Jan. 3, 1939. E. C. McFARLANE 2,142,795

ROTARY PLUG VALVE

Filed Jan. 18, 1937 2 Sheets-Sheet 1

Fig. 1

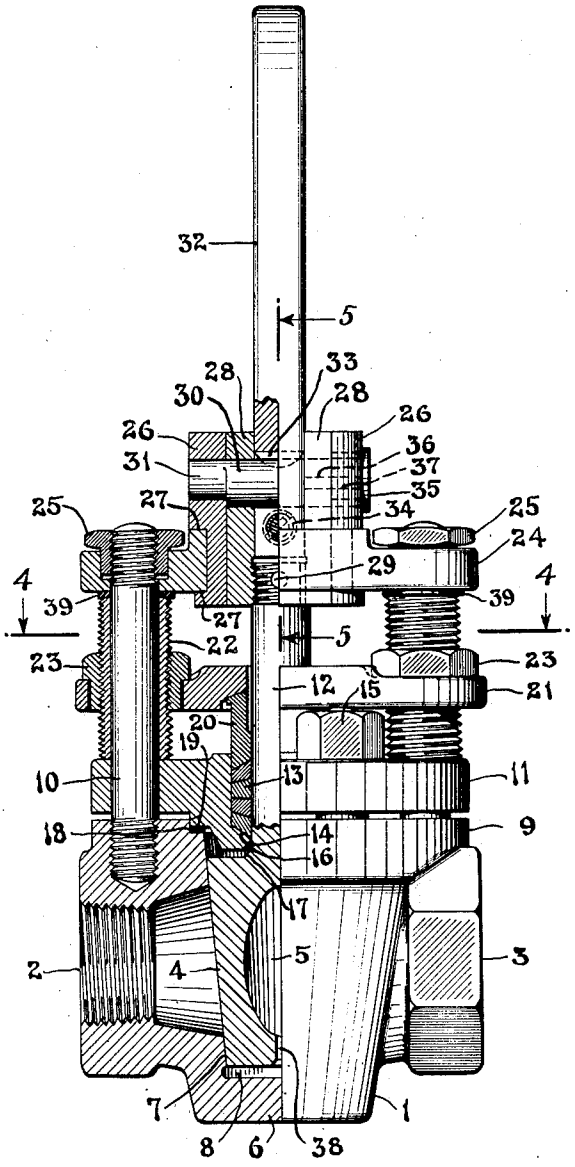

Fig. 2

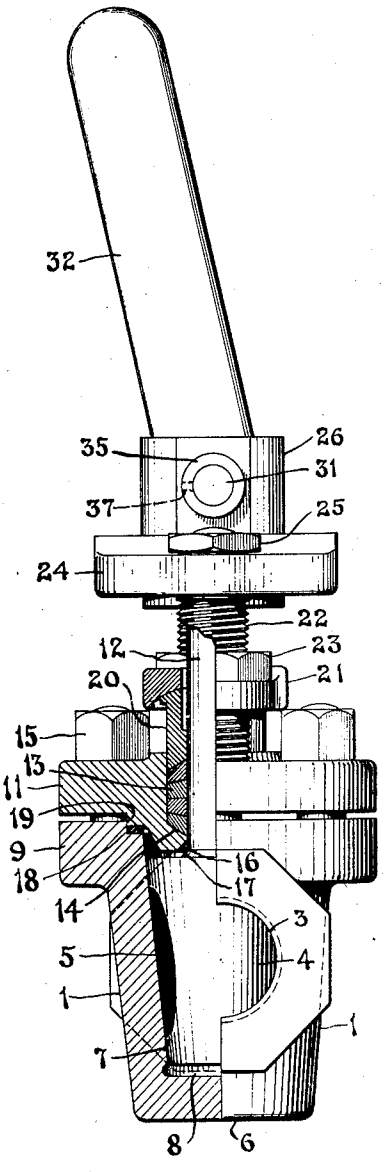

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Fig. 3

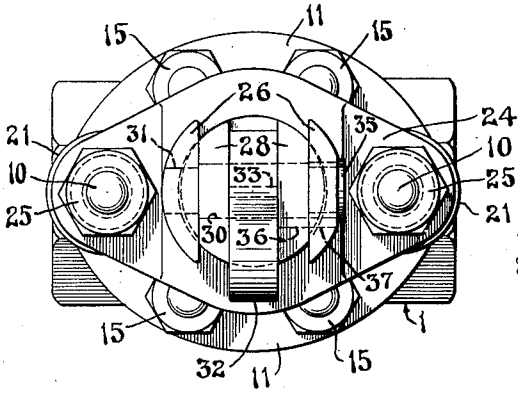


Fig. 4

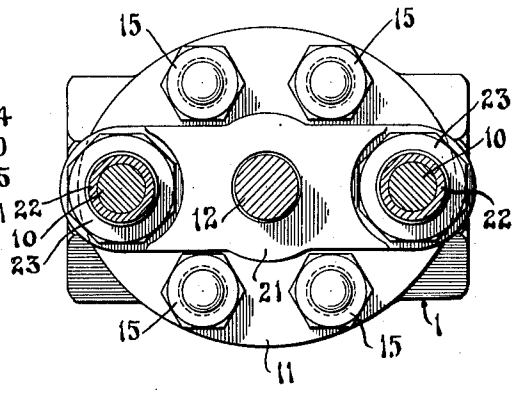


Fig. 5

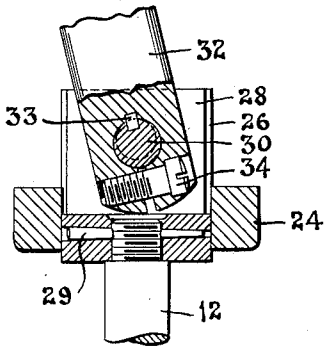


Fig. 6

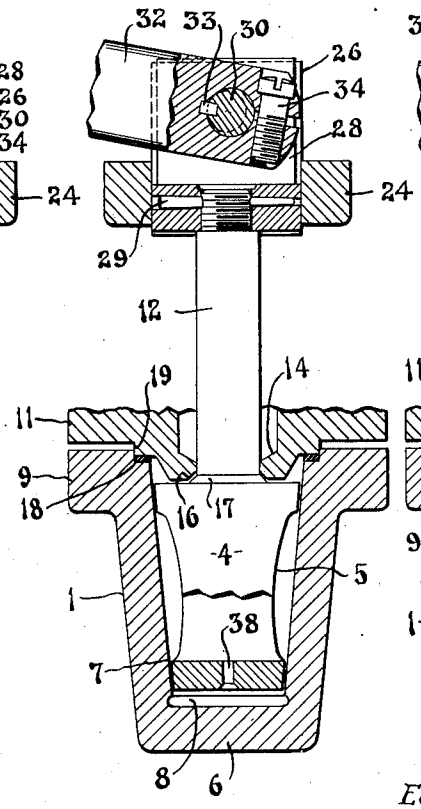
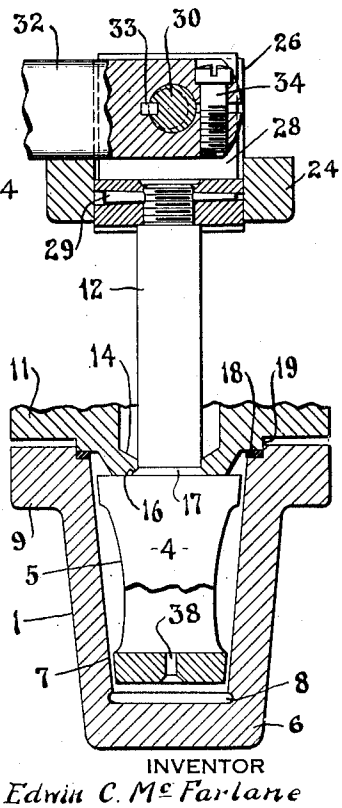


Fig. 7



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Patented Jan. 3, 1939

2,142,795

UNITED STATES PATENT OFFICE

2,142,795

ROTARY PLUG VALVE

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Application January 18, 1937, Serial No. 121,102

4 Claims. (Cl. 251—97)

This invention relates to valves of the type commonly referred to as plug cocks. It is well known that in valves of this type it is usual to grind the tapered plug and seat to provide a close uniform fit of the plug within the valve seat to prevent leakage and uneven wear of the plug and seat in use, and thus automatically maintain a close fit throughout the surface of the plug over a long period of use without the necessity for regrinding. It is also well known that it is desirable to have a small taper to the plug and seat to provide the best close seating of the plug. It is also well known that under such conditions the plug may seat so tightly or freeze that operation of the valve becomes difficult. Therefore means have been provided for unseating or relieving the frictional engagement of the plug before attempting to rotate the plug for opening or closing the valve ports.

