice fitting comprising a body having a passage for the flow of pressure fluid and a housing connected to said body, a plate interposed between said housing and body, said plate having a slot therein forming communication between said housing and said passage, a spring and line pressure operated door for closing said slot, an orifice plate carrier having an orifice plate therein disposed in said passage and extending into said housing through said slot, elevating means mounted in said housing having pivotal connection with said orifice plate carrier for moving said orifice plate carrier from said passage into said housing, a valve for exhausting fluid pressure from said housing, and means on said valve engaged by said elevating means for operating said valve during the movement of said orifice plate carrier into said housing by said elevating means.

2. In an orifice fitting comprising a body having a passage for the flow of pressure fluid and a housing connected to said body, a plate interposed between said housing and body, said plate having a slot therein forming communication between said housing and said passage, a spring operated door for closing said slot, an orifice plate carrier having an orifice plate therein disposed and seated in said passage and extending into said housing through said slot, elevating means mounted in said housing having pivotal connection with said orifice plate carrier for moving said orifice plate from said passage into said housing, said housing being provided with a vertical opening, an upper door for closing said vertical opening, rotatable means supporting said door, a rotary shaft having engagement with said rotatable means for opening and closing said upper door, a valve for exhausting fluid pressure from said housing, means on said valve engaged by said elevating means for operating said valve during the inital movement of said orifice plate carrier in said housing, means on said elevating means for engaging said rotary shaft upon the completion of said elevating means engagement with said valve means for causing said rotatable means to move said upper door to open position, means for discontinuing the rotary movement of said shaft on the opening of said upper door, and means engaging said orifice plate as the elevating means continues its movement for swinging said orifice plate through said vertical opening.

3. In an orifice fitting comprising a body having a passage for the flow of pressure fluid and a housing connected to said body, a plate interposed between said housing and body, said plate having a slot therein forming communication between said housing and said passage, spring operated means for closing said slot, an orifice plate carrier having an orifice plate therein disposed in said passage and extending into said housing through said slot, elevating means mounted in said housing having pivotal connection with said orifice plate carrier for moving said orifice plate from said passage into said housing, said housing having a vertical opening therein, a door for closing said opening, rotatable means mounted in said housing for opening and closing said door, a rotary shaft connected to said rotatable means, means operable by said elevating means for imparting rotary movement to said rotary shaft for operating said rotatable means to move said door to open position, means for preventing rotation of said rotary shaft upon the opening of said door, and means for engaging said orifice plate on the continued movement of said elevating means for swinging said orifice plate through the vertical opening of said chamber.

4. In an orifice fitting comprising a body having a passage for the flow of pressure fluid and a housing connected to said body, a plate interposed between said housing and body, said plate having a slot therein forming communication between said housing and said passage, a spring operated door for closing said slot, an orifice plate carrier having an orifice plate therein dis-

posed and seated in said passage and extending into said chamber through said slot, elevating means mounted in said chamber having pivotal connection with said orifice plate carrier for moving said orifice plate from said passage into said housing, said housing having a vertical opening, an upper door for closing said opening, rotatable means mounted in said housing for opening and closing said upper door, a rotary shaft journaled in said housing and connected to said rotatable means, said rotary shaft having an upper groove and a lower groove extending axially thereof and arranged in parallelism, a spiral groove connecting said parallel grooves, a pin on said elevating means traveling in said axial grooves to withhold said rotary shaft against rotation, said elevating means moving said pin through said spiral groove from one of said axial grooves to the other said axial groove for imparting rotary motion to said rotary shaft and said rotatable means.

5. In an orifice fitting comprising a body having a passage for the flow of pressure fluid and a housing connected to said body, a plate interposed between said housing and body, said plate having a slot therein forming communication between said housing and said passage, a spring operated door for closing said slot, an orifice plate carrier having an orifice plate therein disposed in said passage and extending into said housing through said slot, elevating means mounted in said housing having pivotal connection with said orifice plate carrier for moving said orifice plate from said passage into said housing, said housing having a vertical opening, an upper door for closing said opening, rotatable means mounted in said housing for opening and closing said upper door, a rotary shaft journaled in said housing and connected to said rotatable means, a valve for exhausting fluid pressure from said housing having a valve stem for controlling the flow of fluid through said valve, a sleeve connected to said valve stem and being provided with a spiral slot and stepped slot, means for engaging said spiral slot of said sleeve to allow said sleeve to have rotary movement with said valve stem and preventing vertcial movement of said sleeve with respect to said valve stem, means on said elevating means traveling through said stepped slot during the travel of said elevating means for causing said sleeve to be rotated to move said valve stem, said rotary shaft having an upper groove and a lower groove extending axially thereof and arranged in parallelism, a spiral groove connecting said parallel grooves, a pin on said elevating means traveling in said axial grooves to withhold said rotary shaft against rotation, said elevating means moving said pin through said spiral groove from one of said axial grooves to the other said axial groove, said elevating means upon the completion of the rotation of said sleeve moving said pin through said spiral groove of said rotary shaft for imparting rotary motion to said rotary shaft and said rotatable means.

6. In an orifice fitting comprising a body having a passage for the flow of pressure fluid and a housing connected to said body, a plate interposed between said body and housing, said plate having a slot therein forming communication between said housing and said passage, spring operated means for closing said slot, an orifice plate carrier having an orifice plate therein disposed in said passage and extending into said housing through said slot, elevating means mounted in said chamber having pivotal connection with said orifice plate carrier for moving said orifice plate from said passage into said housing, said housing having a vertical opening, a door for closing said opening, upper and lower rings mounted in said chamber, posts interposed between and connected to said rings, said door pivoted to said rings, a rotary shaft journaled in said housing and connected to said rings for rotating said rings to open and close said door, a valve for exhausting fluid pressure from said housing having a valve stem for controlling the flow of fluid through said valve, a sleeve connected to said valve stem and being provided with a spiral slot and a stepped slot, means for engaging said spiral slot of said sleeve to allow said sleeve to have rotary movement with said valve stem and preventing vertical movement of said sleeve with respect to said valve stem, means on said elevating means traveling through said stepped slot during the travel of said elevating means for causing said sleeve to be rotated to move said valve stem, said rotary shaft having an upper groove and a lower groove extending axially thereof and arranged in parallelism, a spiral groove connecting said parallel grooves, a pin on said elevating means traveling in said axial grooves to withhold said rotary shaft against rotation, said elevating means moving said pin through said spiral groove from one of said axial grooves to the other of said axial grooves, said elevating means upon the completion of the rotation of said sleeve moving said pin through said spiral groove of said rotary shaft for imparting rotary motion to said rotary shaft and said upper and lower rings.

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