

Jan. 22, 1946.

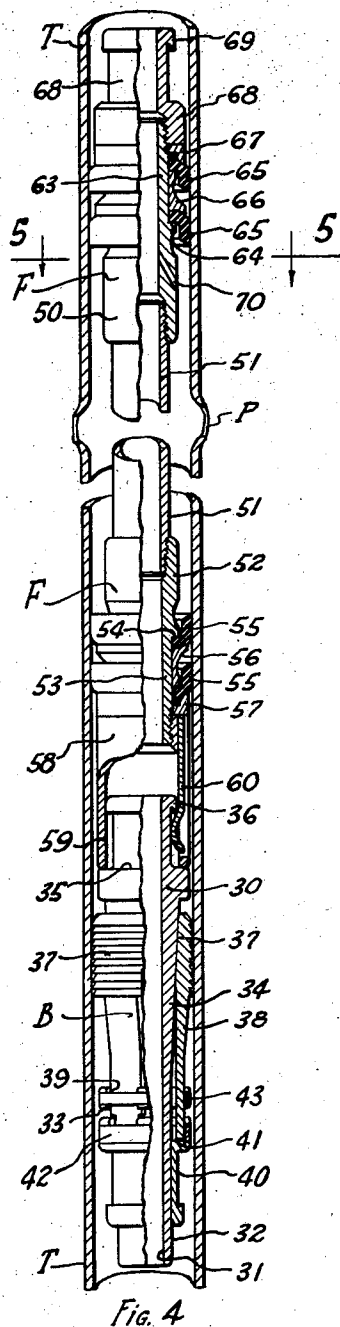
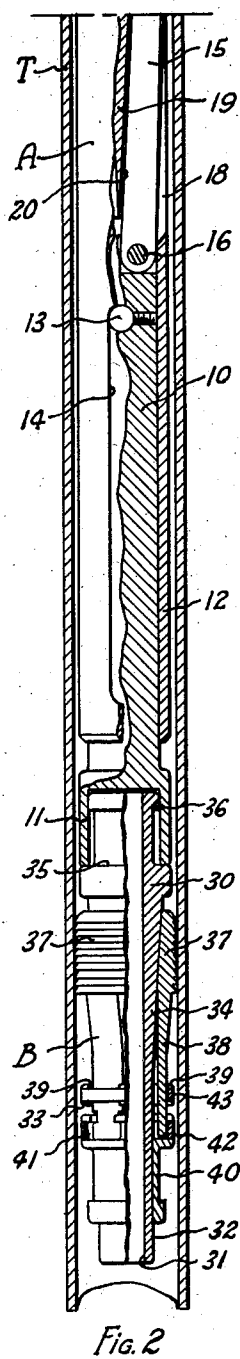
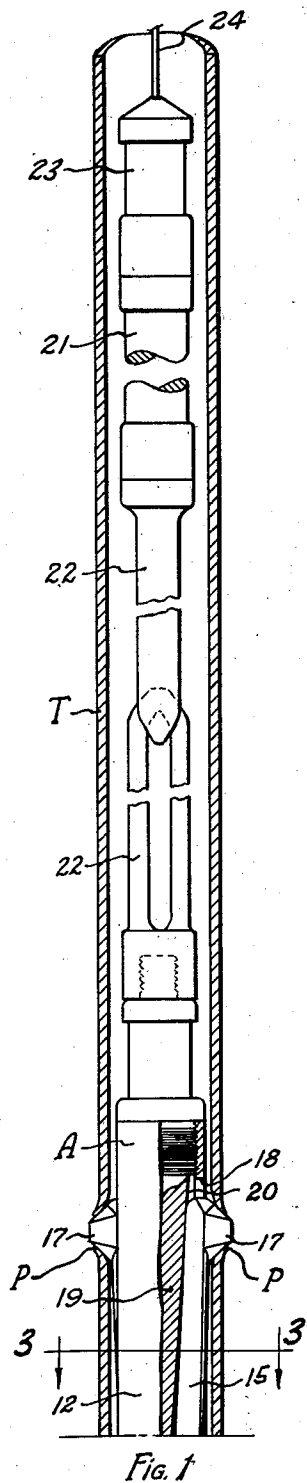
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2,393,404

