May 19, 1936. J. C. SINGLETON 2,041,439

COMBINATION PACKER, PACKER SETTING TOOL, AND BOTTOM SHUT-OFF VALVE

Filed Nov. 26, 1934 2 Sheets-Sheet 1

Fig. 1.

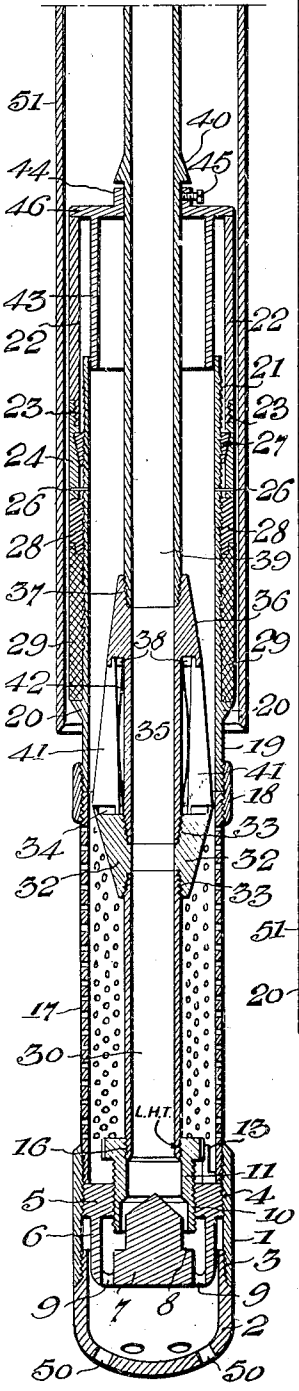


Fig. 2.

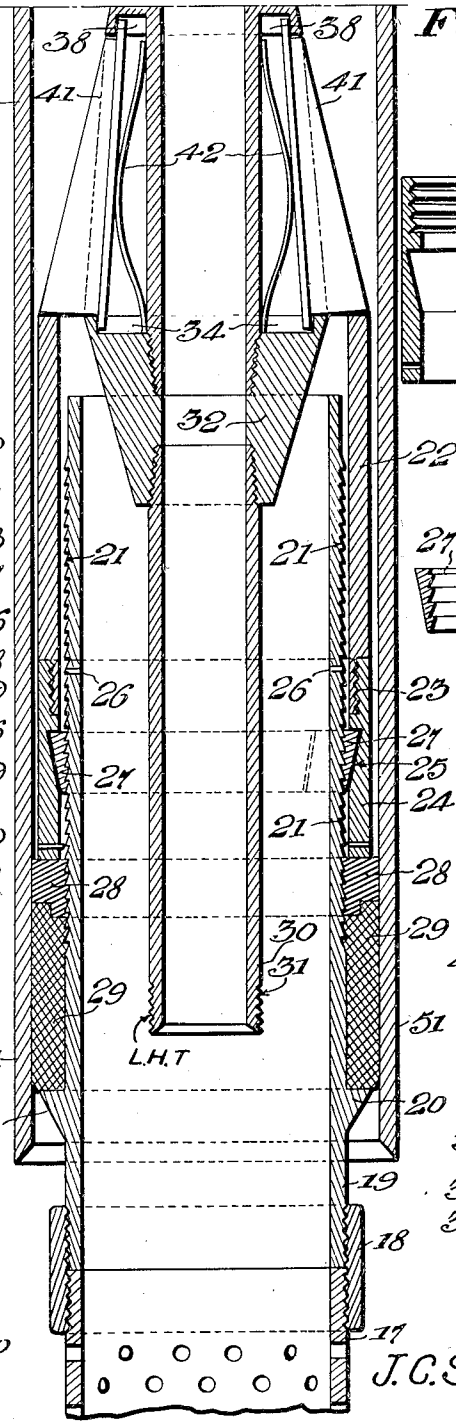


Fig. 3.

