June 12, 1928. 1,673,451

A. J. HARTFIELD ET AL

DISTANT CONTROL VALVE

Filed May 12, 1924

Fig. 1.

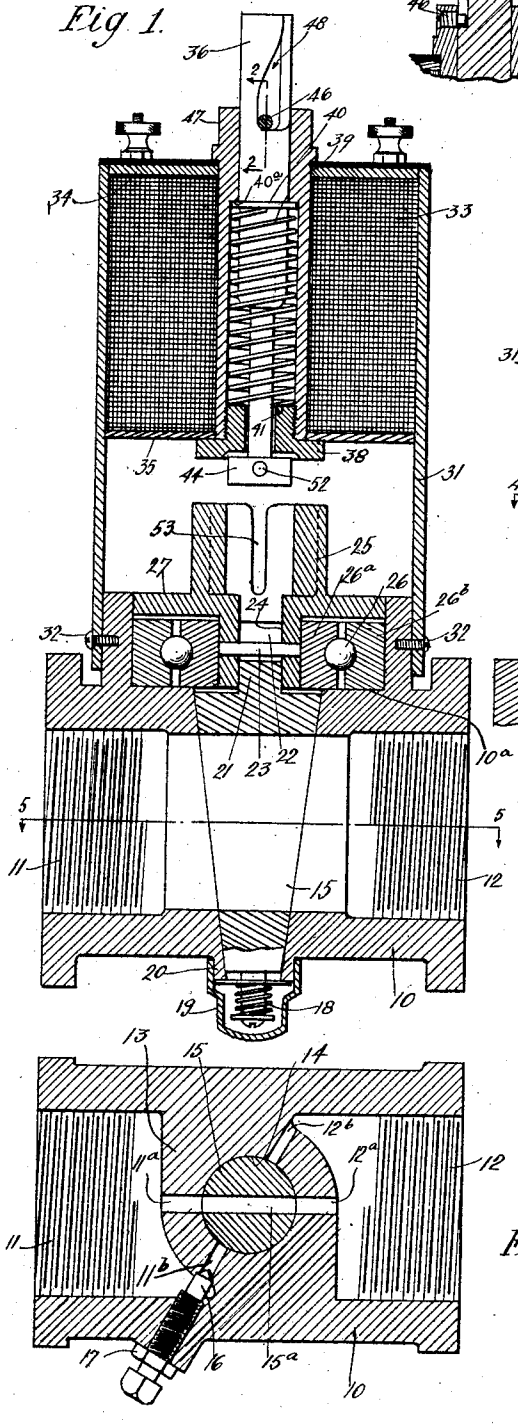


Fig. 2.

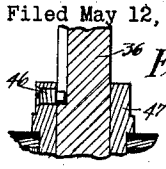


Fig. 3.

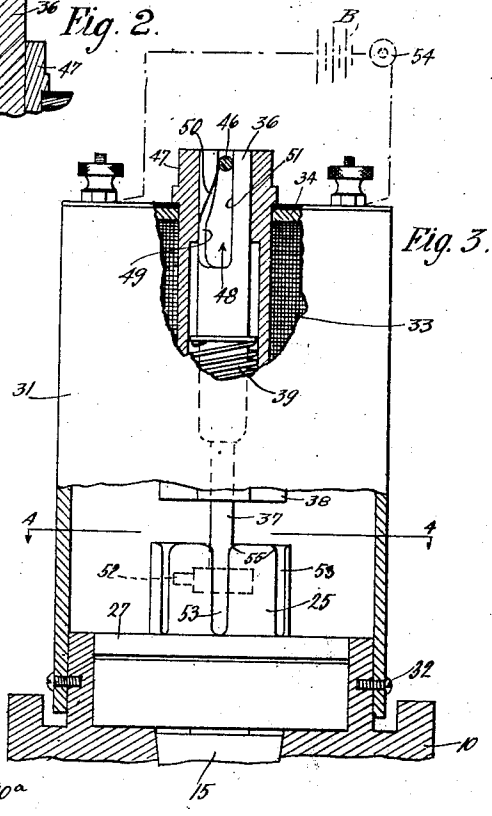


Fig. 4.