METHODS AND MEANS FOR FLOWING WELLS

Filed Nov. 13, 1941

2 Sheets-Sheet 1



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METHODS AND MEANS FOR FLOWING WELLS

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2 Sheets-Sheet 2

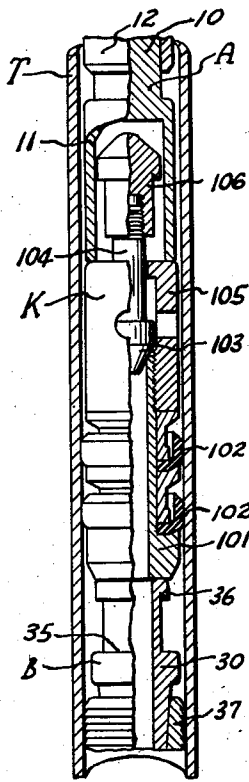


Fig. 7

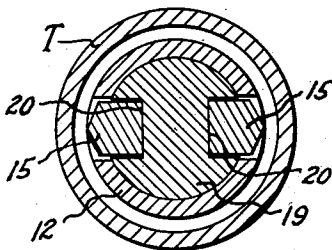


Fig. 3

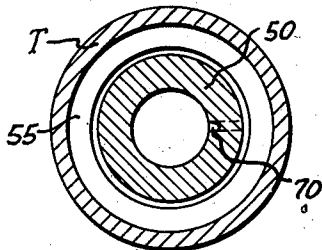


Fig. 5

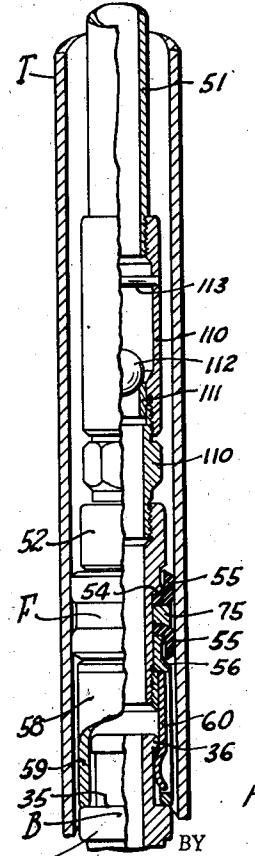
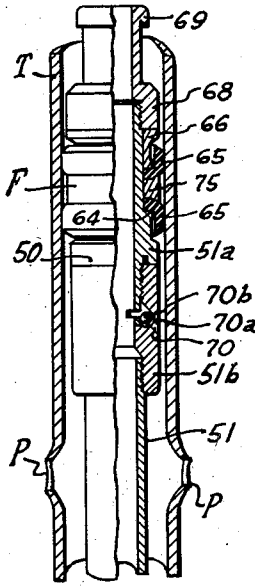


