

Dec. 5, 1939.

C. C. BROWN

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PLUGGING TOOL

Filed July 23, 1936

2 Sheets-Sheet 1

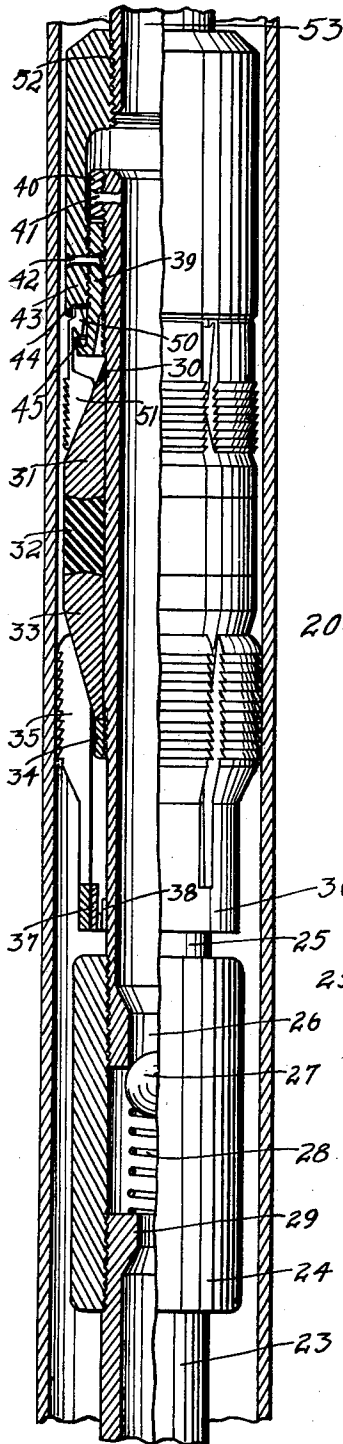


Fig. 2.