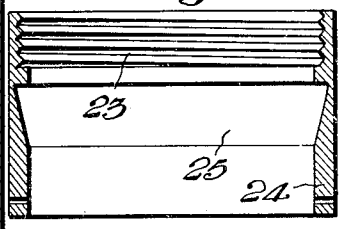
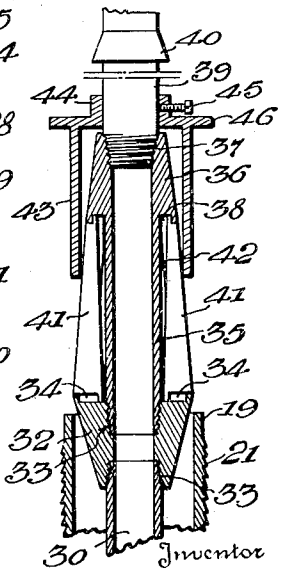


Fig. 4.



Fig. 5.



Inventor

J. C. SINGLETON

By Albert F. Dieterich

Attorney

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COMBINATION PACKER, PACKER SETTING TOOL, AND BOTTOM SHUT-OFF VALVE

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Fig.8.

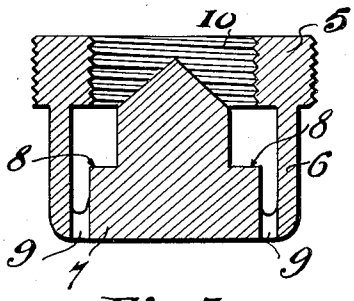


Fig.7.

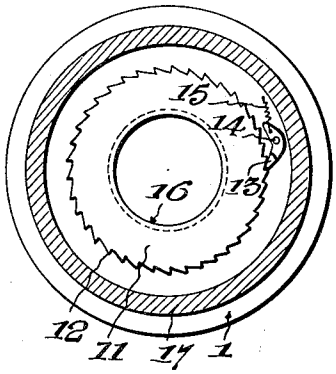


Fig.11.

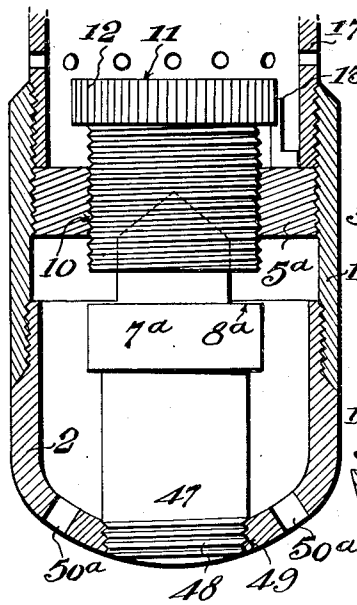


Fig.9.

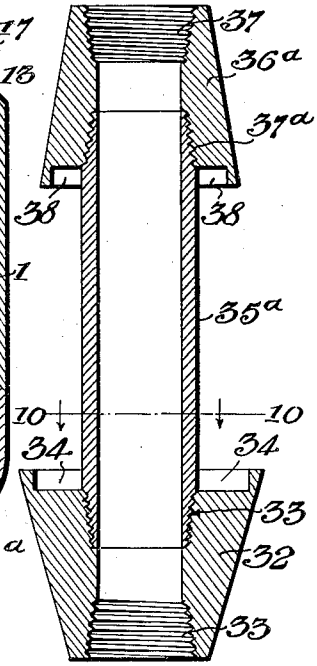


Fig.6.