Fig. 8

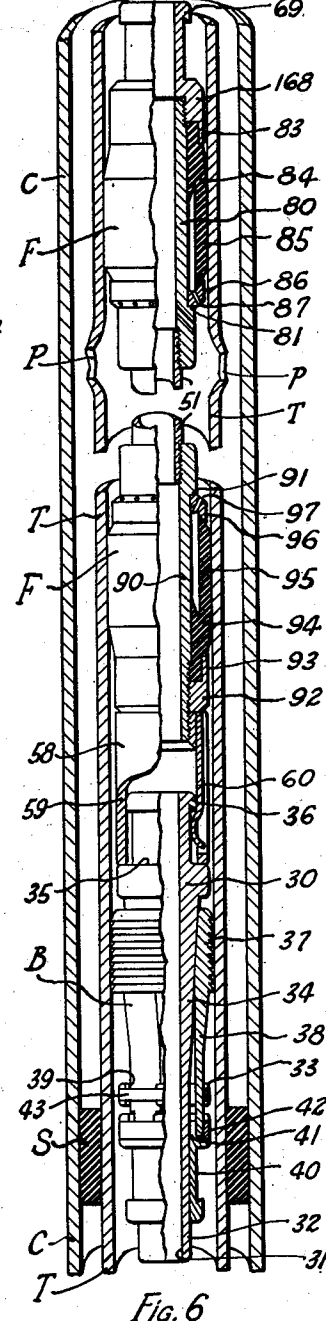


Fig. 6

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UNITED STATES PATENT OFFICE

2,393,404

METHOD AND MEANS FOR FLOWING WELLS

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4 Claims. (Cl. 166-2)

This invention relates to new and useful improvements in methods of preparing wells.

Frequently, in modern drilling practice, productive oil and gas formations are drilled through in order to reach the desired lower oil producing horizon. In some instances the well casing is extended completely through all formations to the bottom of the well, and is then perforated at the desired producing formation. In other installations a formation packer may be set to seal off outside the flow conductor or tubing between an upper gas producing formation and a lower oil producing formation to prevent production of the gas from such upper formation.

Eventually, the pressure of the oil producing formation will decline to such an extent that some extraneous means for raising the oil to the surface must be resorted to. The extraneous means employed may be some form of mechanical pumping, or it may be some form of gas or fluid injection pumping.

It has been found that, in certain wells, a considerable amount of free gas will accumulate in the annular space between the tubing and casing above the liquid level, and it may be desired to use this free gas for aerating the oil column in the tubing to cause such oil to flow from the well.

In other wells it may be desired that the gas from an upper formation, above the packer, be made available for use as a lifting agent to flow the oil from the well.

And, in other wells, such a natural source of lifting fluid may not be available, and the operator may desire to inject a lifting fluid into the annular space between the casing and tubing for use in flowing the oil to the well surface through the tubing.

In order to accurately control the admission of extraneous lifting fluid into the tubing for flowing the oil to the surface, in the past it has been necessary that the tubing first be removed from the well bore so that suitable "jet collars" or other flow inlet devices might be mounted in the tubing string for admitting the extraneous lifting fluid into the bore of the tubing in controlled quantities for properly flowing the oil to the surface.

Such manipulation of the tubing is not desirable for many reasons. In some wells it might be unwise to "break" the seal of the packer, since many packers may not be satisfactorily removed from and repositioned within the well. It would also be necessary to remove and re-insert the tub-

ing each time it was desired to change the size of the inlet controlling admission of the lifting fluid, in order to meet varying flowing conditions. Also, the initial installation would require removal and re-insertion of the tubing. Obviously, the cost of such operations would quickly amount to a large sum.

It is, therefore, an important object of the invention to provide a novel method and means for establishing controlled admission of a lifting fluid into the well flow conductor at a desired elevation in the well, and which may be utilized without manipulation or movement of the flow conductor.

It is a further object of the invention to provide an improved method of preparing a well wherein the anchor or stop utilized in connection with the means for perforating the tubing wall to establish flow therethrough is also utilized for positively and correctly positioning the side inlet flow controlling device, whereby such device will be accurately located with respect to the perforation to assure proper functioning of the device.

Another object of the invention is to provide means for use in wells wherein the annular space between the tubing and casing above the packer has been filled with loading fluids, whereby such loading fluids may be circulated out of the well bore to permit production of the well from two zones, or to permit injection of an extraneous lifting fluid into the annular space for lifting fluids in the tubing to the well surface.

Still another object of the invention is to provide a novel method and means for circulating loading fluids out of wells as above described wherein such fluids are removed from the well bore without subjecting the producing formation to the pressure and extraneous fluids incident to such circulation.

A particular object of the invention is to provide a method of the character described which may be utilized within the usual well tubing without the necessity of installing special landing nipples or collars and the like, resulting in reduction of the cost and the time involved in preparing a well for operation.