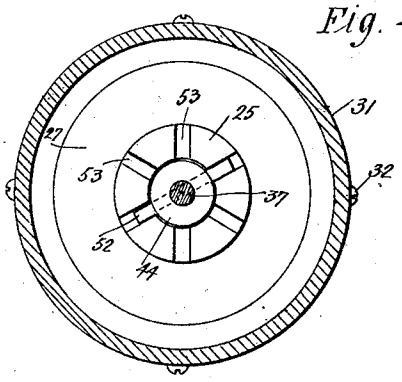


Fig 5.

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Patented June 12, 1928. 1,673,451

UNITED STATES PATENT OFFICE.

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DISTANT-CONTROL VALVE.

Application filed May 12, 1924. Serial No. 712,753.

This invention relates generally to valves and valve actuating means, and more particularly has to do with distant control valves.

In the preferred embodiment of our invention, the valve is provided with a plurality of transverse bores of varying effective diameters, all intercepted by a common valve plug adapted to be rotated to bring its ports into successive register with said transverse bores to provide open ways through the valve. We preferably employ electromagnet means for accomplishing the rotation of the plug, as such means is especially desirable from the standpoint of distant control.

An illustration of the adaptability of such a valve to a particular purpose may be described in connection with gas burning furnaces. In such a situation, our valve is interposed in the gas line leading to the furnace, and a control switch electrically connected to the valve actuating means is preferably located in or near the room to be heated by that particular furnace.

We provide an actuating plunger which is adapted to be moved longitudinally, preferably by an electro-magnet, and a novel mechanism translates this longitudinal movement into rotative movement on the part of the valve plug. The translating mechanism and valve ports are so coordinated that successive movements of the plunger accomplish successive registry and blanking of the ports.

In a copending application filed by us May 12th, 1924, Ser. No. 712,752, we have illustrated and described a translating mechanism wherein the plug rotation is accomplished through the combined rotative movement of the plunger as brought about by a spiral engagement between the plunger and a fixed casing, and a spiral engagement between the plunger and a member carried by the plug. The spiral engagement between plunger and plug carried member necessitates the provision of special means for diverting the force of plunger thrust from the plug, proper, in order that the plug will not become driven into its seat with sufficient force to cause "valve binding" which might result in failure of the actuating mechanism.

However, in carrying out the present invention we need provide no spiral engagement between plunger and plug carried member since the degree of plunger rotation accomplished through the spiral engagement of the plunger with the fixed casing is sufficient to rotate the plug through proper angles upon each downstroke of the plunger. The connection between plunger and plug carried member need only be in the nature of a pin and vertical slot arrangement, and the plug carried member being free of end thrust, no binding action on the plug is brought about, and therefore no special arrangements need be provided to prevent the plug from binding, as is true in the actuating means disclosed in said copending application.

Other features of novelty and objects of our invention will be more fully described in connection with the following detailed description, reference being had to the accompanying drawings in which:

Figure 1 is a longitudinal section of our valve, showing it in full open position.

Fig. 2 is a fragmentary section on line 2—2 of Fig. 1.

Fig. 3 is a fragmentary view similar to Fig. 1, with parts in elevation, but showing the valve actuating plunger at the limit of its downward movement.

Fig. 4 is a horizontal section on line 4—4 of Fig. 2; and

Fig. 5 is a horizontal section on line 5—5 of Fig. 1.

At 10 is indicated a usual valve body having major bores 11 and 12 separated by a partition 13, the latter being provided with a tapered valve seat 14 adapted to receive valve plug 15, said plug being tapered complementarily to the seat. The diametrically opposed bores 11^a and 12^a in partition 13 communicate with bores 11 and 12, respectively; while diametrically opposed bores 11^b and 12^b also communicate with bores 11 and 12, respectively. As a means for varying the effective diameter of the valve bores, I may introduce a needle valve 16 into one or more of such bores, such needle valve being set in adjustment as by lock nut 17. In order to differentiate between the bores in the valve body I will term 11^a and 12^a as "full open bores" and 11^b and 12^b as "restricted bores". Plug 15 is provided with a

port 15ª in horizontal alinement with the full open and restricted bores and is adapted to be brought into successive register with each set of diametrically opposed bores upon the plug being rotated.