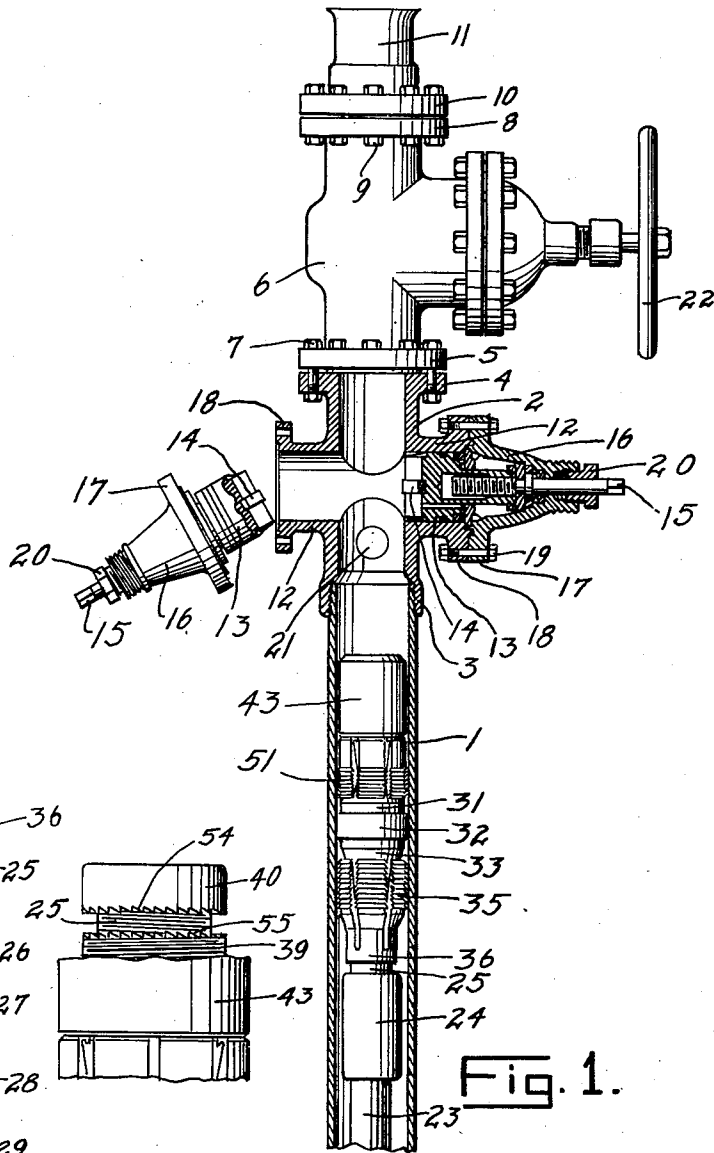


Fig. 3.

Fig. 1.