A still further object of the invention is to provide means of the character described wherein all parts of the device may be removed from the tubing bore to afford unobstructed access to the bottom, if desired.

Another object of the invention is to provide improved means for controlling admission of lifting fluid from the annular space outside the well

flow conductor into said flow conductor, which means may be installed in the usual and customary well tubing by means operable from the well surface.

Still another object of the invention is to provide a method of the character described wherein the element having the orifice controlling admission of lifting fluid may be readily removed from the well tubing to permit changing the orifice size and said element may then be re-inserted in said tubing in proper position with respect to the perforations therein to assure proper functioning of the device.

A still further object of the invention is to provide, in a well flow conductor having a flow inlet at its lower portion and having a side inlet perforated in its walls above such flow inlet, a device of the character described for controlling flow of fluids entering said conductor through said flow inlet and side inlet, said device sealing between said inlets to prevent uncontrolled flow therebetween or through the conductor, and having valve means for preventing back-flow of fluids through either or both of said inlets, as desired.

Additional objects and advantages of the invention will be apparent from a reading of the following description of a device constructed in accordance with the invention, and reference to the accompanying drawings thereof, wherein:

Figure 1 is a view, partly in elevation and partly in section, of the upper portion of a perforator being utilized in accordance with the invention,

Figure 2 is a continuation of Figure 1, and shows the lower portion of the perforator and a stop or anchor utilized in accordance with the invention,

Figure 3 is an enlarged horizontal cross-sectional view taken on the line 3—3 of Figure 1,

Figure 4 is a view, partly in elevation and partly in section, of a side inlet flow controlling device constructed for use in accordance with the invention, and showing the same positioned in a well,

Figure 5 is an enlarged horizontal cross-sectional view taken on the line 5—5 of Figure 4,

Figure 6 is a view similar to Figure 4, showing a slightly modified form of device for use in accordance with the invention,

Figure 7 is a view, partly in elevation and partly in section, of a closure member for use with the perforator, and

Figure 8 is a view, partly in elevation and partly in section, of a modified form of the flow controlling device.

In the drawings, the letter A designates generally a perforator for use in a well flow conductor or tubing T. The perforator used may be any of several suitable types, but the perforator shown herein includes a base member 10 having a depending skirt 11, and a cylindrical sleeve 12 telescopes and is slidable on the upper portion of the base member. A key pin 13 in the base member is slidable within an elongate key slot 14 in the sleeve to provide a positive connection between said sleeve and base and to define the limits of movement therebetween.

Elongate cutters or knives 15 are pivotally secured to the upper end of the base member by means of pins 16 and have projecting cutter points 17 at their upper ends. Elongate slots 18 are provided in the sleeve 12 and the cutter points are slidable longitudinally therein and expandable radially therethrough.

For expanding the cutters or knives to drive their points through the wall of the flow con-

ductor or tubing, a wedge member 19 is connected to the upper end of the sleeve 12 and extends axially downward therein, as is clearly shown in Figures 1 and 2. The wedge member is formed with opposed inclined surfaces 20 upon which the upper ends of the cutters are slidable. Obviously, as the wedge member and sleeve are moved downwardly with relation to the cutters and base member, the inclined surfaces 20 will urge the cutter points 17 radially outward and force said points through the tubing wall to form perforations therein.

The wedge member is forced downwardly by means of hammer blows delivered by manipulation of an ordinary weight member or sinker bar 21 and link jars 22 which are connected by a suitable socket 23 to a flexible wire line 24.

After the tubing has been perforated, upward movement of the wedge member and sleeve will withdraw said wedge member from between the cutters or knives to permit them to retract. Engagement of the lower end of the slot 18 in the sleeve with the outer edge of the knives and with the inclined under surface of the cutting points positively retracts said points to permit withdrawal of the tool from the tubing.