Heretofore in plug cocks of this type it was common practice to provide means for unseating the plug involving a separate or distinct movement apart from the movement of the operating handle, lever or hand wheel employed for rotating the plug to open or close the ports. Such means involved in some forms a single operating device adapted to perform the two functions by a shift in the operating connection, or separate operating devices for each function, or a separate tool, such as a wrench or key for either or both movements. In other constructions a gear and screw arrangement was employed. In all cases the operation was necessarily slow and required some form of index or indicating device to insure the proper successive movements, and to indicate the open or closed position of the plug and the seated or unseated position.

In my application for patent filed December 5, 1936, Serial No. 114,344, I have described a form of plug cock in which the unseating of the plug is accomplished through the agency of a differential screw operated by a hand wheel or lever which when the plug is unseated by one rotary movement of the hand wheel or lever the operative connection is shifted to a coupling member on the plug stem and both the hand wheel and coupling member are rotated to rotate the plug for opening or closing the ports, and then the operative connection is again shifted into re-engagement with the differential screw element to reseat to plug. Such sequence of operations is necessary in all forms of rotary plug cocks of this type as heretofore proposed.

The main object of my invention is to provide an operating mechanism which will simplify the operating movements ordinarily required and greatly simplify the construction and avoid the necessity for indicating means.

My invention is illustrated in the accompanying drawings, in which,—

Figure 1 is a longitudinal elevation and half vertical central section of the complete valve structure.

Figure 2 a similar end view looking from the right of Figure 1.

Figure 3 a top plan view.

Figure 4 a horizontal cross-section on the line 4—4 of Figure 1, and

Figures 5, 6 and 7 vertical sectional views showing the positions of the operating lever at three different positions of the rotary plug.

Referring to the drawings, 1 indicates the usual valve casing and 2 and 3 the inlet and outlet ports. These ports may, as indicated, be screw threaded to receive screw threaded pipe, or may be provided with flanges for coupling to flanged coupling members. The casing is centrally bored with a taper to receive tapered rotary plug 4 having a port 5 of an area to provide a straight line flow through the valve. In order to allow for proper grinding of the plug seat, the hub of the casing is cast with an outward bulge 6 within which is the lower circular face 7 of the plug seat leaving a recess 8 for clearance of the grinding tool and for the proper seating of the plug within the tapered bore. At the top, the casing is enlarged to form a flange 9 which is drilled and tapped to receive bolts and studs. At opposite ends of the casing directly over the ports the tapped holes receive stud bolts 10. Sleeved on studs 10 is a bonnet 11 having a central opening through which plug stem 12 passes and within which opening packing 13 is packed against seat 14 at the underside of the bonnet. The bonnet is bolted to the valve casing by bolts 15. The underside of seat 14 is ground to a bevel 16 to form a seat for the bevelled fillet 17 at the top of plug 4, the seat and fillet forming a seal to prevent leakage around the stem 12 when the plug is unseated. The top of the casing flange 9 has a circular recess to receive gasket 18 on which bonnet base 19 is seated so that when the bonnet is clamped in position by bolts 15 the casing is sealed at that point. Sleeved on the plug stem 12 is a packing gland 20 which slides within the cylindrical bore in bonnet 11. The top of gland 20 is preferably of larger diameter than its cylindrical part and is bevelled to fit a bevelled recess in gland yoke 21 which has a central opening of larger diameter than the plug

stem so as not to be in frictional contact therewith. Sleeved on studs 10 are externally screw threaded tubes 22, and yoke 21 is provided with circular holes to receive collar nuts 23 which are threaded on tubes 22 to force the gland yoke down upon gland 20 for squeezing packing 13 around plug stem 12. This arrangement of the packing yoke on tubes 22 permits release of the yoke to move it and gland 20 upward to renew the packing 13 and replace the gland and yoke without disturbing any other parts of the valve. Repacking may be done either while the plug 4 is in the open or closed position, or in the seated or unseated position, since the seal formed at the seat and fillet 16—17 will prevent leakage around the plug stem.

