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J. R. YANCEY

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PLUG INSERTING AND REMOVING APPARATUS

Filed June 17, 1938

3 Sheets-Sheet 1

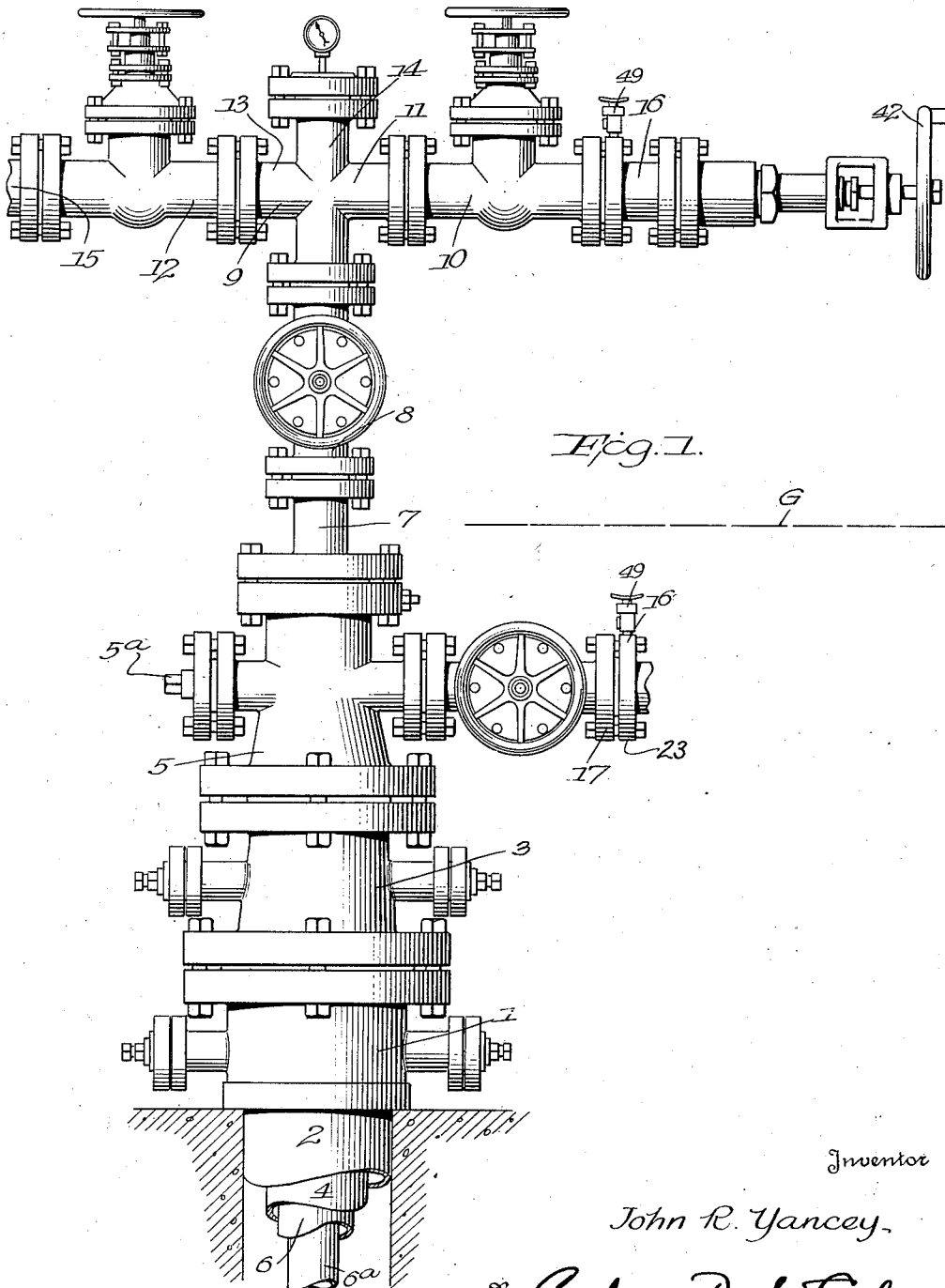


Fig. 1.