For positively locating and assuring actuation of the perforator, and for subsequently positively locating the flow controlling member, as will be hereinafter described, a removable stop or anchor member B is first positioned at the desired elevation within the well flow conductor by means of tools connected to and manipulated by means of the flexible wire line.

The stop or anchor includes an elongate tubular mandrel 30 having an axial bore 31. The lower portion 32 of the mandrel is substantially cylindrical and an external annular flange 33 is provided at the upper end of this cylindrical section. Immediately above the flange 33, the mandrel is flared outwardly and upwardly to form a slip expanding section 34, and an upwardly facing annular shoulder 35 is formed at the upper end of the flared section. A retrieving connection including an undercut annular flange 36 at the upper end of the mandrel is spaced above the shoulder 35 and is adapted to be engaged by a suitable retrieving tool (not shown) whereby the stop B may be removed from the well tubing.

Gripping elements or slips 37 having gripping teeth on their outer surface are slidable on the flared or inclined portion 34 of the mandrel. Handles 38 depend from the slips and extend downwardly through slots 39 in the flange 33. The lower ends of the slip handles are loosely connected to a slip carrier or sleeve 40 by means of the engagement of their T-shaped lower ends within correspondingly T-shaped slots 41 provided in the upper portion of the slip carrier. The slips are restrained against outward displacement from the T-shaped slots in the slip carrier by a band 42 which surrounds said carrier and is secured in an annular groove formed in its outer surface. A similar band 43 prevents outward displacement of the slip handles from the slots 39 in the annular flange 33. The slip carrier is slidable on the lower cylindrical portion 32 of the mandrel and upward movement of the slips on the mandrel is limited by the engagement of the carrier with the flange 33.

As will readily be seen, the weight of the slips will urge them to their lowermost position on the mandrel, engaging the flange 33. However, downward movement of the mandrel with rela-

tion to the slips will move the flared slip expanding section 34 downwardly between the slips and force them outwardly into gripping engagement with the wall of the tubing. Such relative movement may be obtained by suddenly lowering the mandrel. The slips will remain substantially stationary, due to their inertia, and the flared portion of the mandrel will move between them to immediately expand them into gripping engagement with the tubing.

When the stop has been lowered into the well and anchored at the desired elevation therein, the perforator A is lowered into the flow conductor until the skirt 11 on the lower end of the base 10 telescopes the retrieving connection on the mandrel of the stop. The lower end of the skirt will engage the upwardly facing shoulder 35 to stop further downward movement of the base and the knives or cutters carried thereby. As the sleeve 12 and the wedge member 19 continue to move downwardly with relation to the knives, the cutter points 17 are expanded, and, by manipulation of the jars 22 and sinker bar 21, are forced through the wall of the tubing, as has been explained, to form perforations P therein.

By accurately locating the stop member B in the well flow conductor, the position of the perforations is assured as being at the desired elevation in the well, since the location of said stop member may be checked with suitable measuring instruments prior to installation and use of the perforator. Thus, if the stop is not located properly to permit perforating at the desired elevation, said stop may be repositioned in the tubing to locate the perforator knives, and hence the perforations, at the desired elevation. It is to be noted that this may be done prior to perforating, so as to prevent forming undesired perforations in the tubing.

After the tubing has been perforated as has been described, the perforator is removed from the well and a side inlet flow controlling device F is positioned therein, as is clearly shown in Figures 4, 6 and 8, for positively controlling fluids which enter the bore of the flow conductor through the perforations P.

In the form of the device shown in Figure 4, the flow controlling device has an elongate tubular mandrel section which includes an upper cup section 50, a spacer member 51, and a lower cup section 52.

The lower portion of the lower cup section is reduced in diameter to form a shank 53 and an external annular shoulder 54. A plurality of upwardly facing flexible packing cups 55 surround the shank and are spaced from each other by a suitable spacer collar or ring 56. The uppermost cup abuts the shoulder 54 and the lowermost cup is retained on the shank by a follower ring 57, which is in turn held on the shank by a friction latch member 58 that is screw-threaded onto the lower end of the cup section.

