

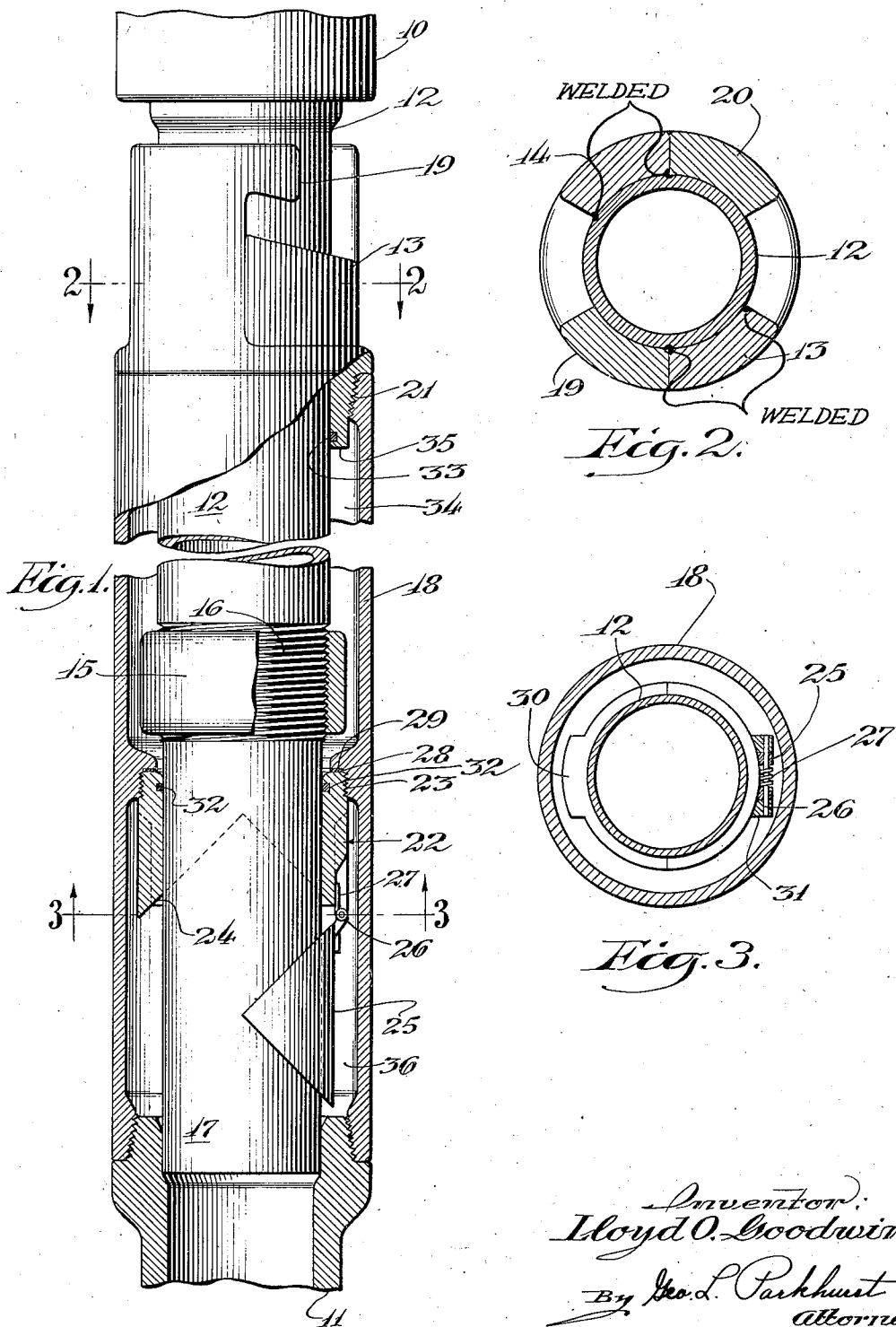
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BACK PRESSURE VALVE

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BACK-PRESSURE VALVE

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2 Claims. (Cl. 251-8)

This invention relates to a check valve for oil and gas wells and more particularly to a check valve which may be placed near the lower end of a tubing string and remotely operated from the surface to control the upward flow of fluid through it.

In normal drilling practice it is customary to use a float and back pressure valve in connection with a drilling string to float the string into place and to prevent upward flow of fluid through the drill string after a high pressure formation is reached. In this system the viscous drilling fluid goes down through the string and rises in the annular space between the drill pipe and casing, the velocity being great enough to carry the cuttings to the surface. It often happens, however, that in some fields the walls of the hole slough off, producing a large chamber, or cavernous formations may be penetrated so that the cross-sectional area of the well becomes large and the corresponding velocity of the drilling fluid in the well outside the drill string becomes so low that cuttings will be deposited in these cavernous formations. Circulation in the opposite direction, i. e., reverse circulation, has been used advantageously to overcome this difficulty, allowing a less viscous fluid to be used due to the greater velocity and turbulent flow of the fluid as it rises through the stem.