In the present showing I have illustrated plug 15 as being arranged to rotate through an angle of sixty degrees upon each actuation thereof and it will be clearly seen that a complete revolution of the plug caused by successive actuations of the rotating mechanism will allow two periods of communication between the full open bores, two periods between the restricted bores, and two periods when communication between bores 11 and 12 is entirely cut off. As plug 15 is allowed to rotate in but one direction, the successive valve positions during a complete revolution of plug 15 will be as follows: Full open, as shown; closed; restricted; full open; closed; and restricted. Of course, it is within the province of our invention to provide bores in varying numbers and means for moving the plug 15 through correspondingly varied angles, but it will serve the purpose of description to explain the entire mechanism as being adapted to accomplish the above specific relative movement.

Plug 15 is held properly seated and freely rotatable within the valve by such means as removably mounted coil spring 18. Cap 19 protects the spring and is frictionally retained on boss 20 of body 10. The shank 21 of plug 15 is slotted at 22 to receive a cross bar 23 carried by tubular extension 24 of rim cam. Tubular extensions 24 loosely encircles shank 21 and together with the slot and cross bar connection just described allows limited longitudinal movement of the plug 15 with respect to member 25 whereby the seating of plug 15 is in no way affected by longitudinal thrust exerted on member 25. The upper face of the valve body 10 is recessed at 10ª to receive thrust bearing 26, the race 26ª, thereof, being pressed on extension 24 and the periphery of race 26ᵇ engaging the walls which define recess 10ª. It will be seen that since the lower face of the bearing 26 rests on the valve body, thrust imparted to member 25, will be taken up by the bearing which also serves to aid in the axial alinement of rotatable member 25 with respect to plug 15 and the plunger, to be described.

Disk 27 which is adapted to rotate as one with member 25 and plug 15, serves as a convenient means for mounting contact members (not shown) for a signal system adapted to indicate the position of plug bore 15ª relative to the valve body bores. An example of such contact members and systems is illustrated and described in our copending application filed April 7, 1923, Ser. No. 630,564.

A metallic casing 31 is positioned on valve body 10 by screws 32, and a solenoid 33, iron clad by reason of being enclosed in casing 31 and between the metallic upper and lower plates 34 and 35, respectively, is provided with a plunger or core 36 which has an extension 37, preferably non-magnetic, slidable through an aperture in pole-piece 38, the latter being threaded into the coil supporting structure of the solenoid. An expansive coil spring 39 encircles plunger 36 and is interposed between a shoulder 40 thereon and pole-piece 38 in a manner to normally urge said plunger to its uppermost limit of travel, this limit being established by contact of an actuating cam 44, non-movably fixed on the plunger, with the pole-piece or by the engagement of collar 40 with shoulder 40ª. Preferably, the upper extremity of spring 39 is secured to plunger 36 at shoulder 40, and the lower end of the spring is secured to pole-piece 38 at 41. The spring tends to rotate the plunger in a counter-clockwise direction, as viewed from above Fig. 1.

A cam pin 46 is mounted on the upper extension of solenoid tube 47, or on any other suitable stationary element of the solenoid or valve assembly, and this pin projects into cam groove 48 which is milled in the peripheral face of plunger 36. The left side defining wall of groove 48 has a face 49 which extends parallel to the axis of the plunger for a short distance, and merges into cam face 50 which spirals upwardly and to the right. The right side defining wall 51 of the groove may extend, throughout its length, substantially parallel to the plunger axis. Spring 39 tends to retain the left side face of the groove defining wall in engagement with pin 46, but the yieldability of the spring allows an interruption of such engagement during certain periods of valve actuation.

Actuating cam 44 has a cross bar 52 which, when in the upper or starting position of Figure 1, is in vertical alinement with certain of the vertical slots 53 provided in cam 25. The slots are six in number and are spaced at equal angles. Plug bore 15ª is axially parallel with one pair of diametrically opposite notches 53, so successive 60° rotations of cam 25 brings about the hereinbefore described sequence valve opening and closing movements.