The latch member includes a sleeve 59 which is adapted to telescope the retrieving connection on the upper end of the stop B and to engage the upwardly facing shoulder 35, whereby the flow device is supported on said shoulder. A friction spring 60 is mounted in a longitudinally extending slot in the wall of the sleeve and is formed to slidably engage under the undercut flange 36 to restrain upward displacement of the flow controlling device from its position in the well. Of course, suitable restraining means other than the latch member may be employed, if desired.

The upper cup section 50 is formed with a neck 63 of reduced diameter at its upper end whereby a shoulder 64 is provided. Flexible sealing cups 65, facing downwardly, surround the neck and are spaced from each other by a suitable spacer collar or ring 66. The lowermost cup abuts the shoulder 64 and the uppermost cup is retained on the neck by a follower ring 67. A collar 68 is secured to the upper end of the cup section by screw threads and prevents displacement of the follower ring 67 therefrom. The upper portion of the collar 68 is reduced in diameter to form a retrieving connection thereon having an undercut flange 69 at its upper end, whereby the flow controlling device may be engaged by a suitable tool (not shown) and lowered into or removed from the well flow conductor.

As is clearly shown in Figure 4, the spacer member 51 is of sufficient length to locate the upper cup section assembly 50 above the perforations P, while the lower cup section assembly 52 is positioned below said perforations. Obviously, this spacer member may be so lengthened as to place the cups on opposite sides of perforations made by any suitable perforator.

Since the cup section assemblies are located on opposite sides of the perforations P, it will be seen that any fluids entering the bore of the flow conductor through said perforations will be confined between the cup sections in the annular space between the spacer member and the wall of the flow conductor.

It is to be particularly noted that the stop member B provides a positive means for properly locating the flow controlling device F with respect to the perforations P, whereby the cup section assemblies are positioned on opposite sides of the perforations. Without the stop member, proper installation and positioning of the flow controlling device would be extremely difficult.

For admitting the fluids from the perforations into the bore of the flow controlling device F and to the bore of the flow conductor thereabove in controlled quantities, a flow controlling inlet orifice or opening 70 is provided in the lower portion of the upper cup section 50. While the orifice has been shown as located in the upper cup section, it may just as successfully be placed at any suitable point between the cups 55 and 65.

Thus, fluids entering through the perforations are permitted to flow in controlled quantities and at controlled rates through the orifice 70 into the bore of the flow controlling device and thence into the bore of the flow conductor to aerate and lift or flow the liquids in said conductor to the well surface.

If it should be desired that an orifice of a different size be used instead of the orifice 70, the flow controlling device F may be removed from the well by means of a suitable tool (not shown) lowered into the well on the flexible line 24 to engage the undercut flange 69 at the upper end of the device and lift the device from the well. The friction spring 60 will slide over the flange 66 on the stop B and thus permit the entire device to be raised. The orifice may then be changed and the flow controlling device lowered into the well and repositioned upon the stop B in exactly correct position with relation to the perforations P for controlling the admission of fluids through said perforations into the flow conductor, since the stop B is not moved or otherwise disturbed during such removal and repositioning of the flow controlling device F.

Manifestly, a device has been described which may be employed for providing for and control-

ling the admission of extraneous lifting fluid into the bore of a flow conductor for raising oil to the surface. The device may be used in wells wherein free gas has accumulated in the annular space above the liquid level, or in wells wherein an upper gas producing formation has been sealed off by a packer, and it is desired to use such gas for lifting or flowing the oil to the surface; and in wells wherein it is desired to inject lifting fluid into the annular space at the surface, for admission into the flow conductor in the lower portion of the well for lifting the oil to the surface.