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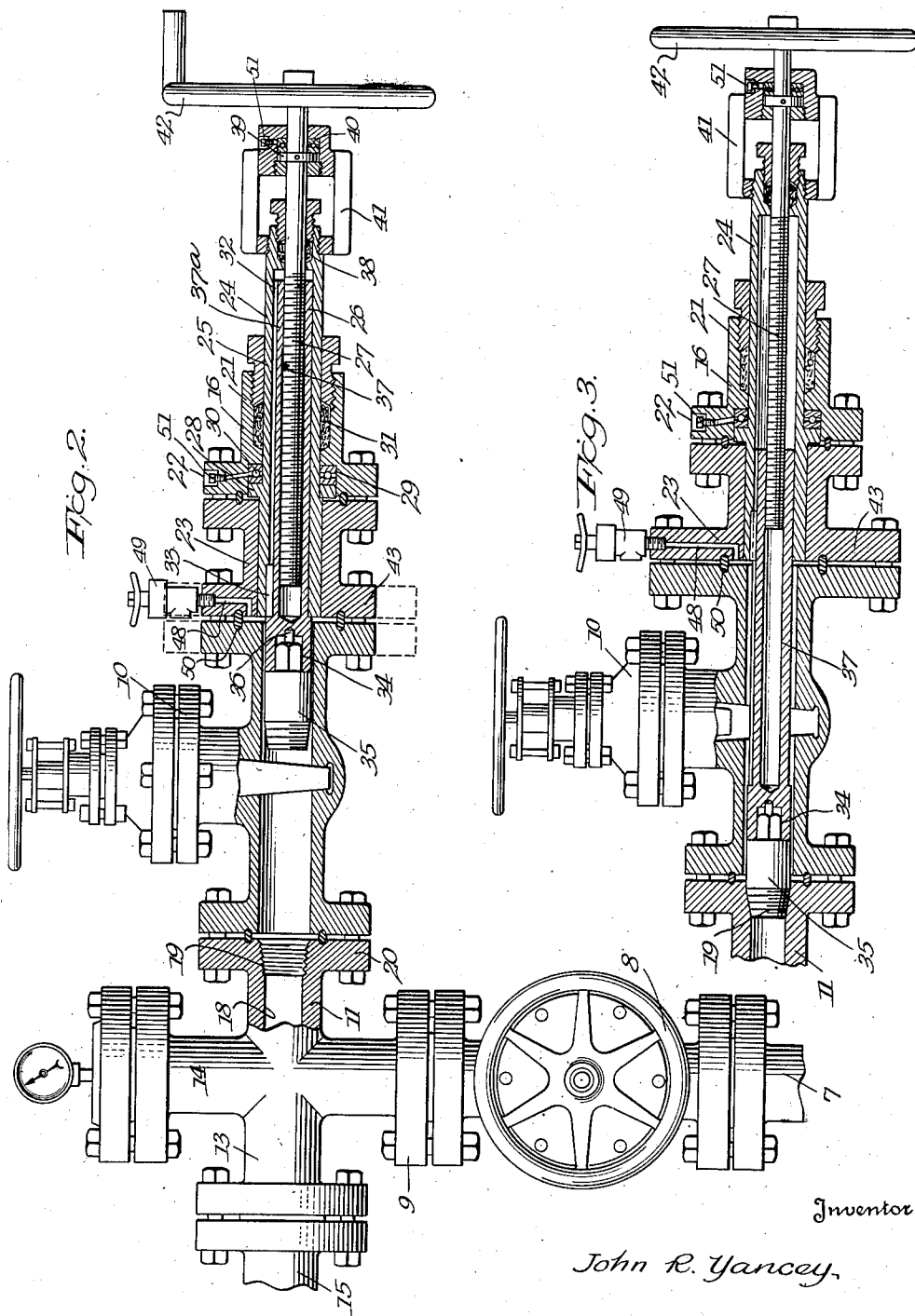
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3 Sheets-Sheet 2



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PLUG INSERTING AND REMOVING
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4 Claims. (Cl. 29—84)

The present invention relates to a plug inserting and removing apparatus.