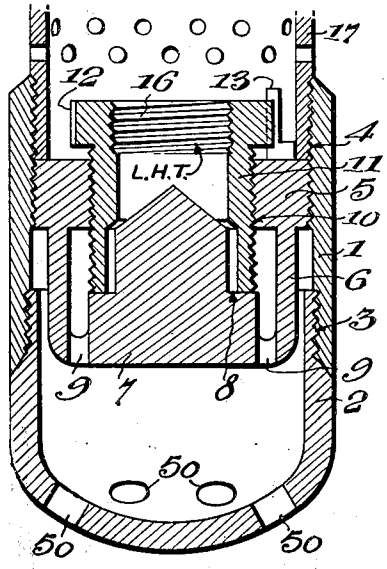
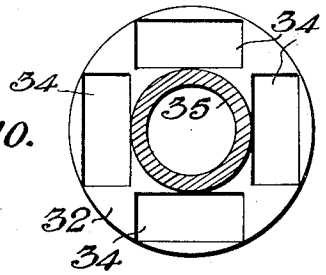


Fig.10.



Inventor

J. C. SINGLETON

By Albert F. Dieterich

Attorney

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UNITED STATES PATENT OFFICE

2,041,439

COMBINATION PACKER, PACKER SETTING TOOL, AND BOTTOM SHUT-OFF VALVE

John Christian Singleton, Vinton, La.

Application November 26, 1934, Serial No. 754,864

17 Claims. (Cl. 166—10)

My invention comprises a new bottom shutoff valve, a well packer, and a packer setting tool rigidly connected to the bottom shutoff valve and a drill stem extending to the top of the well.

The invention has for an object to eliminate the use of extra tools and operations in setting the screen in the well.

The invention further has for its object to provide a structure of the character referred to above by the use of which one operation only is required to close the valve, lift the setting tool into operative relation to the packer top sleeve, let down and set the packer and wash the inside of the screen preparatory to the bringing in of the well.

Further, the invention has for its object to provide a bottom shutoff valve controlled by a rigid threaded connection to the packer setting tool drill stem extending to the top of the well, thus affording a positive means of determining when the valve is closed when desired.

Further, it is an object to provide a rigid threaded connection directly from the bottom shutoff valve to the packer setting tool drill stem extending to the top of the well, thus making a direct connection from the top of the well to the bottom of the screen, strengthening and supporting the screen when going into the well and preventing damage to the screen while going into the well.

Further, it is an object to provide a packer setting tool not threadedly connected to the packer; one which permits of spacing the setting tool at any place desired between the top end of the packer and the bottom of the well screen, permitting the setting stem to be withdrawn high enough up in the well so that after the packer has been set the setting tool may be left sitting on the top sleeve of the packer and there will be no loose wash pipe hanging down into the well screen.

A further object is to provide a packer setting tool which will help to hold the packer, screen, etc., down in the well should the pressure in the well tend to shove the packer, screen, etc., up in the casing.

Further, it is an object to provide a packer without threaded inside connection for the setting tool, thereby allowing the full thickness of the pipe to be left and giving a better seat for a lead face seal should it become necessary to put one in the well later, also permitting the spacing of the setting tool in the screen as desired.

Again, it is an object to provide a guide hood for guiding the packer setting tool dogs into the packer and to fit down tightly on the top sleeve of the packer, thereby making a tight, leak-proof joint to keep sand and trash from entering packer, screen, etc., from the top end and holding the packer, screen, etc., in line; also serving as a guide should the screen have to be withdrawn before setting.

Other objects will in part be obvious and in part be pointed out hereinafter.

To the attainment of the aforesaid objects and ends, the invention still further resides in the novel details of construction, combination and arrangement of parts, all of which will be first fully described in the following detailed description and then be particularly pointed out in the appended claims, reference being had to the accompanying drawings, in which:—

Figure 1 is a vertical longitudinal section of the lower end of a well casing with my invention in position, the parts being in the positions they assume before setting the packing.

Figure 2 is an enlarged detail vertical section of a portion of the structure shown in Figure 1 with the packer set.

Figure 3 is a detail section of the bowl.

Figure 4 is a detail section of the slip.

Figure 5 is a detail vertical section showing how the dogs are held in by the guide head sleeve while inserting the packer tool into the inside sleeve of the packer.

Figure 6 is an enlarged detail vertical section of the bottom shutoff valve unit with the valve closed.

Figure 7 is a plan view of the parts shown in Figure 6.