Cicero C. Brown.
Inventor

J. Vincent Martin
and
Ralph H. Browning.
Attorneys

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2 Sheets-Sheet 2

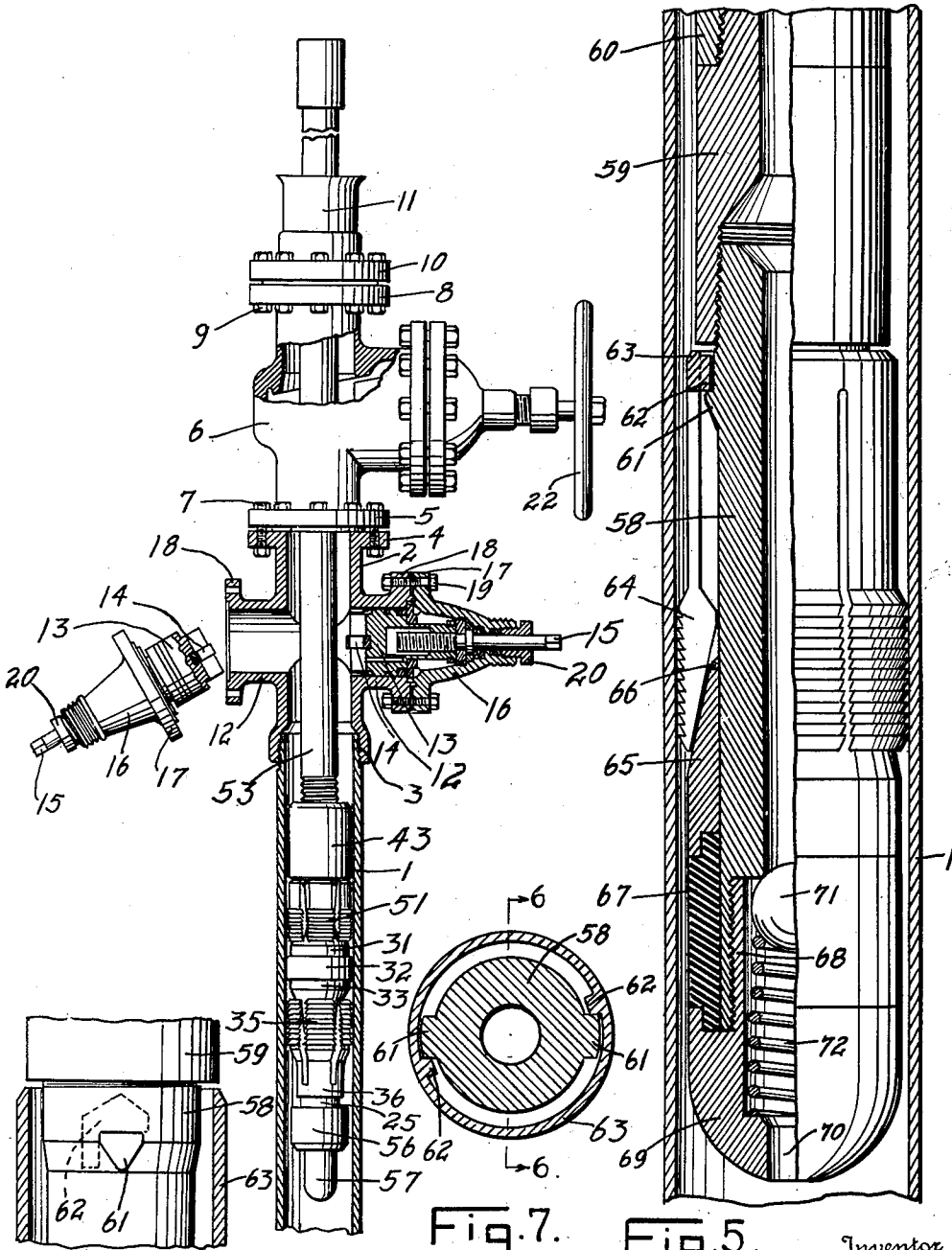


Fig. 6.

Fig 4

Fig. 7.

Fig. 5.

Inventor
Cicero C. Brown.

By

J. Vincent Martin
and
Ralph H. Browning
Attorneys

UNITED STATES PATENT OFFICE

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PLUGGING TOOL

Cicero C. Brown, Houston, Tex.

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7 Claims. (Cl. 166—13)

This device relates in general to a plugging tool, and more particularly has reference to a means for plugging off the upper end of an oil well, or the like, so that control of the well may be maintained during a change of equipment at the upper end of the well.

It is customary in connection with oil wells and the like to provide a casing and a tubing within the casing, and to provide various devices, such as valves and mechanisms known as blow out preventers, etc., for controlling the flow of fluid from the well. During the course of assembling or dis-assembling such equipment, or making changes in its arrangement, it is sometimes desirable to remove a portion of the equipment, such as a ram of a blow out preventer, below the location of any valve capable of shutting off the well.

It is an object of this invention to provide a device which will permit the removal or replacement of any or all of the equipment at the top of the well without opening the well in a manner such as to let it get out of control.

It is a further object to provide a tool whereby a well may be plugged below the control equipment at the top thereof, and may later be opened after any desired operations have been performed on such control equipment.

It is an object to provide such a tool which may be positively positioned so as to prevent it from either being pulled into or blown out of the well.

It is another object to provide a tool of the character set forth which will permit of circulating fluid therethrough in a downward direction, but will prevent flow of fluid in an upward direction.

It is a further object to provide such a tool which, in addition to plugging the well, may serve as a hanger for supporting the tubing or drill pipe during the time the well is plugged.

One other object of this invention is to provide such a tool with packing adapted to seal against the inner walls of the well casing, or the like, and to arrange such packing in such a manner that any force tending to move said plug upwardly or downwardly within the well will cause said packing to be set more firmly.

With the foregoing and other objects in view, this invention contemplates the various parts and combinations set forth by way of example in the accompanying drawings, and the following description, it being understood, however, that the said drawings and description are by way of example and illustration only, and are not by way

of limitation of the scope of this invention. Such limitation is to be only by the prior art and by the terms of the appended claims.

Referring now to the drawings in which like numerals indicate corresponding parts throughout:

Fig. 1 is a view partly in vertical cross section illustrating the equipment adjacent the upper end of the well with a part thereof removed for replacement or repair and with a plugging tool constructed in accordance with this invention in position for closing the well.

Fig. 2 is an enlarged view partly in vertical cross section illustrating the plugging tool shown in Fig. 1 and the manner in which it is operated.

Fig. 3 is an enlarged elevation of a portion of the mechanism shown in Fig. 2.

Fig. 4 is a view similar to Fig. 1, but illustrating the manner of operating the plugging tool, and showing a slight modification.

Fig. 5 is a view similar to Fig. 2, but illustrating a modification.