In modern oil well practice, most outlets upon the well head are provided with two separate means by which connections may be made to each outlet. One connecting means consists of a radial flange having bolt holes circumferentially spaced about the same. By means of this flange, correspondingly flanged fittings may be secured to the outlet by bolts. The other type of connection provided upon each outlet is a screw thread at the mouth of the outlet bore. This connecting means is provided for the purpose of receiving a threaded plug.

By the arrangement described above, the outlet may be closed by a threaded plug and, while the threaded plug is still in outlet closing position, a flanged fitting including a valve, usually of the gate type, may be secured to the outlet and the plug removed through the gate valve by a tool of the type described in my Patent No. 2,077,507, Device for adjusting fittings and the like under fluid pressure, issued April 20, 1937. Conversely, when the outlet carries a valve secured to the outlet by the connecting means of flange type, a plug may be inserted through the valve to close the outlet and the valve may then be removed for repair and replacement.

Some of the outlets upon an oil well are down within the cellar which surrounds the well head and since such cellars frequently contain harmful gases, it is desirable to provide a plug inserting and removing tool which can be readily operated and by minimum labor. Other outlets are above the cellar, but it is also desirable that plug inserting or removing operations performed on these outlets be conducted as expeditiously as possible.

An important object of the present invention is to provide an apparatus of the type referred to which is of minimum dimensions, can be operated with speed and a minimum of effort, and which is so designed that various emergencies which might arise during the operation of removing or replacing the plug through the valve can be readily and safely met.

Enormous pressures are encountered in the deep wells drilled at the present time, and the inward movement of a plug through an outlet valve is, of course, resisted by such pressure. With the plug handling tools heretofore developed, since the pressure resisting inward movement of the plug was equal to the pressure of the well multiplied by the area of the removal tool stem, a considerable number of operators

was required to overcome this pressure. The apparatus of the present invention is so designed that the pressure acting on the inner face of the plug is permitted to flow through the interior of the apparatus to a point to the rear of the plug, thereby equalizing the pressure on both ends of the plug and permitting the entire operation to be handled with less labor. An advantage resulting from this arrangement is that the operation can be conducted within a shorter period of time. This is extremely important because of the gases frequently present in the cellar and referred to above.

The other object of the invention stated above, e. g., that of having the apparatus so constructed that various emergencies arising during the operation can be readily met, is accomplished by having the apparatus of such construction that should threads on the operating elements of the tool become galled, as by the action of sand or dirt in the well, or from any other cause, the plug carrying element of the tool and the plug itself can be quickly retracted and the outlet valve closed. More particularly, it frequently occurs that after the plug has been moved to a point past the open outlet valve, but before the plug has been threaded into the Christmas tree outlet, sand or pressure conditions may cause the operating portions of the apparatus to become jammed. In this event, it is necessary to remove the apparatus and reclose the valve so that the operating elements may be cleaned or repaired, but with prior apparatuses of this type, the jamming of the threaded operating elements prevented the apparatus from being withdrawn. As indicated immediately above, the apparatus of the present invention is so designed that the tool may readily be operated to enable it to be withdrawn past the valve should the normal operating means become jammed. It may be stated that this withdrawal can be performed with equal readiness if the plug has been engaged and unthreaded from the outlet, and if the normal operating means then becomes jammed.

Other objects and advantages of the invention will be apparent from the accompanying drawings wherein,

Figure 1 is a side elevation showing a well head structure with the apparatus of the present invention connected to an outlet gate valve which, in turn, is secured to the well head Christmas tree. The view indicates a second point upon the well head at which the apparatus may be used.