Figure 8 is a detail vertical section of the valve cage and seat member, per se.

Figure 9 is an enlarged detail vertical section of a slightly modified setting tool "block".

Figure 10 is a cross section on the line 10—10 of Figure 9.

Figure 11 is a detail vertical section of a modified structure of the bottom shutoff valve unit.

In the drawings in which like numerals and letters of reference indicate like parts in all the figures, 1 represents the set shoe sleeve and 2 indicates the set shoe guide plug which is threaded into the sleeve as at 3. The sleeve 1 is threaded at 4 to receive the lower threaded end of the screen 17, it being understood that the screen 17 may be of any approved construction.

The valve cage base 5 carries the cylindrical body 6 that is provided with the valve seat member 7, against the seat 8 of which the valve 11 is

adapted to be brought into engagement to close the passage through the valve seat member. The latter has openings 9 through which water may be pumped into the plug 2, from whence it escapes through apertures 50. The valve cage base 5 is internally threaded as at 10. (All threads in the structure herein described are right hand threads except the threads which connect the lower section of the tubing or drill stem 30 with the valve 11 and those threads 16 are left hand threads, also indicated in the drawings by the letters L. H. T.)

The shutoff valve proper 11 has a ratchet flange 12 with which a pawl 13, that is pivoted at 14 on the valve cage base 5, is held in constant cooperative engagement by a spring 15. The purpose of the pawl and ratchet device is to prevent the valve 11 unscrewing while the tubing 30 is being screwed into the valve.

The screen 17 is coupled to the inside sleeve 19 of the packer by coupling 18, said sleeve being provided with a collar 20 on which rests the packing 29 composed of canvas, burlap or other suitable material.

Above the collar 20 the inside sleeve 19 of the packer is provided with a bat-wing thread 21 to cooperate with the correspondingly threaded split slip 27 that is held within the slip socket 25 of the bowl 24 which is threaded at 23 to the lower end of the top sleeve 22 of the packer.

In assembling the parts preparatory to putting them into the well, the sleeves 19 and 22 are held in position with relation to each other by temporary pins 26 which are constructed to be sheared off when the packing is being set. Located between the bowl 24 and the packing 29 is a lead ring 28 forming, in connection with the packing, the well seal.

31 designates the left hand threads on the lower end of the lower section 30 of the drill stem tubing, which end screws into the threads 16 of the valve 11.

The setting tool comprises a "block" consisting of a lower head 32 into the lower threaded end 33 of which the upper threaded end of the lower section 30 of the drill stem tubing fits. The "block" also includes the upper head 36 and the connecting coupling pipe 35 threadedly connected with head 32 and which may be integral with the head 36, as shown in Figures 1 and 2, or may be a separate part as indicated in Figure 9. When a separate part, the coupling pipe 35*a* is connected with the upper head 36*a* of the "block" by a threaded joint 37*a*. The "blocks" 32 and 36 each have a set of dog receiving recesses 34 and 38 respectively for the reception of the dogs 41.

39 designates the tubing or drill stem which extends to the top of the well and which may be made of pipe sections coupled together in the usual way. The lower section of the drill stem 39 is threaded, at 37, into the upper head 36 of the setting tool "block", as at 37, and at a suitable distance above its lower end it is provided with a collar 40 serving as an upper stop for the guide head collar 44. The dogs 41 are continuously urged outwardly by means of springs 42. In assembling the packer tool with the packer it is of course necessary to hold the dogs 41 contracted and in order to facilitate this and expedite the entry of the dogs into the top sleeve of the packer, and for other purposes hereinbefore indicated and hereinafter again referred to, I provide a guide head having a sleeve 43 secured tothe tubing 39 by a set screw 45 passing through a collar 44 on the head. The guide head also includes a flange 46 which is adapted, when the parts are assembled preparatory to inserting them into the well, to rest on and form a cap or closure for the upper end of the top sleeve 22 of the packer (see Figure 1).