In every case, perforations may be definitely and accurately located to secure the admission of the lifting fluid, and the flow controlling device may then be as accurately placed for positively controlling the admission of such fluids. All this may be done, and is done, without moving or otherwise disturbing the flow conductor in any manner to "break" the seal which may have been obtained by the use of a packer. The high cost and the time delay attendant upon raising the tubing string to permit installation of "jet collars," or other flow devices requiring that landing nipples or collars be connected in the flow conductor, is eliminated, and the size of the orifice for controlling admission of the lifting fluid may be readily changed without moving the flow conductor.

A modified form of device for use in accordance with the invention is illustrated in Figure 6, wherein is shown a well having a casing C, a flow conductor or tubing string T, and a packer or seal S therebetween. A slightly modified form of flow controlling device is illustrated as supported upon and releasably secured to the stop or anchor B. The modification consists of replacing the sealing cups of the previous form with fluid pressure expansible sleeves.

The upper cup section 80 has its lower end portion enlarged in diameter to form an upwardly facing annular shoulder 81. A collar 168 having a retrieving connection 169 and a depending annular skirt 83 thereon is secured to the upper end of the cup section by screw threads. An elongate flexible packing sleeve 84, made of neoprene, rubber, or other suitable material, has its upper end molded or otherwise secured within the annular skirt 83 on the collar. As is clearly shown, the upper portion of the packing sleeve has its bore engaging and sealing against the outer surface of the cup section, while the lower portion of its bore is enlarged to form an elongate sealing lip 85. The external diameter of the sleeve is substantially the same as the bore of the well flow conductor so as to seal thereagainst under low pressures.

An inverted guide ring or thimble 86 surrounds the cup section and abuts the shoulder 81, and the lower end of the lip of the packing sleeve is confined within the thimble to prevent it from catching between pipe sections and being torn off the cup section. Ports 87 provide means for well fluids to enter the bore of the sleeve to deform the same into tight sealing engagement with the walls of the flow conductor and with the cup section.

A similar packing sleeve 94 is mounted on the lower cup section 90, and has its lower end molded or otherwise secured within an annular recess 93 formed in a supporting collar 92 mounted on the lower end of said cup section. The upper portion of the bore of the sleeve is enlarged to form an elongate lip 95, which is confined at its upper end within a thimble 96 surrounding the lower cup section and abutting against a shoulder 91 formed

thereon. Ports 97 provide communication between the bore of the sleeve and fluid entering through the perforations P.

Other than the packing assemblies, the parts of this form of the flow controlling device are identical with and are numbered the same as those in the first form.

Obviously, since the packing sleeves 84 and 94 are located on opposite sides of the perforations, fluids entering the bore of the conductor through such perforations will be confined between said sleeves and directed through the flow controlling orifice or opening 70 into the bore of the device for flowing the oil upwardly in the conductor.

It is pointed out that the annular space between the casing C and the tubing T above the packer S may have been "loaded" with fluid containing mud or other heavy agents to reduce the pressure differential load on the packer; or there may be a gas producing formation above the packer which has been sealed off from the lower oil producing formation by said packer; or it may be desired to use the annular space as a conductor for lifting fluid injected at the well surface. In any case, the tubing T may be perforated just above the packer in the manner already described to establish communication between the tubing and the annular space and a flow controlling device may then be positioned in the well to control the admission of fluids through the perforations to the flow conductor.

In wells where the "loading" fluid is present above the packer, perforating will enable the operator to circulate and remove such fluid from the annular space. This may be done for the purpose of relieving the weight of the fluid on the packer, or to facilitate removal of the packer, or to establish a conduit through the annular space for lifting fluid injected at the surface and admitted through the perforations to the bore of the tubing for raising the oil therein to the surface.

In many instances it will be desired that the oil producing formation below the packer be prevented from being subjected to the high pressures and the heavy agents and other foreign matter of the "loading" fluid which are incident to circulation of such fluid from the well.

For temporarily closing the bore of the tubing below the point at which it is to be perforated, a closure member K is provided and is arranged to engage and be supported by the upper end of the stop B, as clearly shown in Figure 7.