Figure 2 shows the Christmas tree included in

Figure 1, and also shows the apparatus of the present invention in vertical section.

Figure 3 is a view generally similar to Figure 1, but showing the elements of the apparatus in another position with respect to each other.

Figure 4 is a vertical sectional view, on a larger scale, of a slightly modified form of the apparatus, and

Figure 5 is a detail vertical sectional view of the preferred form of plug engaging means intended to be used on the plug carrier of the present invention.

Referring to Figure 1, this figure shows a typical well head fitted for flowing, the numeral 1 designating a lower casing head attached to an outer string of casing 2, and to support an inner string of casing 4, an upper casing head 3 to support an inner string of casing 6 and an upper casing head or tubing head 5 which supports the flow tubing 6a. An adapter 7 is provided above the tubing head 5, the adapter supporting a master manifold valve 8 which controls the flow to a Christmas tree 9. A gate valve 10 is shown connected to one lateral arm 11 of the Christmas tree 9 and a second gate valve 12 is shown connected to the opposite lateral arm 13. The upper arm 14 of the Christmas tree is shown closed. The ground level about the particular installation shown is indicated by the dotted line G.

As is well-known, flow from the well would ordinarily occur through a line such as 15 leading from one arm of the Christmas tree, in the present instance, the lateral arm 13, and through the gate valve 12 connected thereto to a point of oil storage.

For the purpose of describing the operation of the present apparatus, it is to be assumed that the lateral arm 11 of the Christmas tree has previously had a flow line including gate valve 10 connected thereto and that after closing of gate valve 10, all of this flow line except valve 10 was disconnected, thereby enabling the tool 16 of the present invention to be connected to valve 10. Further, it is to be assumed that oil from the well is now flowing through the gate valve 12 and its line 15, these having been connected to the lateral arm 13 of the Christmas tree 9 prior to closing of gate valve 10, so that flow from the well would not be interrupted.

Figure 1 also shows a gate valve 17 connected to one of the outlets of the tubing head 5. This is merely to indicate how the apparatus of the present invention may be used to remove or insert plugs in an outlet of the casing head.

As explained in my above-mentioned Patent No. 2,077,507, the use of an apparatus of the present type is in no way limited to use upon the lateral outlets of a Christmas tree. The showing at valve 17 of Figure 1 is an example of how the device may be used upon other external outlets of the well head. In fact, the above-mentioned patent also fully describes how such an apparatus may be used to insert or remove plugs in various internal passages or bores of well head fittings.

Referring to Figure 2, the Christmas tree fitting 9 there illustrated is of the type disclosed in my patent No. 2,104,177, January 4, 1938, for Pipe fittings. Both lateral arms, at least, are of identical construction, each being provided with a bore 18 having its outer end threaded as indicated at 19. Also, a radial flange 20 extends about each arm to receive bolts whereby a fitting may be connected thereto. Valve 10, connected to lateral arm 11 of Christmas tree 9 by bolts ex-

tending through the flange 20, is shown in closed position.

The apparatus 16 comprises a base fitting or housing 21 including a radial flange 22 whereby it may be secured to a radial flange on an adapter 23 interposed between the outer end of the gate valve 10 and the housing 21. A ram 24, generally comprising a sleeve 25, plug carrier 26, and operating rod 27 is mounted in housing 21, sleeve 25 being arranged for rotation within housing 21, and having a flange 28 intermediate its ends and positioned in a counter-bore 29 at the inner end of the housing. The rear surface of flange 28 bears upon a ball race 30 which acts as a thrust bearing for the sleeve. The outer portion of the bore of housing 21 is packed as indicated at 31, the packing being compressed by a sleeve nut to form a pressure-tight joint about sleeve 25. One or more keyways 32 extend along the exterior of the carrier 26, each keyway being adapted to receive a relatively short key 33 secured to the inner end of the sleeve 25. The inner end of carrier 26 is provided with a socket 34, preferably of hexagonal form and adapted to fit over the head of a plug such as 35 so that the plug may be rotated with the carrier element. The plug shown is of the pressure-equalizing type disclosed in my above-mentioned Patent No. 2,077,507 and the socket 34 is provided with a stem 36 for the purpose of holding the valve of the plug open as described in said patent, and as hereinafter described.