Instead of constructing the bottom shutoff valve as shown in Figures 1 and 6 to 8 inclusive, its structure may be modified as indicated in Figure 11. In this figure those parts of identical structure with those in Figure 6 bear the same reference numeral, while those of corresponding structure, slightly modified, bear the same reference numeral, plus the index letter *a*, so a repetition of the description of those parts here is believed to be unnecessary. In the structure of Figure 11 the valve seat member 7*a*, instead of being integral with the base 5*a*, is formed on a pillar 47 which is threaded at 48 into the threaded aperture 49 of the set shoe guide plug 2*a*.

The well casing is indicated in Figures 1 and 2 of the drawings by the reference numeral 51 and it may be of the usual and accepted kind.

Operation

The set shoe 1, 2, and the bottom shutoff valve 5—11 are made up on the well screen 17. The packer 19—29 is made up on the well screen also. The valve setting stem 30 is then fitted into the head 32 of the seal setting tool or drill stem 32—38, 41, 42. The guide hood 43, 44 is loosened and run down over the dogs 41. The tool is then run into the packer and screen and additional pipe 39 added until pipe 30 reaches valve 11. The drill stem (pipe 39, etc.) is then turned in a left hand direction to screw pipe 31 into the thread 16 of the opened valve 11, the valve being held against unscrewing by the pawl 13. The assembly is now ready to be run into the well casing 51. The guide head 43—44—46 is made fast by set screw 45 so that the flange 46 rests on and forms a closure for the top sleeve 22 of the packer before the assembly is run into the well casing.

As the assembly is lowered into the well additional sections are added to the pipe 39 as is customary, and water is pumped down and through the bottom shutoff valve 11—7 and plug 2 to wash the well outside. After the set shoe 2 has reached the bottom and the operator has finished washing the outside by pumping water through, the set stem (tubing 39—35—30) is rotated in a right hand direction while the pump is permitted to run at low speed; when the bottom shutoff valve is fully closed it will momentarily stop the pump and the operator will know thereby that the valve is closed. The stem will continue to be rotated to the right which will unscrew the pipe 30 from the valve 11, whereupon the tool may be raised until the dogs 41 are above the upper end of the top sleeve 22 of the packer when the dogs will spring out. The setting tool will then be let down, until the dogs engage the top sleeve 22, with enough force to shear off the pin 26 and force the seal down and the packing out against the casing 51 and inside sleeve 19 to form a water-tight joint. The well is now ready to be washed on the inside as usual.

From the foregoing it will readily be seen that my invention embodies the following characteristics:

1. There is an improved feature of connecting with a threaded rigid stem from the top of the well to the shutoff valve with the packer setting tool stem instead of connecting to the top end of the inside sleeve of the packer as has heretofore been the practice; this eliminates a loose

wash pipe hanging from the packer setting tool to back pressure valve which is of smaller size pipe. My invention uses the setting tool stem as the wash pipe.

2. There is an improved feature in having a packer with no threaded connection in the top end of the inside sleeve for the setting tool; thus saving the cost of threading, and leaving more pipe for a lead face seal. The pipe is the same size on the top end, which is an advantage if it be desired to fish it out later with a spear or die tap.

3. The invention permits the use of tubing for the packing setting tool and shutoff valve stem which will be of the same size pipe from top to bottom of the well, making it unnecessary to pull out the stem to remove a smaller size wash pipe, as has heretofore been the case with those structures in common use.

4. The bottom shutoff valve is fully open while going into the well, allowing fluid to enter as the screen is lowered, saving time for having to stop and fill up the pipe from the top end. This feature alone will save from two to three hours' time on the present day type of deep wells, and should the well be bridged over it allows full pump pressure for pumping out the bridge.