Fig. 6 is an enlarged view partly in vertical cross section taken along the line 6—6 of Fig. 7, illustrating a detail of the tool shown in Fig. 5.

Fig. 7 is a view in horizontal cross section showing the structure illustrated in Fig. 6.

Referring now to Fig. 1, the casing 1 is shown as being provided with a blow out preventer of the ram type at its upper end. The housing 2 of this blow out preventer is threaded at 3 to the upper end of the casing, and is provided with a flange 4 at its upper end adapted to receive the lower flange 5 of a gate valve 6 and be joined thereto by means such as bolts 7. The upper end of this gate valve is similarly provided with a flange 8 adapted to be joined by means of bolts 9 with a flange 10 on the ball nipple 11.

The blow out preventer housing 2 is formed with laterally extending branches or cylinders 12 adapted to receive the rams 13. These rams 13 are cut away adjacent their inner ends to embrace a tubing or the like extending through the blow out preventer, and are provided with packings 14 along these cut away faces so as to form a seal with such tubing. The rams are operated by means of the shafts 15 which shafts are mounted within housings 16 adapted to be secured by means of their flanges 17 to the flanges 18 on the blow out preventer housing 2, these flanges being secured together by means such as the bolts 19. The outer ends of the housings 16 are provided with stuffing boxes and packings adapted to be compressed by the gland nuts 20. Below the rams 13 the housing 2 of the

blow out preventer is provided with lateral openings 21 for the purpose of communication with the interior of the casing when the tubing is extended through the blow out preventer and the rams thereof closed.

5 The gate valve 6 is operated in a customary manner by means of a hand wheel 22.

As illustrated in this figure and in Fig. 2, a special fitting 23 is provided adapted at its lower end to receive the tubing (not shown), and at its upper end to receive the coupling member 24. 10 The upper end of this coupling member likewise receives a special section of tubing 25. This special section 25 is provided with an internally upset portion 26 at its lower end which forms a seat for the ball valve 27. This ball valve is spring pressed into position by means of a spring 28 positioned therebelow, the shoulder 29 formed by an internal upset in the special section of 15 tubing 23 providing a seat for the lower end of the spring 28.

Adjacent its upper end, the section of tubing 25 is formed with an external downwardly facing shoulder 30 against which the upper mandrel 31 25 is positioned. A packing ring 32 surrounds the tubing section 25 below the mandrel 31, and a second mandrel 33 is positioned below the packing 32. The mandrels 31 and 33 are externally tapered in opposite directions, both of them increasing in diameter toward the packing 32. 30 The lower mandrel 33 is held in position by means of a ring 34 threaded upon a special thread on the exterior of the tubing 25.

So long as the plugging tool is not locked in position within a well, the mandrels 31 and 33, 35 and the packing 32 occupy the position shown in Fig. 2; and the packing 32 does not form a seal between the tubing section 25 which forms the body of the plugging tool and the inner wall of the casing 1. Below the mandrel 33, however, 40 there is a set of slips 35 adapted to engage the inner wall of the casing 1, and having an inwardly inclined upper surface adapted to cooperate with the inwardly inclined lower surface of the mandrel 33. These slips 35 are formed by 45 slitting a sleeve 36 to a point adjacent its lower end, this lower end portion, however, being left in the form of a complete ring. Inside of the ring 36 is an inward projection 37 of L-shape, the horizontal portion of the L being adapted to removably receive a lug 38 mounted on the exterior of the tubing section 25. It is to be noted that 50 while Fig. 2 only shows one set of L-shaped members 37 and lugs 38, a number of these would probably be employed at intervals about the circumference of the sleeve. It is noted further that the sleeve 36 is rotatable with respect to the body member of the tubing 25, and that by rotating the tubing one way or the other when the 55 sleeve is in its lower position upon the tubing, the L-shaped members 37 and the lugs 38 may be engaged with or disengaged from each other.