Carrier element 26 includes a bore 37 opening to its outer end and extending substantially the full length of the element, the extreme outer end of the bore being threaded as indicated at 37a. The operating rod 27 is mounted in the bore 37 and engages the threads 37a. As indicated in the larger scale showing of Figure 4, the threads are of large cross-section. The outer end of rod 27 is unthreaded and extends through a packing 38 in sleeve 25. Adjacent its extreme outer end, rod 27 has a collar 39 secured thereto and this collar bears against a thrust bearing 40 carried within a spider 41 threadedly connected to the outer end of sleeve 25. An operating wheel 42 is fixed to the extreme outer end of rod 27.

It will be observed that the sleeve 25, and carrier element 26 extend through the adapter 23 and that adapter 23 has a radial flange 43 at its inner end adapted to have sealed contact with the outer radial flange on gate valve 10. Various sized gate valves are used upon different wells, and a number of adapters may be provided with the apparatus, each having an inner flange of a size to fit a different standard gate valve, as indicated in dotted lines in Figure 2.

Adapter 23 has a bleeder valve passage 48 in its inner flange 43, the passage extending from the face of the flange to the perimeter of the flange, and the outer end of the passage having a bleeder valve 49 connected thereto. It will be noted that the inner end of passage 48 is inwardly of the packing groove 50.

Suitable lubricating fittings and passages 51 may be provided for the bearings 30 and 40.

In operation, to plug the bore 18 of lateral outlet 11 of Christmas tree 9, the apparatus of the present invention is secured to the outer end of the gate valve in the position shown in Figure 2, a plug 35 having been fitted in the socket 34 of carrier element 26. Positioning of the plug in the socket 34 will cause the stem 36 to open a normally closed check valve, not shown, in the plug, as described in my said Patent No. 2,077,507.

Since all of the joints within the apparatus are entirely sealed and the apparatus itself is sealed to the outer end of the gate valve 10, the valve element of the gate valve may now be opened. Hand wheel 42 may then be rotated to cause carrier element 26 to be moved inwardly through the bore of the gate valve, this movement of the carrier element of course resulting from the fact that the carrier element is held against rotation by being keyed to sleeve 25 and sleeve 25 is not being rotated. Advancing movement of plug 35 will not be resisted by any pressure acting upon its inner face because the pressure of the well may flow past the plug and the adjacent portion of carrier 26 and thence past key 33 through keyway 32 to the space behind carrier element 26 and about the operating rod 27. The pressure will then move between the threads between carrier 26 and rod 27 and to the forward end of bore 37, thereby entirely equalizing all pressure. The threads on the members 26 and 27 will permit passage of pressure between them, particularly because the threads at 37a extend only along a relatively short extent of member 26. As a result, the pressure acting upon the inner end of plug 35 and carrier 26 will be the same as that behind these elements. Since the pressure behind the plug and all forwardly moving elements of the apparatus is thus equal to the pressure in front of the plug, and every element which is moving forwardly, it follows that the plug can be moved forward with minimum labor and within a comparatively short period of time.

When the plug reaches a point adjacent the threads 19 of bore 18 of the Christmas tree fitting 9, the plug may be threaded into the bore by applying tongs to the sleeve 25 at a point beyond the end of housing 21. Rotation of the sleeve 25 will of course rotate the entire ram 24, including carrier element 26, with the result that the plug will be threaded upon the threads 19 if slightly faster rotary movement is simultaneously applied to the hand wheel 42 to move the plug inwardly.