5. The bottom shutoff valve provides a positive means of knowing that the bottom is closed off tight, eliminating a possible leaking back pressure valve. This is invaluable to the well man, especially on deep wells of high gas pressure. After the well has been properly washed on the outside of the screen, the pump is permitted to run at a low speed while the stem is rotated to the right, when valve is closed it will cause the pump to stop, thus signaling the operator that the valve is fully closed. The operator will continue to rotate the stem to the right until the left hand thread on the end of the setting stem has unscrewed from the valve and the pump will then begin to run again, at which time the operator will pull the setting tool up above the top sleeve of the packer and let it down with sufficient force to set the packer as above described.

6. The bottom shutoff valve saves the time and expense of having to make an extra trip into the well to plug a leaking back pressure valve and reclaim a well, which may cost thousands of dollars.

7. The bottom shutoff valve and set shoe are short, allowing the taking in of more oil or water sand in the well, which may repay its cost many times in each production.

8. The setting stem is of the same size pipe connected directly to the set shoe on the lower end of the well screen, thus eliminating the threaded connection in the packer, eliminating a smaller size wash pipe, eliminating a wash pipe hanging loose through the setting tool to the bottom valve, affording the same size hole through the stem from top of the well to the bottom, and making it unnecessary to withdraw the stem to remove setting tool and wash pipe in order to have the same size hole or pipe from top to bottom.

Other advantages of my invention will be clear to those skilled in the art, and from the foregoing description, taken in connection with the accompanying drawings, it is thought that the complete construction, operation and advantages of the invention will be apparent.

I desire it to be understood that slight changes in the details of construction, arrangement and proportioning of parts, etc., may readily be made without departing from the spirit of the invention or the scope of the appended claims.

What I claim is:

1. In an apparatus of the character described, a well screen; a set shoe mounted on the lower end of said screen; a bottom shutoff valve mechanism mounted in said shoe and including a valve cage with a valve seat, a valve threaded into the cage with a right hand thread and having a passage with a left hand thread at the top; a packer mounted on the upper end of the screen and including an inside sleeve, a packing around the sleeve, a bowl above the packing, a slip in the bowl, the slip and the inside sleeve having cooperating bat-wing threads, and a top sleeve secured above the bowl; a well drill stem and a packer setting tool carried by the stem to fit within said inside sleeve and said screen and having a lower pipe section provided with a left hand thread at its end to screw into said valve while the same is open.

2. In an apparatus of the character described, a well screen; a set shoe mounted on the lower end of said screen; a bottom shutoff valve mechanism mounted in said shoe and including a valve cage with a valve seat, a valve threaded into the cage with a right hand thread and having a passage with a left hand thread at the top; a packer mounted on the upper end of the screen and including an inside sleeve, a packing around the sleeve, a bowl above the packing, a slip in the bowl, the slip and the inside sleeve having cooperating bat-wing threads, and a top sleeve secured above the bowl; a shear pin connecting said bowl to said inside sleeve at a place where the packing will remain unexpanded; a well drill stem and a packer setting tool carried by the stem to fit within said inside sleeve and said screen and having a lower pipe section provided with a left hand thread at its end to screw into said valve while the same is open.

3. In an apparatus of the character described, a well screen; a set shoe mounted on the lower end of said screen; a bottom shutoff valve mechanism mounted in said shoe and including a valve cage with a valve seat, a valve threaded into the cage with a right hand thread and having a passage with a left hand thread at the top; a packer mounted on the upper end of the screen and including an inside sleeve, a packing around the sleeve, a bowl above the packing, a slip in the bowl, the slip and the inside sleeve having cooperating bat-wing threads, and a top sleeve secured above the bowl; a well drill stem and a packer setting tool carried by the stem to fit within said inside sleeve and said screen and having a lower pipe section provided with a left hand thread at its end to screw into said valve while the same is open; a guide head with a sleeve slidingly fitting into said inside sleeve and having a flange to seat on the upper end of said top sleeve as a closure therefor.