It has become a practice of late in rotary drilling to drill into the producing formation with a light drilling fluid, such as oil, to prevent the permeable channels in the formation from being choked with water or plugged by mud. When this system is used, drill cuttings tend to settle out readily due to the low viscosity of the fluid; hence the velocity of the drilling fluid has to be made relatively great. For this reason reverse circulation is the most satisfactory answer to the problem.

In completing some wells it is necessary that they be shot to make a greater drainage area in order that they may be produced economically. This shooting leaves a large cavern. Regular circulation cannot be used to remove the loose material in the well since the velocity of the drilling fluid in the annular space would be so low in the area shot that the cuttings could not be carried out. Therefore reverse circulation is mandatory in such cases. Still other examples could be given to show that reverse circulation is becoming of considerable importance in oil well drilling.

When reverse circulation has been used in the past in drilling into high pressure formations

it has been necessary to use a very heavy drilling fluid and risk ruining the formation by forcing much mud and water into it or else allow the well to produce while the drill stem is being run in or pulled out. If the well is allowed to flow during the pulling operation it is readily seen that there is an enormous waste of drilling fluid, not to mention the inconveniences and hazards to the drilling crew. Pressure drilling, that is, drilling with a relatively low density liquid while keeping back pressure on the well to prevent a blowout, cannot normally be employed when using reverse circulation, since each time a new section of drill pipe was added pressure would be off the system and a blowout would occur. It is obvious that in pressure drilling by reverse circulation, the above-mentioned float and back pressure valve which is familiar to those skilled in the art would be inoperable since it prevents upward flow through the tubing string.

Similarly when it is necessary to "pull" a producing string which is under pressure, either the well must be filled with mud which involves considerable risk, or the well must be allowed to flow, constituting unnecessary waste and hazard.

It is an object of my invention to provide equipment that will prevent waste and eliminate hazard in pressure drilling with reverse circulation. It is a further object of my invention to provide means for assuring positive elimination of upward flow through the drilling string while permitting unrestricted flow in either direction at other times, all at the will of the operator.

A further object of my invention is to provide a back pressure valve for use in reverse circulation drilling in which the raising of the drill pipe can be accomplished with the valve closed when the drill pipe is pulled to change bits or for any other purpose, but in which the raising of the drill pipe can also be accomplished without closing the valve when it is desired to lift the drill bit off bottom without discontinuing circulation.

Another object of my invention is to provide a valve for a producing string of tubing that will impede production while the string is being pulled and run.

It is a further object of my invention to provide a valve of the type described adapted to yield the maximum possible opening so that circulation will not be impeded and in order that apparatus such as surveying devices, logging de-

vices, core barrels, etc. can be inserted into the well through the tubing string.

Further objects and advantages of my invention will be apparent upon the perusal of this specification. For simplicity, a certain embodiment of my invention will be described with particular reference to the accompanying drawing which forms a part of this specification and are to be read in connection therewith. In the drawing:

Figure 1 is a view partly in elevation and partly in longitudinal cross section of a string of tubing and one particular form of adjustable back-pressure valve in its compressed position;

Figure 2 is a horizontal section taken along line 2—2 of Figure 1;

Figure 3 is an enlarged horizontal section taken along line 3—3 of Figure 1;

Turning now to Figure 1 for more detailed description, at the top is shown a regular collar or tool joint 10 such as is used near the bottom of a string of drill pipe or tubing. At the bottom is a special sub 11 through which the valve is connected to the lower part of the string of drill pipe or tubing. Above collar 10 and below the sub 11 there is no departure from the customary arrangement of tubing or drill pipe string. Screwed into the collar 10 is a special quill 12 to which two lugs 13 and 14 (Figure 2) are attached by welding or other means. A collar 15 is connected by threads 16 to the quill 12. The lower part 17 of the quill 12 can be formed as a continuation of quill 12 turned to the root diameter of the threads 16, or this member can be made as another nipple connected by threads to collar 15. The former construction in which the quill 17 is a continuation of quill 12 as shown is preferable since it allows a more compact arrangement of parts.

Sleeve 18 surrounds quill 12 as shown and at the top of this sleeve is a pair of hooks 19 and 20 connected by threads 21. Each hook 19 forms a socket for the projecting hook 20. These hooks are adapted to restrict longitudinal motion between quill 12 and sleeve 18 except when unlatched by rotating the tubing one-quarter turn to the left while the lower portion of the tubing string is anchored. A valve assembly 22 is connected to sleeve 18 by threads 23 and is composed of a valve seat 24, a flapper 25, a pin 26 on which the flapper rotates and a light spring 27 to close the flapper. A gasket 28 is placed between valve assembly 22 and shoulder 29 carried by sleeve 18. Ears 30 and 31, shown most clearly in Figure 3, are placed on the valve seat 24 to facilitate its installation.