When the plug 35 has been firmly seated and sealed in the threaded socket 19 as shown in Figure 3, the hand wheel may be rotated in the reverse direction to draw the carrier 26 from the plug by rectilinear movement. When the carrier is backed off the plug, the valve, not shown, within the plug will be closed by the well pressure, thereby entirely sealing the bore 18. After the carrier 26 has been retracted to the position shown in Figure 2 the apparatus 16 may be removed from the gate valve 10 and the valve disconnected from the Christmas tree 9 for repair or replacement.

Should the threads connecting carrier 26 and stem 27 become jammed during movement of the carrier in either direction, as by reason of sand in the fluid flowing into the apparatus, this difficulty can be remedied by removing the spider 41 from its threaded relation with sleeve 25, and the stem 27 can then be moved outwardly in sleeve 24, drawing the carrier 26 with it. After the carrier has thus been moved to the position of Figure 2, gate valve 10 may be reclosed to prevent flow, in case no plug is seated in bore 18, and the apparatus 16 may be disconnected from the gate valve so that the jamb may be corrected.

It will be appreciated that the above-described capacity of the present apparatus for overcoming what has heretofore been a serious emergency with apparatus of this type is of great importance.

In order to remove a plug from threaded connection with a Christmas tree, a gate valve such

as 10 would first be secured to the Christmas tree by bolts extending through the radial flanges of the tree and valve, respectively, and then the apparatus 16, including an adapter 23 of proper size to fit the valve, would be fitted to the outer end of the valve. With the valve open, the carrier element 26 can be moved inwardly by rotation of hand wheel 42 so that its socket 34 will engage the headed end of the plug as shown in Figure 3. If the walls of the socket 34 are not exactly aligned with the surfaces of the headed end of plug 35, alignment can be obtained by slight rotation of sleeve 25 by tongs, and forward movement of the carrier 26 by rotation of hand wheel 42 may then be resumed.

Engagement of the stem 36 positioned within socket 34 with the closed valve of the plug will cause the valve, not shown, in the plug to open, permitting the pressure within the Christmas tree to escape into the passage of the valve 10 and also to flow to the rear portion of the apparatus 16 as described above. Rotation of the sleeve 24 by means of tongs will cause the plug to be unthreaded from the outlet threads 19, and after the plug has thus been unthreaded, it may be retracted to the position of Figure 2 by rotation of hand wheel 42. The valve 10 may then be closed and the apparatus 16, including the adapter 23, can be disconnected from the valve 10. A flow line may then be connected to the valve.

The provision of the bleeder valve 49 and its passage 48 will enable pressure within the apparatus to be relieved before the apparatus is removed from the well head fittings.

As has been indicated above, the apparatus of the present invention may be used to remove a plug from any outlet of a well head. For example, the plug indicated at 5a on the tubing head 5 may be removed by operations similar to those discussed above, or a plug could be inserted through the gate valve 17 shown for present purposes of description in Figure 1. The apparatus of the present invention is particularly satisfactory for conducting operations upon fittings such as a tubing head 5 positioned within the well cellar because the inclusion in the apparatus of a ram provided with an operating structure which is normally non-extensible gives ample room for operating the device, and hence increases the speed of operation, quite aside from the fact that the device itself is readily operable because of the equalization of pressure which occurs. It will be understood that the device is of such size relative to the dimensions of the normal well cellar that even if it becomes necessary to remove the spider 41 and move the elements 26 and 27 outwardly by rectilinear movement, such operation can be satisfactorily conducted.