4. In an apparatus of the character described, a well screen; a set shoe mounted on the lower end of said screen; a bottom shutoff valve mechanism mounted in said shoe and including a valve cage with a valve seat, a valve threaded into the cage with a right hand thread and having a passage with a left hand thread at the top; a packer mounted on the upper end of the screen and including an inside sleeve, a packing around the sleeve, a bowl above the packing, a slip in the bowl, the slip and the inside sleeve having coop-

erating bat-wing threads, and a top sleeve secured above the bowl; a well drill stem and a packer setting tool carried by the stem to fit within said inside sleeve and said screen and having a lower pipe section provided with a left hand thread at its end to screw into said valve while the same is open, a guide head with a sleeve slidingly fitting into said inside sleeve and having a flange to seat on the upper end of said top sleeve as a closure therefor, said guide head being slidably mounted on said drill stem to be engaged with said packer setting tool and guided into said inside sleeve.

5. In an apparatus of the character described, a well screen; a set shoe mounted on the lower end of said screen; a bottom shutoff valve mechanism mounted in said shoe and including a valve cage with a valve seat, a valve threaded into the cage with a right hand thread and having a passage with a left hand thread at the top; a packer mounted on the upper end of the screen and including an inside sleeve, a packing around the sleeve, a bowl above the packing, a slip in the bowl, the slip and the inside sleeve having cooperating bat-wing threads, and a top sleeve secured above the bowl; a well drill stem and a packer setting tool carried by the stem to fit within said inside sleeve and said screen and having a lower pipe section provided with a left hand thread at its end to screw into said valve while the same is open; said packer setting tool comprising a "block", radial dogs and pushout springs therefor mounted in said "block"; a guide head slidably mounted on said drill stem and having a portion to be engaged with said radial dogs to push them in and guide the packer setting tool into said inside sleeve.

6. In an apparatus of the character described, a well screen; a set shoe mounted on the lower end of said screen; a bottom shutoff valve mechanism mounted in said shoe and including a valve cage with a valve seat, a valve threaded into the cage with a right hand thread and having a passage with a left hand thread at the top; a packer mounted on the upper end of the screen and including an inside sleeve, a packing around the sleeve, a bowl above the packing, a slip in the bowl, the slip and the inside sleeve having cooperating bat-wing threads, and a top sleeve secured above the bowl; a well drill stem and a packer setting tool carried by the stem to fit within said inside sleeve and said screen and having a lower pipe section provided with a left hand thread at its end to screw into said valve while the same is open; said stem, said packer setting tool and said lower pipe section having a uniform internal diameter throughout and serving the three-fold function of a water pipe, a valve closing tool and a packer setting tool.

7. In an apparatus of the character described, a well screen; a set shoe mounted on the lower end of said screen; a bottom shutoff valve mechanism mounted in said shoe and including a valve cage with a valve seat, a valve threaded into the cage with a right hand thread and having a passage with a left hand thread at the top; a packer mounted on the upper end of the screen and including an inside sleeve, a packing around the sleeve, a bowl above the packing, a slip in the bowl, the slip and the inside sleeve having cooperating bat-wing threads, and a top sleeve secured above the bowl; a well drill stem and a packer setting tool carried by the stem to fit within said inside sleeve and said screen and having a lower pipe section provided with a left hand thread at its end to screw into said valve while the same is open; said packer setting tool comprising a lower head, an upper head and a connecting pipe section between said heads, radially disposed dogs and dog thrust out springs carried by said heads, said heads being frusto-conical and tapering downwardly and upwardly respectively.

8. A set shoe comprising a set shoe sleeve, a set shoe guide plug secured to the lower end of said sleeve and having water outlets, the upper end of said sleeve having provisions for mounting it on the lower end of a screen, a base and a valve seat member mounted in said shoe and located above said outlets, a downwardly seating tubular valve screwed into said base with a right hand thread, means to hold said valve against unscrewing beyond a predetermined distance, said valve having an internal left hand thread to receive a valve closing stem.