Rings of packing 32 and 33 below and above the annular space 34 between quill 12 and sleeve 18 prevent the entrance of sand particles which might prevent the motion between the mandrel or quill 12 and sleeve 18. There is sufficient longitudinal movement allowed between collar 15 and hook base 35 so that the lower end of quill 17 will have excess play after opening or closing flapper 25. This longitudinal movement is limited by the length of hooks 19 and 20, which should not pass lugs 13 and 14 to allow unrestricted relative rotation; this relative rotation can satisfactorily be limited to about 100 degrees. When used in connection with a producing string where no rotation is required, hooks 19 and 20 and lugs 13 and 14 are, of course, not required. Valve flapper 25, which closes into cylindrical seat 24 when the valve is extended, is a cylin-

drical section with diameter equal to that of seat 24.

The quill 12 has a relatively close fit with the hook base 35, the valve body and the special sub 11 which strengthens the valve and prevents wobbling and accumulation of sand or cuttings in the annular spaces 34 and 36.

In operation using the above embodiment of my invention, the valve is preferably placed above and adjacent the drill or wash collar when making up a drill string, with the valve extended, i. e. hooks 19 and 20 are unlatched and valve flapper 25 is closed. When the bottom of the hole is reached the weight of the string causes relative longitudinal motion of the quill 12 and the sleeve 18, opening flapper 25 and allowing circulation and drilling to be commenced.

Before additional joints are added it is customary practice to clean and ream the walls by raising and lowering the bit the length of the kelly while circulation and rotation are maintained. Since the valve is kept open while hooks 19 and 20 are engaged, this raising and lowering are permitted while circulation is maintained. When the bit reaches bottom again it is only necessary to reverse rotation of the stem to unlatch the hooks 19 and 20, after which, when the stem is raised so that the kelly may be disconnected, the valve automatically closes as soon as fluid rushes up in the stem. Thus, blowouts are prevented, and normal operation may be at once resumed without further precaution when a new joint is added. To remove the tools from the hole a similar operation is carried out to close the valve. This permits the drill stem to be removed while still maintaining pressure on the formation.

Similarly when my valve is used in connection with a production string it is preferably placed above and adjacent an anchor such as a tubing catcher, a tubing catcher anchor, or a perforated pipe which can be anchored on the bottom of the well. The operations of closing and opening the valve are identical to that in a drill string except that when hooks 19 and 20 are left off no special precautions need be taken to open or close the valve, since this operation is automatically accomplished when the tubing is set down.

Although I have described my invention in detail and therefore utilized certain specific terms and language herein, it will be apparent to those skilled in the art that many modifications and combinations of equipment are possible within the scope of the invention. It is understood that the present embodiment is illustrative in nature, rather than restrictive, and that other changes and modifications may be resorted to without departing from the scope of the claims appended hereto.

I claim:

1. A check valve assembly which comprises a quill fixed to and in communication with a first pipe of substantially the same internal diameter, a sleeve around said quill and fixed to a second pipe, cooperating means carried by said quill and said sleeve respectively and constructed and arranged to transmit torque from said quill to said sleeve, and to permit a small restricted axial movement therebetween in one position and a large axial movement in another position, means for limiting said large axial movement, a cylindrical valve seat fixed to and within said sleeve and of greater internal diameter than the external diameter of said quill, a valve pivotally

mounted in the space between the quill and the sleeve on an axis perpendicular to the axis of the quill and adapted to close on said seat, said valve being so constructed and arranged that in open position it is entirely disposed in the space between the quill and the sleeve so that the quill may extend through the valve seat and past said valve, means for urging the valve toward a closed position, said limited large axial movement being of such extent that the quill will hold the valve open in one position and will permit valve closure in another position and said small restricted axial movement providing necessary clearance but positively preventing valve closure, and means for preventing fluids from flowing around said valve from the second pipe to the first pipe.

2. A check valve for a string of drill pipe disposed in a well, said valve being adapted to remote control operation by manipulation of said pipe, comprising a hollow quill the inside diameter of which is approximately that of said drill pipe, one end of said quill being adapted to be fixed to the end of a first section of said drill pipe, a hollow sleeve around said quill one end of which is adapted to be fixed to the end of a second section of said drill pipe, a cylindrical valve seat positioned within said sleeve and of sufficient internal diameter to permit said quill to slide therethrough, a flapper valve rotatably mounted within said sleeve on an axis substan-

5 tially perpendicular to the axis of said pipe and adapted to close on said seat, means urging said valve towards closed position, at least two co-operating members attached respectively to said quill and said sleeve, one of said members defining at least one projection, the other of said members defining at least one slot, said projection being adapted on rotation of said quill relative to said sleeve to fit into said slot in the other of said members to form a positive interlock, whereby said members define two relative positions of said quill and said valve, in the interlocked position said quill projecting through said seat maintaining said valve in fully open position between said quill and said sleeve and said quill being restricted to small longitudinal motion relative to said seat, in the other of said positions said quill being free only upon longitudinal motion of said sections of said drill pipe to slide relative to said seat, freeing said valve and permitting it to close, means within said sleeve for limiting the longitudinal motion of said sections upon freeing of said valve, and packing means disposed between said seat and said quill and between said sleeve and said quill whereby in either of said positions passage for fluid between said first and second sections of said drill pipe is only through said quill.

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