At its upper end, the tubing 25 is formed with a left-hand thread adapted to receive a short sleeve-like member 39 and a locking collar 40 65 thereabove. The collar 40 is secured in place on the tubing 25 by means of a rivet 41 so that the member 39 cannot be backed off the end of the tubing section 25.

70 The member 39 is also threaded on its exterior and a rivet 42 extends therethrough and locks in place a slip collar 43 which is threaded onto the said exterior threads so that by rotation of the slip collar 43 the sleeve 39 may also be

rotated to move it upwardly or downwardly upon the tubing section 25.

The lower edge of the slip collar 43 is formed with a lip 44, and the lower edge of the sleeve member 39 is turned upwardly to form a lip 45 5 in opposed relation to lip 44 on the slip collar 43.

Between these two lips and retained thereby are the heads 50 from which are supported slip sections 51 adapted to engage the upper mandrel 31. It will be noted that when the slips 51 are 10 lowered by the downward movement of the slip collar 43 and the sleeve 39, that the slips 51 will first engage the inner wall of the casing 1, and upon further downward movement will cause the mandrel 31 to move downwardly and further 15 compress the packing 32. The sleeve 39 is moved downwardly by means of the slip collar 43 as hereinbefore stated, this collar being threaded at its upper end 52 to receive a handling nipple 53 for this purpose. It is noted that when the 20 handling nipple 53 is rotated to the left, it moves the sleeve 39 and the slips 51 downwardly into locking position, and that when rotated to the right, it moves these members upwardly. The extent of the downward movement is limited by 25 the engagement of the slips 51 with the walls of the casing and with the mandrel 31, and when the resistance becomes great enough, further turning to the left will break the nipple 53 loose from its threaded engagement with the collar 43 30 and the nipple may then be removed. When the nipple is turned to the right, however, as in retracting the slips 51, this rotation is limited by the engagement of the teeth 54, which are formed on the lower edge of the ring 40 as shown in Fig. 35 3, with teeth 55 formed on the upper edge of the sleeve 39. This makes it possible for the nipple 53 to be threaded into the upper end of the coupling 43 with sufficient tightness to enable it to set the slips 51 to the desired degree.

Referring now to Fig. 4, the coupling 24 has in this instance been replaced with a coupling 56 40 and the lower end of this coupling has been closed by suitable means such as a bull plug 57. It is to be understood that the plugging tool shown in Figs. 1 and 2 is the same as that illustrated in Fig. 4, and that the same may be employed in either form, depending on whether or 45 not the tubing is to be supported from the plugging tool. It is further apparent that the plugging tool of Figs. 1 and 2 may be employed just as shown therein without suspending the tubing therefrom, inasmuch as the ball valve 27 will prevent upward flow through the tool.

Referring now to the form illustrated in Fig. 5, 55 the plugging tool in this instance is provided with a body 58 having its upper end externally threaded to receive the fitting 59. The fitting 59 in turn threadedly receives the member 60 which may be suspended from the customary traveling block or other hoisting device at the upper end of the well.

The body 58 a short distance below its threaded upper end is provided with an outstanding lug 61 similar to the lug 38 on the body 25 shown in Fig. 2. This lug 61 is likewise adapted to engage 65 with an inwardly extending projection 62 upon the sleeve-like member 63. This sleeve-like member 63 is adapted to support the slips 64, and this composite member consisting of the ring or sleeve 63 and the slips 64 is very similar to the member consisting of the ring 36 and the slips 35 of Fig. 2, except that it is disposed in inverted position.

The lower ends of the slips 64 are formed with

a downwardly and outwardly inclined inner surface adapted to contact with the downwardly and outwardly inclined outer surface of a mandrel 65. The upward movement of this mandrel is limited by a stop 66 formed on the body 58. Below the mandrel is positioned a packing 67, and the lower end of this packing is held against downward movement by a bull plug having an upwardly projecting sleeve 68 threaded into the lower end of the body 58. This bull plug is indicated by the numeral 69, and has an opening 70 through its lower end. The interior of the bull plug has an enlarged opening or chamber therein, within which is disposed a ball valve 71 corresponding to the ball valve 27 in Fig. 2, and a spring 72 corresponding to the spring 28 of Fig. 2. As will be seen, this ball valve is adapted to seat against the lower end of the bore through the body 58 and prevent upward flow through this body.