9. A set shoe comprising a set shoe sleeve, a set shoe guide plug secured to the lower end of said sleeve and having water outlets, the upper end of said sleeve having provisions for mounting it on the lower end of a screen, a base and a valve seat member mounted in said shoe and located above said outlets, a downwardly seating tubular valve screwed into said base with a right hand thread, means to hold said valve against unscrewing beyond a predetermined distance, said valve having an internal left hand thread to receive a valve closing stem, said valve seat member being carried by said base.

10. A set shoe comprising a set shoe sleeve, a set shoe guide plug secured to the lower end of said sleeve and having water outlets, the upper end of said sleeve having provisions for mounting it on the lower end of a screen, a base and a valve seat member mounted in said shoe and located above said outlets, a downwardly seating tubular valve screwed into said base with a right hand thread, means to hold said valve against unscrewing beyond a predetermined distance, said valve having an internal left hand thread to receive a valve closing stem, said valve seat member including a pillar mounted on said guide plug.

11. A set shoe comprising a sleeve whose upper end is adapted for connection to a screen, a set shoe guide plug secured to the lower end of said sleeve, a cage having a base threaded into the upper end of said sleeve, and having a passage with a valve seat, said base having a threaded passage, a tubular valve open at both ends and threaded through said passage with its lower end adapted to be closed by contact with said valve seat, and means cooperating with said valve to prevent it being unscrewed beyond a predetermined degree.

12. A set shoe comprising a sleeve whose upper end is adapted for connection to a screen, a set shoe guide plug secured to the lower end of said sleeve, a cage having a base threaded into the upper end of said sleeve, and having a passage with a valve seat, a well screen whose lower end is threaded into said sleeve to jam-lock said base therein, said base having a threaded passage, a tubular valve open at both ends and threaded through said passage with its lower end adapted to be closed by contact with said valve seat, and means cooperating with said valve to prevent it being unscrewed beyond a predetermined degree.

13. A set shoe comprising a sleeve whose upper end is adapted for connection to a screen, a set shoe guide plug secured to the lower end of said

sleeve, a cage having a base threaded into the upper end of said sleeve, and having a passage with a valve seat, said base having a threaded passage, a tubular valve open at both ends and threaded through said passage with its lower end adapted to be closed by contact with said valve seat, and means cooperating with said valve to prevent it being unscrewed beyond a predetermined degree, said valve having a right hand threaded engagement with said base and having a left hand thread at its upper end for connection to a valve closing tool.

14. In an apparatus of the character described, the combination of a well screen, a set shoe on the lower end thereof, a packer coupled to the upper end thereof, a bottom shutoff valve in said set shoe, a combined drill-stem wash-pipe valve-closing tool and packer setting tool assembly located within said packer and screen and coupled to said valve, said assembly being adapted to be turned as a unit in one direction to close said valve and upon further rotation in the same direction to be uncoupled from said valve and then be free to be raised above the packer to perform the function of a setting tool.

15. In an apparatus of the character described, the combination of a well screen, a set shoe on the lower end thereof, a packer coupled to the upper end thereof, a bottom shutoff valve in said set shoe, a combined drill-stem wash-pipe valve-closing tool and packer setting tool assembly located within said packer and screen and coupled to said valve, said assembly being adapted to be turned as a unit in one direction to close said valve and upon further rotation in the same direction to be uncoupled from said valve and then be free to be raised above the packer to perform the function of a setting tool, said assembly having a duct of uniform diameter from the top to the shutoff valve at the bottom.

16. A set shoe, a valve cage including a base and a valve seat member secured in said shoe, said valve seat member being supported below said base, said base having a threaded passage, a tubular valve open at both ends and screwed into and through said passage to engage said valve seat member and close said passage.

17. A set shoe, a valve cage including a base and a valve seat member secured in said shoe, said valve seat member being supported below said base, said base having a threaded passage, a tubular valve open at both ends and screwed into and through said passage to engage said valve seat member and close said passage, said threaded passage and said valve having corresponding right hand threads for connection, and said valve having an internal left hand thread to receive a valve closing stem with threaded engagement.

JOHN CHRISTIAN SINGLETON.