We have shown solenoid 33 in circuit with a source of electricity B. the circuit being controlled by switch 54. When the solenoid is energized by closing the circuit, plunger 36 moves longitudinally towards center in the usual manner. During initial movement, while pin 46 and face 49 are in engagement, the plunger moves down without rotation and cross bar 52 enters registering slots 53. Continued depression of the plunger brings spiral face 50 into engagement with pin 46 which causes a clockwise rotation of plunger 36 and hence of cam 25 and plug 15, the slid-

ing side engagement between slot and bar being in the nature of a lost motion connection. The spiral is of such a lead as will cause a 60° rotation of the plunger and plug during each full plunger depression, and this rotation accomplishes the desired valve change.

When solenoid 33 is de-energized by opening its circuit, spring 39 immediately raises plunger 36. As long as bar 52 engages slots 53, the plunger will move up without coincident rotation, the inertia of plug 15ª and its associated elements and the frictional resistance to such rotation being sufficient to offset the effort of spring 39 to rotate the plunger counter-clockwise. The straight side face 51, of course, allows this relative longitudinal movement, without relative rotation, between plunger 36 and tube 47.

When bar 52 clears cam 25, spring 39 acts to rotate plunger 36 counterclockwise until face 49 strikes pin 46, the plunger continuing in its upward movement and returning to its starting position, as shown in Fig. 1, where it lies with bar 52 in register with the newly presented slots 53.

The corners 55 of cam 25 may be chamfered slightly to allow bar 52 to enter the notches even though said bar and notches lie slightly out of vertical alinement.

While we have shown and described a preferred embodiment of our invention, we do not wish to be limited thereto except for such limitations as the claims may import.

We claim:

1. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being in alinement with and movable longitudinally through its support towards and away from the plug, means for limiting the movement of the plunger away from the plug, a tubular member carried by the plug in end to end relation with the plunger, said member having a plurality of serrations on its plunger opposed end, one defining wall of each serration being substantially parallel to the plug axis, a bar on the plunger in alinement with but spaced from a given serration when the plunger is at its limit of movement away from the plug, means for moving the plunger longitudinally, means adapted to hold the bar in alinement with said given serration during movement of the plunger towards the plug until said cross bar enters said serration, and means on the plunger and plunger support adapted to have spiral engagement during a continuation of said plunger movement towards the plug whereby the bar is rotated and engages said one wall of the given serration to impart rotary movement to the plug and without imposing end thrust on the tubular member or plug.

2. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being in alinement with and movable longitudinally through its support towards and away from the plug, means for limiting the movement of the plunger away from the plug, a tubular member carried by the plug in end to end relation with the plunger, said member having a plurality of serrations on its plunger opposed end, one defining wall of each serration being substantially parallel to the plug axis, a bar on the plunger in alinement with but spaced from a given serration when the plunger is at its limit of movement away from the plug, means for moving the plunger longitudinally, means adapted to hold the bar in alinement with said given serration during movement of the plunger towards the plug until said cross bar enters said serration, and means on the plunger and plunger support adapted to have spiral engagement during a continuation of said plunger towards the plug whereby the bar is rotated and engages said one wall of the given serration to impart rotary movement to the plug and without imposing end thrust on the tubular member or plug.

3. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being in alinement with and movable longitudinally through its support towards and away from the plug, means for limiting the movement of the plunger away from the plug, a tubular member carried by the plug in end to end relation with the plunger movement, said member having a plurality of serrations on its plunger opposed end, one defining wall of each serration being substantially parallel to the plug axis, a bar on the plunger in alinement with but spaced from a given serration when the plunger is at its limit of movement away from the plug, yieldable means for holding the plunger at its limit of movement away from the plug, means for moving the plunger longiudinally towards the plug, means adapted to hold the bar in alinement with said given serration during movement of the plunger towards the plug until said cross bar enters said serration, and means on the plunger and plunger support adapted to have spiral engagement during a continuation of said plunger towards the plug whereby the bar is rotated and engages said one wall of the given serration to impart rotary movement to the plug and without imposing end thrust on the tubular member or plug.

4. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger

being in alinement with and movable longitudinally through its support towards and away from the plug, means for limiting the movement of the plunger away from the plug, a tubular member carried by the plug in end to end relation with the plunger, said member having a plurality of serrations on its plunger opposed end, one defining wall of each serration being substantially parallel to the plug axis, a bar on the plunger in alinement with but spaced from a given serration when the plunger is at its limit of movement away from the plug, means for moving the plunger longitudinally, means adapted to hold the bar in alinement with said given serration during movement of the plunger towards the plug until said cross bar enters said serration, and cam means on the plunger and plunger support adapted to have spiral engagement during a continuation of said plunger movement towards the plug whereby the bar is rotated and engages said one wall of the given serration to impart rotary movement to the plug and without imposing end thrust on the tubular member or plug; said cam means being inoperative during subsequent longitudinal movement of the plunger away from the plug, whereby, during such subsequent movement, said plug is unaffected by said plunger movement.

5. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being in alinement with and movable longitudinally through its support towards and away from the plug, means for limiting the movement of the plunger away from the plug, a tubular member carried by the plug in end to end relation with the plunger, said member having a plurality of serrations on its plunger opposed end, one defining wall of each serration being substantially parallel to the plug axis, a bar on the plunger in alinement with but spaced from a given serration when the plunger is at its limit of movement away from the plug, means for moving the plunger longitudinally, means adapted to hold the bar in alinement with said given serration during movement of the plunger towards the plug until said cross bar enters said serration, cam means on the plunger and plunger support adapted to have spiral engagement during a continuation of said plunger movement towards the plug whereby the bar is rotated and engages said one wall of the given serration to impart rotary movement to the plug and without imposing end thrust on the tubular member or plug; said cam means being inoperative during subsequent longitudinal movement of the plunger away from the plug, whereby, during such subsequent movement, said plug is unaffected by said plunger movement, and yieldable means adapted to rotate the plunger in a manner to return said bar to its initial position after said bar is withdrawn from engagement with said one serration wall.

6. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being in alinement with and movable longitudinally through its support towards and away from the plug, means for limiting the movement of the plunger away from the plug, a tubular member carried by the plug in end to end relation with the plunger, said member having a plurality of serrations on its plunger opposed end, one defining wall of each serration being substantially parallel to the plug axis, a bar on the plunger in alinement with but spaced from a given serration when the plunger is at its limit of movement away from the plug, means for moving the plunger longitudinally towards the plug, means adapted to hold the bar in alinement with said given serration during movement of the plunger towards the plug until said cross bar enters said serration, means on the plunger and plunger support adapted to have spiral engagement during a continuation of said plunger movement towards the plug whereby the bar is rotated and engages said one wall of the given serration to impart rotary movement to the plug and without imposing end thrust on the tubular member or plug; and yieldable means adapted to return the plunger to its limit of movement away from the plunger and to rotate the plunger in a manner to return said bar to its initial position.

7. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being in alinement with and movable longitudinally through its support towards and away from the plug, means for limiting the movement of the plunger away from the plug, a tubular member carried by the plug in end to end relation with the plunger, said member having a plurality of serrations on its plunger opposed end, one defining wall of each serration being substantially parallel to the plug axis, a bar on the plunger in alinement with but spaced from a given serration when the plunger is at its limit of movement away from the plug, means for moving the plunger longitudinally, means adapted to hold the bar in alinement with said given serration during movement of the plunger towards the plug until said cross bar enters said serration, means on the plunger and plunger support adapted to have spiral engagement during a continuation of said plunger movement towards the plug whereby the bar is rotated and engages said one wall of the given serration to impart rotary movement to the plug and without imposing end thrust on the tubular member or plug; and yieldable means adapted to rotate the

plunger in a direction opposite to that effected by the spiral engagement after said bar is disengaged from said one wall of the given serration during such subsequent longitudinal movement.

8. In a valve embodying a rotatable ported plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being in alinement with an movable longitudinally through its support towards and away from the plug, means for limiting the movement of the plunger away from the plug, a tubular member carried by the plug in end to end relation with the plunger, said member having a plurality of equi-spaced serrations on its plunger opposed end, one defining wall of each serration being substantially parallel to the plug axis, a bar on the plunger in alinement with but spaced from a given serration when the plunger is at its limit of movement away from the plug, means for moving the plunger longitudinally, means adapted to hold the bar in alinement with said given serration during movement of the plunger towards the plug until said cross bar enters said serration, and means on the plunger and plunger support adapted to have spiral engagement movement during a continuation of said plunger towards the plug whereby the bar is rotated and engages said one wall of the given serration to impart rotary movement to the plug and without imposing end thrust on the tubular member or plug, the spiral engagement being such that the plug rotation effected thereby is of a degree to bring the succeeding serration into the initial position of said given serration, and to effect a predetermined change in the relative position of ports provided in the valve body and plug.

9. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being movable longitudinally through its support towards and away from the plug, means for moving the plunger longitudinally, means for limiting the movement of the plunger away from the plug, a member carried by the plug in end to end relation with the plunger and having a plurality of serrations on its plunger opposed end, a member on the plunger adapted to enter one of the serrations when the plunger is moved longitudinally towards the plug, and means on the plunger and plunger support adapted to have spiral engagement during continuation of said movement of the plunger towards the plug and after said plunger carried member has entered said serration, whereby said plunger carried member is rotated and engages the plug carried member to impart rotary movement to the plug without imposing end thrust on said plug carried member.

10. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being movable longitudinally through its support towards and away from the plug, means for moving the plunger longitudinally, means for limiting the movement of the plunger away from the plug, a member carried by the plug in end to end relation with the plunger and having a plurality of equi-spaced serrations on its plunger opposed end, a member on the plunger adapted to enter one of the serrations when the plunger is moved longitudinally towards the plug, and means on the plunger and plunger support adapted to have spiral engagement during continuation of said movement of the plunger towards the plug and after said plunger carried member has entered said serration, whereby said plunger carried member is rotated and engages the plug carried member to impart rotary movement to the plug without imposing end thrust on said plug carried member, the spiral engagement being such that the plug rotation effected thereby is of a degree to bring the succeeding serration into the initial position of said one serration.

11. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being movable longitudinally through its support towards and away from the plug, means for moving the plunger longitudinally, means for limiting the movement of the plunger away from the plug, a member carried by the plug in end to end relation with the plunger and having a plurality of equi-spaced serrations on its plunger opposed end, a member on the plunger adapted to enter one of the serrations when the plunger is moved longitudinally towards the plug, and means on the plunger and plunger support adapted to have spiral engagement during continuation of said movement of the plunger towards the plug and after said plunger carried member has entered said serration, whereby said plunger carried member is rotated and engages the plug carried member to impart rotary movement to the plug without imposing end thrust on said plug carried member, the spiral engagement being such that the plug rotation effected thereby is of a degree to bring the succeeding serration into the initial position of said one serration; and yieldable means adapted to return the plunger to its limit of movement away from the plunger.

12. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being movable longitudinally through its support towards and away from the plug, means for moving the plunger longitudinally, means for limiting the movement of

the plunger away from the plug, a member carried by the plug in end to end relation with the plunger and having a plurality of equi-spaced serrations on its plunger opposed end, a member on the plunger adapted to enter one of the serrations when the plunger is moved longitudinally towards the plug, and means on the plunger and plunger support adapted to have spiral engagement during continuation of said movement of the plunger towards the plug and after said plunger carried member has entered said serration, whereby said plunger carried member is rotated and engages the plug carried member to impart rotary movement to the plug without imposing end thrust on said plug carried member, the spiral engagement being such that the plug rotation effected thereby is of a degree to bring the succeeding serration into the initial position of said one serration; and yieldable means adapted to return the plunger to its limit of movement away from the plunger and to rotate the plunger in a manner to return said plunger carried member to its initial position.

13. In a valve embodying a rotatable plug, a plunger, a plunger support in fixed relation with respect to the plug, said plunger being movable longitudinally through its support towards and away from the plug, means for moving the plunger longitudinally, means for limiting the movement of the plunger away from the plug, yieldable means for holding the plunger at its limit of movement away from the plug, a member carried by the plug in end to end relation with the plunger and having a plurality of serrations on its plunger opposed end, a member on the plunger adapted to enter one of the serrations when the plunger is moved longitudinally towards the plug, and means on the plunger and plunger support adapted to have spiral engagement during continuation of said movement of the plunger towards the plug and after said plunger carried member has entered said serration, whereby said plunger carried member is rotated and engages the plug carried member to impart rotary movement to the plug without imposing end thrust on said plug carried member.

In witness that we claim the foregoing we have hereunto subscribed our names this 19th day of April 1924.

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WALLACE HOLBROOK.