In operation, the plugging tools hereinbefore described may be employed, whenever it is desired to remove or replace a portion of the equipment at the top of an oil well without releasing the pressure within the oil well. With reference to Figs. 1 and 4, the tool may for instance be employed during the replacement of the rams 13 of a blow out preventer, it being contemplated that the packings on these rams have either worn out or that it is desired to provide rams which will accommodate a different size of tubing. In this instance, the tool is threaded onto the upper end of the tubing which is in the well, and a nipple 53 is threaded into the upper end of the slip collar 43. The rams of the blow out preventer are then opened and the tool is lowered into the upper end of the casing 1. The body of the tool is then lifted and rotated slightly to the right to cause the disengagement of the lugs 38 from the L-shaped members 37, after which the tool is again moved downwardly. The slips 35, however, will now remain in whatever position they were when the said lugs were disengaged, and as the tool is moved downwardly with respect to the slips, it will form a wedging engagement between the wall of the casing and the lower mandrel 33. Further downward movement of the tool will cause the locking of these slips against the casing wall, and will cause an upward sliding movement of the mandrel 33, thus compressing the packing 32 and causing it to form a seal between the body 25 and the wall of the casing.

In order to prevent the upward movement of the plugging tool under increasing gas pressure from the well, the nipple 53 is then rotated to the left, moving the sleeve 39 and the slips 51 downwardly. This movement causes the slips 51 to wedge between the casing wall and the upper mandrel 31, thus locking the tool against upward movement and further compressing the packing 32. When the extent of movement of slips 51 has been reached, further rotation to the left will disengage the nipple 53 from the collar 43 and will permit the removal of the nipple. The ball valve 27 under these circumstances prevents upward flow through the tool. The well is now plugged, and any operation desired may be performed with respect to any of the equipment on the upper end of the well without releasing the pressure within the well.

After the work has been completed upon the equipment at the upper end of the well, the nipple may again be inserted and rotated to the right, and the process above described will be

reversed, the plug being then released from its locking and sealing engagement with the casing. If at this time it be found that the well is under high pressure due to the accumulation of gas pressure while the well has been closed off, it may be found desirable to pump a heavy mud in through the nipple 53 and into the well in order to hold back and overcome the pressure which has thus accumulated. This may be done if necessary, and the tool may then be removed from the well and the blow out preventer rams closed about the tubing below the plugging tool.

The form illustrated in Fig. 4 is operated in substantially the same manner, the only difference being that the coupling 56 and the bull plug 57 are substituted for the coupling 24 and the nipple 23, and the form illustrated in Fig. 4 is not adapted to support the tubing.

The form in Fig. 5 is operated in a slightly different manner, being lowered into the casing until the point is reached where it is desired to set the tool. The tool is then rotated to the right to disengage the L-shaped members 62 from the lugs 61, and it is then raised by means of the hoisting equipment at the top of the well to cause the body 58 to move upwardly with respect to the slips 64, and to cause these slips to form a wedging lock between the casing wall and the mandrel 65, moving the mandrel 65 downwardly with respect to the body 58, and expanding the packing 67. The plugging tool is held in this position by an upward stress on the hoisting device as long as is desired to plug the well, and when it is released and forced downwardly the body of the tool may then be rotated to the left to engage the lugs 61 with the members 62 after which the tool may readily be removed from the well.

In view of the foregoing, it will be seen that means has been provided for carrying out all the objects and advantages of this invention, and that a plugging tool has been provided which is capable of simply and effectively plugging a well so that any desired operations may be performed on the equipment at the top of the well without releasing the well pressure.