Referring to Figure 4, the structure shown there is identical with that of Figures 1 to 3 except that a removable spider 41 is not provided and the apparatus is also shown connected directly to a gate valve 10. Referring to the outer end of the Figure 4 structure, the collar 39 of the operating rod 27 bears against a ball race 40 mounted within a sleeve 25a generally corresponding to the sleeve 25 of Figure 2. The outer portion of operating rod 27 extends through a bore 45, and a packing 46 forms a seal between rod 27 and sleeve 25a. This structure is entirely satisfactory for use on wells where the possibilities of the operating rod 27 and sleeve 26 becoming jammed are negligible. Referring to the inner end of the Figure 4 structure, it will be noted

that the sleeve 25a terminates at the inner end of housing 21 and is there provided with a thrust flange 28. It will be understood that the Figure 2 apparatus may also have its sleeve 24 formed in this same way, and regardless of whether it is to be used with an adapter.

It has been stated above that operation of a plug inserting and removal tool is hampered by sand in the oil of the well. Other causes of difficulty are corroded spots in the well fittings through which the tool is operated, sediment, and bits of formation. Because of the fact that pressure within the present apparatus is completely equalized, and an operator therefor does not have to operate the device against well pressure, if the operation of the apparatus becomes difficult, the operator will immediately know that the resistance is due to one of the above-mentioned causes and so will move the carrier element 26 outwardly by non-rotational movement before the apparatus becomes badly jammed. In other words, because the present tool operates entirely without resistance of well pressure, an operator will be sensitive to obstructions which would not be given due regard by one operating a non-equalized or only partially equalized apparatus. In fact, the latter operator, on the other hand, would be very apt to force a tool into a jammed position against an obstruction, thinking that he was merely combatting well pressure. If necessary, a reamer may be placed on the carrier element 26 of the present device and any obstruction removed. Also, if the operation being conducted is one of plug inserting, and it is found that the plug will not engage the threads 19 because these threads are galled, the carrier may be withdrawn, the plug removed, and a tap may be fitted to the carrier 26 to straighten out the threads.

Figure 5 shows the preferred construction of the plug engaging end of plug carrier 26. As there shown, the plug holder 26a is threaded upon the body of element 26 and hence can be removed and replaced by another holder 26a formed to receive a plug of another size. The valve operating stem 36 is carried by a head 36a threaded in the bore 37 and closing the inner end of this bore. The use of a removable plug holder 26a and adapters 23 further permits the present apparatus to be used upon fittings of a wide size range.

It will be understood that the invention is not limited to the details of construction shown in the drawings and that the example of the use of the apparatus and method which has been given does not include all of the uses of which it is capable; also, that the phraseology employed in the specification is for the purpose of description and not of limitation.

I claim:

1. In a device for use in removing a valve or the like which controls flow through the outlet from a fitting having fluid under high pressure therein, a housing having means for fluid-tight connection with the valve when the same is closed, said housing having a bore to form a high pressure fluid-tight chamber with the bore of the valve, a carrier in the bore of said housing wholly within the chamber formed thereby, said carrier being arranged for longitudinal movement in said housing, means for preventing said carrier from rotation with respect to said housing during its longitudinal movement, said carrier having means on one end for removably carrying a plug for the outlet from the fitting, said housing hav-

ing an opening therethrough to its bore, a rod extending through the opening in said housing and into the chamber formed thereby, said rod being mounted for rotation in said chamber, means for preventing longitudinal movement of said rod with respect to said housing during its rotation therein, fluid-tight sealing means between said rod and said housing, and means within said housing and the chamber formed thereby operatively associated with said carrier and said rod for translating the rotary motion of said rod into longitudinal movement of said carrier, whereby said carrier is moved longitudinally in the chamber toward said outlet by the rotation of said rod when the valve is open without forcing said rod into said chamber against the pressure therein, thereby maintaining constant the volume of the fluid in said chamber.