A trunnion yoke 24 is seated on tubes 22 and sleeved on the ends of stud bolts 10 and secured in position by collar nuts 25. When yoke 24 is seated and secured in position by nuts 25, tubes 22 are secured thereby against endwise and rotary movement on the studs when screwing down the packing yoke nuts 23. Trunnion yoke 24 has a large circular hole concentric with stem 12, and seated in this hole are a pair of trunnion blocks 26. These blocks are arcuate on the outer faces as seen in Figure 3, and have arcuate grooves forming shoulders 27, see Figure 1, which straddle the yoke and hold the trunnion blocks against longitudinal displacement. The radius of the grooves in blocks 26 is slightly less than the radius of the trunnion seat on yoke 24 as seen in dotted lines in Figure 3 to permit slight lateral movement of the trunnions. The inner faces of these blocks are flat and parallel and spaced apart when in position on the yoke to receive a stirrup 28 having a central screw threaded hole into which the screw threaded end of plug stem 12 is screwed and pinned against unscrewing by taper pin 29. The sides of the stirrup 28 are drilled to form bearings for an eccentric shaft 30 having journals 31 working in trunnions 26. The width of the stirrup is such as to provide a close sliding fit between the parallel inner faces of the trunnion blocks and when in place the latter are held by the stirrup against displacement from the trunnion yoke, and both the trunnion blocks and stirrup are free to rotate together on the trunnion yoke. A handle or operating lever 32 is sleeved on eccentric shaft 30 between the sides of the stirrup and is splined thereto by a removable key 33. The lever 32 is preferably split at its inner end as seen in Figure 5 and is pinched on the eccentric shaft by screw 34. Lever 32 has a free working fit between the sides of the stirrup so that it may be freely tilted to rock the eccentric shaft on its journals in the trunnion blocks, and the slight lateral play of the trunnion blocks on yoke 24 permits lateral shift of the trunnions and avoids cramping of the stirrup by the eccentric shaft and hence avoids straining the plug stem.

For the purpose of facilitating the assembly of the trunnion blocks, stirrup, lever and eccentric shaft, the bore of one of the trunnions is of larger diameter than the diameter of the eccentric section of shaft 30 to permit insertion of the shaft through that trunnion and through the stirrup and lever 32 and into the trunnion at the opposite side. To provide a bearing of the proper diameter for journal 31 at the trunnion having the enlarged bore a flanged bushing 35 is provided, see Figures 1 and 2. The key 33 is applied to the eccentric shaft before insertion through the trunnion, stirrup and lever, and therefore the trunnion block having the enlarged bore and the side of the stirrup adjacent thereto are provided with slots 37 and 36, respectively, to allow the key 33 to pass through and into the key slot on the lever 32.

To insure full reseating of the plug after opening or closing the ports, a vent hole 38 is provided at the bottom of the plug which maintains open communication between the recess 8 and port 5 of the plug so that when reseating the plug any fluid in the recess 8 will not prevent complete seating of the plug. Also to insure proper seating of the plug after regrinding, washers 39, see Figure 1, are inserted between tubes 22 and yoke 24, so that when the plug is reground and consequently fits slightly deeper into its seat, the yoke is allowed to drop by removing the washer or substituting a thinner one.

In assembling the valve parts, stud bolts 10 may be screwed into position on the casing first and then plug 4 is inserted into its seat. Bonnet 11 is then placed in position and bolts 15 inserted to clamp the bonnet to the casing. The packing 13 may now be inserted in the bonnet chamber around the plug stem, or this may be done after complete assembly of the other parts. Then gland 20 is sleeved on the stem and gland yoke 21 is placed in position with studs 10 projecting through the nut holes and the yoke resting on the gland. Tubes 22 with nuts 23 threaded thereon are then placed on studs 10, and stirrup 28 is screwed onto the plug stem and locked thereto by pin 29. Trunnion yoke 24 with trunnion blocks 26 in position is now placed in position with stirrup 28 sliding up between the trunnion blocks and studs 10 entering the nut holes in the yoke and the yoke resting upon tubes 22. Nuts 25 are then applied and screwed down tight. At this time the casing, plug and stem, bonnet, trunnion yoke, trunnions and stirrup will be fully assembled and in fixed position. Lever 32 is now inserted between the sides of the stirrup, and while held in the horizontal position as shown in Figure 7, the eccentric shaft is inserted through the trunnion having the larger bore with the key 33 in alignment with slots 37 and 36, and through the lever and into the opposite trunnion, and the key 33 entering the key slot in the lever. Bushing 35 is then inserted to center the shaft on its trunnions and screw 34 is screwed up tight to clamp the lever firmly on the eccentric shaft. If the packing was not previously inserted, this may now be done and gland 20 forced down to closely pack the packing 13 around the stem 12 by screwing down collar nuts 23. The valve will then be in the completely assembled condition as seen in Figures 1 and 2.