Having described my invention, I claim:

1. A plugging tool for wells and the like comprising a body having an upwardly facing shoulder thereon, a packing surrounding said body in engagement with said shoulder, a compression ring surrounding said body above said packing for sliding movement toward said packing to compress the same, and a set of slips slidable with respect to said body and adapted to engage the walls of the well and said compression ring to cause expansion of said packing and locking of said body in the well upon small upward movement of said body with respect to said slips.

2. A plugging tool for wells and the like comprising a body having an upwardly facing shoulder thereon, a packing surrounding said body in engagement with said shoulder, a compression ring surrounding said body above said packing for sliding movement toward said packing to compress the same, a set of slips slidable with respect to said body and adapted to engage the walls of the well and said compression ring to cause expansion of said packing and locking of said body in the well on small upward movement of said body with respect to said slips, and releasably interengaging means on said body and said slips for preventing such upward movement of said body with respect to said slips.

3. A plugging tool for wells and the like

comprising a body having an upwardly facing shoulder thereon, a packing surrounding said body in engagement with said shoulder, a compression ring surrounding said body above said packing for sliding movement toward said packing to compress the same, a set of slips slidable with respect to said body and adapted to engage the walls of the well and said compression ring to cause expansion of said packing and locking of said body in the well upon slight upward movement of said body with respect to said slips, releasable interengaging means on said body and said slips for preventing such upward movement of said body with respect to said slips, and means for manipulating the said body so as to position it in the well, release said last mentioned means, and cause upward movement of the body with respect to said slips.

4. A plugging tool comprising a body adapted to close the major portion of an opening, a packing surrounding said body and adapted to be expanded to form a seal between said body and the walls of the opening, slips adjacent one end of said packing adapted to engage the walls of said opening and to expand said packing when said body is moved in one direction with respect to said slips to prevent further movement of said body in said one direction, and oppositely disposed slips movable with respect to said body to engage the walls of such opening and prevent movement of said body in the opposite direction.

5. A plugging tool comprising a body adapted to close the major portion of an opening, a packing surrounding said body and adapted to be expanded to form a seal on said body and the walls of the opening, slips adjacent one end of said packing adapted to engage the walls of such opening and to expand said packing when said body is moved in one direction with respect to said slips to prevent further movement of said body in said one direction, releasably interengaging means on said body and said slips for preventing such movement of said body to set said slips, oppositely disposed slips movable with

respect to said body to engage the walls of such opening and prevent movement of said body in the opposite direction, and means releasably attached to said body for manipulating said body to release said interengaging means, moving said body to set said first slips and expand said packer, and moving said second slips to set position.

6. A plugging tool for wells comprising a body adapted to close the major portion of a well opening, a packing surrounding said body and adapted to be expanded to form a seal between said body and the walls of the well opening, means above said packing forming a stop to restrain upward movement of said packing along said body, means below said packing slidable upwardly on said body to compress said packing against said stop and cause its lateral expansion, slips on said body below said packing adapted to engage the walls of the well opening upon downward movement of said body with respect to said slips, means releasably holding said slips and body together against such relative movement, other slips adapted to engage the wall of the well opening to prevent upward movement of said body, and means for manipulating said body to set said slips and expand said packing.

7. A plugging tool for wells comprising a body adapted to close the major portion of a well opening, a packing surrounding said body and adapted to be expanded to form a seal between said body and the walls of the well opening, slips below and above said packing and movable toward said packing to compress said packing longitudinally and expand it laterally and to wedgingly engage the walls of the well opening, means for releasably holding the lower of said slips against such movement, and means threaded on said body for moving said upper slips toward and away from said packing, and a handling nipple connected to said last mentioned means and adapted to manipulate said body to set the lower of said slips and to move the upper of said slips into set position.

CICERO C. BROWN.