2. In a device for use in removing a valve or the like which controls flow through a threaded outlet from a fitting having fluid under high pressure therein, a housing having means for fluid-tight connection with the valve when the same is closed, said housing having a bore to form a high pressure fluid-tight chamber with the bore of the valve, a carrier in the bore of said housing wholly within the chamber formed thereby, said carrier being arranged for longitudinal movement in said housing, means for preventing said carrier from rotation with respect to said housing during its longitudinal movement, said carrier having means on one end for removably carrying a threaded plug for the outlet from the fitting, said housing having an opening therethrough to its bore, a rod extending through the opening in said housing and into the chamber formed thereby, said rod being mounted for rotation in said chamber, means for preventing longitudinal movement of said rod with respect to said housing during its rotation therein, fluid-tight sealing means between said rod and said housing, means within said housing and the chamber formed thereby operatively associated with said carrier and said rod for translating the rotary motion of said rod into longitudinal movement of said carrier, whereby said carrier is moved longitudinally in the chamber toward said outlet by the rotation of said rod when the valve is open without forcing said rod into said chamber against the pressure therein, thereby maintaining constant the volume of the fluid in said chamber, and means providing for the rotation of said carrier around a longitudinal axis extending there-through, at the termination of its longitudinal movement, to thread said plug in said outlet.

3. In a device for use in removing a valve or the like which controls flow through the outlet from a fitting having fluid under high pressure therein, a housing having means for fluid-tight connection with the valve when the same is closed, said housing having a bore to form a high pressure fluid-tight chamber with the bore of the valve, a carrier in the bore of said housing wholly within the chamber formed thereby, said carrier being arranged for longitudinal movement in said housing, means for preventing said carrier from rotation with respect to said housing during its longitudinal movement therein, said carrier having means on one end for removably carrying a plug for the outlet from the fitting, said housing having an opening in its end in alignment with its bore, a rod extending through the opening in said housing and into the chamber formed thereby, said rod being

mounted for rotation in said chamber, cooperating means on said housing and rod for preventing longitudinal movement of said rod with respect to said housing during its rotation therein, fluid-tight sealing means between said rod and said housing, means within said housing and the chamber formed thereby operatively associated with said carrier and said rod for translating the rotary motion of said rod into longitudinal movement of said carrier, whereby said carrier is moved longitudinally in the chamber toward said outlet by the rotation of said rod when the valve is open without forcing said rod into said chamber against the pressure therein, thereby maintaining constant the volume of fluid in said chamber, said cooperating means on said housing and rod for preventing longitudinal movement of said rod with respect to said housing being releasable whereby said rod may be quickly pulled outwardly to move said carrier outwardly beyond the valve in order to close the same.

4. In a device for removing or operatively attaching a valve or the like for control of flow through the outlet from a fitting having fluid under high pressure therein, a housing having means for fluid-tight connection with the valve, said housing having a bore to form a high pressure fluid-tight chamber with the bore of the valve, an elongated carrier in the bore of said housing wholly in the chamber formed thereby, having means at one end for removably carrying a plug for the outlet from the fitting, said carrier being arranged for outward and inward movement in said chamber and having means

for preventing it from rotational movement with respect to said housing during its longitudinal movement therein, said carrier having a relatively extensive bore extending inwardly from its other end, internal threads in the bore of said carrier, said housing having an opening in its end in alignment with said bore, an operating rod extending through the end opening of said housing and into the chamber formed thereby, the inserted end of said rod having a length of threads in engagement with the threads in the bore of said carrier, means mounting said operating rod in said housing for rotation therein while preventing said rod from longitudinal movement with respect thereto, the threaded connection between said carrier and said rod being sufficiently extensive so that said carrier may be moved outwardly and inwardly in said chamber from and toward said outlet when the valve is open by the rotation of said operating rod, said threaded connection translating the rotary motion of said rod into longitudinal movement of said carrier without projecting said rod into said chamber, thereby maintaining constant the volume of fluid in said chamber, said carrier having both ends in said chamber and having a passage for high pressure fluid leading into its bore, the inner end of said carrier bore thereby comprising an area subject to the high pressure fluid in said chamber and the pressure of fluid in said chamber acting outwardly and inwardly on said carrier being thereby substantially equalized.

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