When it is desired to renew the packing without taking the valve out of service, the plug is raised to the position of Figure 7 with the ports either open or closed, thereby sealing the valve casing at the bonnet seal 16—17. The packing gland yoke may now be released and the gland lifted to remove and replace the packing and the gland reinserted into the bonnet and the yoke screwed down, all without disturbing any of the other parts of the valve. After the packing yoke is adjusted, the operating lever is moved back to the vertical position to reseat the plug.

The function of the eccentric shaft is to raise and lower the plug before and after rotating same through its connection with the stirrup, and to lock the plug in the seated or unseated position. To unseat the plug the operating lever 32 is swung from the position of Figures 2 and 5 to the position of Figure 6, and to rotate the

plug for opening or closing the ports, the lever is swung in either direction while in the horizontal position, and to reseat the plug in either the open or closed position, the lever is moved back to the vertical position. In the position of lever **32** in Figure 5, eccentric **30** has shifted the stirrup to its lowermost position driving the stem down and the plug firmly to its seat. This may be either the open or closed position of the plug. In the position of lever **32** as shown in Figure 6, the eccentric has raised the stirrup and plug to its unseated position and the plug is free to be rotated by the lever in either direction to open or close the ports.

It will be noted that the axis of the eccentric shaft is perpendicular to the axis of the valve plug, and that in the position of the plug as shown in Figures 1 and 2 the valve ports are closed. It will also be noted that the position of the eccentric shaft in the stirrup relative to the plug is such that the plug will be fully seated before the lever reaches the limit of its vertical position, and that the angle of inclination of the operating lever (which may be on either side of the vertical center of the valve) is in a plane perpendicular to the axis of the valve ports, thus indicating that the valve is closed and seated. This relative assembly of the lever, eccentric, stirrup and plug insures the firm seating of the plug before the eccentric can pass over its dead center, and therefore this inclination of the lever when the plug is seated indicates that the valve ports are open when in alignment with the axis of the valve ports, and closed when such inclination is in the plane perpendicular to the axis of the ports.

In opening the valve the lever is first pulled down to the position of Figure 6 and then swung around to rotate the stirrup and trunnions on the yoke **24**, thus rotating the plug to a partly open or fully open position. The angle to which the lever **32** is swung in the horizontal plane indicates the degree of opening of the valve ports, and the plug is reseated by raising the lever to the positions of Figures 2 and 5. When the valve is fully open the lever **32**, before reseating the plug, will be in alignment with the axis of the valve ports and thus the lever will indicate the full open position, and when the plug is reseated while the valve ports are fully open, the inclination of the lever in the plane passing through the axis of the valve ports will still indicate the full open position.

To close the valve ports, the lever is swung downward to the position of Figure 6, unseating the plug, and the plug is rotated by swinging the lever in either direction while in the horizontal plane to a position perpendicular to the axis of the valve ports, thus indicating the fully closed position, and then the plug is reseated by again swinging the lever upward, and the inclination of the lever across the axis of the valve ports as shown in Figure 2 will still indicate that the valve ports are fully closed and the valve plug seated.

Thus it will be seen that no separate indicating means are required for showing the position of the valve plug, and that the operation of the valve is accomplished by two movements of a single operating device without change of operating connection. It will also be seen that there can be no error in operating the valve since the plug cannot be rotated without first swinging the operating lever downward whereupon the lever itself will indicate the open or closed position. Furthermore, since there are no loose parts to be shifted in operating the valve, the valve may be set in any position, that is, the axis of the valve ports may be horizontal or vertical, or the valve body may be set at any angle in a pipe line, or the valve may be set with the plug stem pointing downward without interfering with or affecting the operation of the valve, or affecting the indication of the position of the plug by means of the operating lever.

It will also be understood that while the valve is shown as a one-way valve, the valve casing and plug may be constructed as a multiple way valve without changing the operating mechanism or requiring indicating means other than the operating lever. Furthermore the design is such that the usual standard type of parts may be employed with the exception of the trunnions, stirrup and eccentric shaft.

What I claim is:

1. In a valve, the combination of a casing having a plurality of ports, a tapered rotary plug for controlling communication between said ports, guide posts projecting from the casing, a bonnet for the plug chamber sleeved on said posts and having a passage for the plug stem, a packing chamber in said bonnet, a gland ring for compressing the packing in said chamber, externally screw-threaded tubes sleeved on said posts and seated on said bonnet, a yoke sleeved on said tubes and held seated on said gland by nuts threaded on said tubes, a trunnion yoke sleeved on said posts and held seated on said tubes by nuts threaded on said posts, trunnion blocks rotatably mounted on said yoke, an eccentric shaft journalled in said blocks, a stirrup attached to the plug stem and slidably mounted between said blocks on the eccentric shaft, and a lever secured to said shaft for imparting a rocking movement thereto and through said stirrup axial movement to the plug, and rotary movement to the stirrup and trunnion blocks to rotate said plug.

2. In a valve, the combination of a casing having a plurality of ports, a tapered rotary plug cock for controlling communication between said ports, a stem on said plug projecting through the casing, a yoke mounted on the casing having a circular opening concentric with the plug stem, a stirrup rigidly attached to said stem projecting through said yoke and having flat parallel sides, a pair of trunnion blocks having arcuate grooves for rotatively seating same in the opening of said yoke and parallel inner faces contacting the parallel sides of the stirrup and whereby said blocks are held seated, a shaft journalled in said trunnion blocks having an eccentric section working in bearings in said stirrup, and an operating lever mounted on said shaft whereby movement of said lever in a vertical plane rotates said shaft to impart rectilinear movement to said stirrup, stem and plug to seat or unseat the plug, and movement of said lever in a horizontal plane rotates said trunnion blocks, stirrup, stem and plug to open and close the valve ports.

3. In a valve, the combination of a casing having a plurality of ports, a tapered rotary plug cock for controlling communication between said ports, a stem on said plug projecting through the casing, a yoke mounted on the casing having a circular opening concentric with the plug stem, a stirrup rigidly attached to said stem projecting through said yoke and having flat parallel sides, a pair of trunnion blocks having arcuate grooves for rotatively seating same in the opening of said yoke, the radius of said grooves being less than

the radius of said opening to permit tangential movement of the blocks relative to said stem, and said blocks having parallel inner faces contacting the parallel sides of the stirrup and whereby said blocks are held seated, a shaft journalled in said blocks having an eccentric section working in bearings in said stirrup, and an operating lever mounted on said shaft whereby movement of said lever in a vertical plane rotates said shaft to impart rectilinear movement to said stirrup, stem and plug to seat or unseat the plug and simultaneous tangential movement to the blocks relative to the stem, and movement of said lever in a horizontal plane rotates said blocks, stirrup, stem and plug to open and close the valve ports.

4. In a valve, the combination of a casing having a plurality of ports, a tapered rotary plug cock for controlling communication between said ports, guide posts projecting from the casing, a bonnet for the plug chamber, having a passage for the plug stem, a packing chamber in said bonnet, a gland ring for compressing the packing in said chamber, a yoke for said gland held seated by screw-threaded members on said guide posts, a trunnion yoke on said posts having a circular opening concentric with the plug stem, a pair of separate trunnion blocks having arcuate grooves for rotatively seating same in the opening of said yoke and parallel inner flat faces, a stirrup rigidly attached to the plug stem having parallel flat sides and slidably positioned between said blocks and whereby said blocks are held seated on said yoke, a shaft journalled in said blocks having an eccentric section working in bearings in said stirrup, and a lever secured to said shaft for imparting a rocking movement thereto and through said stirrup axial movement to the plug, and rotary movement to the stirrup and trunnion blocks to rotate said plug.

EDWIN C. McFARLANE.