The closure member includes a tubular body 101 having a pair of spaced upwardly facing sealing cups 102 mounted thereon. The upper end of the bore of the tubular body is bevelled or inclined to provide a valve seat, and a valve head 103 is adapted to engage this seat to close the bore of the body. An upstanding stem 104 extends upwardly from the valve head and is slidable through an inwardly directed flange formed at the upper end of a valve cage 105, which cage surrounds the valve head and is threaded onto the upper end of the tubular body of the closure member. A retrieving neck 106 is fastened to the upper projecting end of the valve stem.

Manifestly, the valve head 103 opens upwardly, and as the closure member is lowered into the well said valve head will raise to permit a free by-passing of fluids in the tubing through the member. Also, in removing the closure member, engagement of a suitable removing tool with the retrieving neck 106, and a subsequent lifting of the tool, will result in the valve head being un-

seated, whereby removal of the closure member is facilitated.

As is clearly shown in the drawings, the closure member is seated upon the upper end of the stop B and the skirt 11 of the perforator is seated upon the upper end of the valve cage 105, telescoping the upper end of the valve stem and the retrieving neck. Manipulation of the flexible line 24 and the jars 22 carried thereby will result in the formation of perforations in the wall of the tubing above the closure member. "Loading" fluids may then enter through the perforations and will be prevented from passing downwardly through the tubing to the lower oil sands. Also, water or other fluids may be pumped downwardly in the tubing and outwardly through the perforations into the annular space between the casing and tubing to displace the "loading" fluids therein, and such circulated fluids will likewise be prevented from passing downwardly through the tubing to the oil formation by the closed closure member K. Obviously, circulation may be downwardly through the annular space and upwardly through the tubing, if desired.

After the "loading" fluids have been circulated from the well, a flow controlling device F may be lowered into the well and supported upon the closure member, or the closure member may be lifted from the well by a suitable removing tool and the desired form of the side inlet flow controlling device F may then be positioned on the stop B for controlling the admission of lifting fluids entering through the perforations P.

In Figure 8 there is shown a flow controlling device having incorporated therein several modifications from the previously described forms.

It is pointed out that, while the sealing cups 55 and 55 of the device shown in Figure 4, as well as the sleeves 84 and 94 of the device of Figure 6, are all directed inwardly toward the perforations; in some installations it is desirable that the cups be arranged to seal off pressures from both above and below within the flow conductor, as well as the pressure of the fluids entering through the perforations. In such installations, the cups would be mounted on the cup sections in the manner illustrated in Figure 8. With this arrangement the cups nearest the perforations face toward each other and the perforations in the usual manner, while the other cups on each section are faced in the opposite direction. The oppositely facing cups on each cup section are separated by and abut against a supporting ring 75, and the spacer collars 56 and 66 confine the cups on the cup section, being held in position thereon by the latch member 58 and the collar 68 respectively.

It will readily be seen that this arrangement of the sealing cups permits the use of the flow controlling device in wells wherein there is a possibility that pressures within the flow conductor above and below the device may become greater than the pressure of the fluids entering through the perforations P.

Furthermore, in many installations it may be desirable that means be provided for preventing fluids which enter the tubing through the perforations P from flowing downwardly through the tubing to the lower oil producing formation. Likewise, it may be desirable to prevent fluids from the lower formation from flowing outwardly through the side inlet and perforations P.

Such valve means are clearly shown in Figure 8. It is pointed out, however, that either one of the valve means alone, or both, may be employed

in the flow control device at any desired time. Also, other forms of the valves may be used, the valves illustrated being merely one suitable construction.

For preventing back flow of fluids downwardly through the tubing, a cage 110 having a replaceable valve seat 111 mounted therein is connected by screw threads between the lower end of the spacer member 51 and the lower cup section 52. A ball valve 112 is adapted to engage said seat 111 to prevent flow downwardly through the cage. A pin 113 extends diametrically across the upper end of the cage 110 and prevents upward displacement of the ball from the cage.

For preventing flow outwardly through the perforations, the upper cup section 50, having the side inlet or orifice 70 therein, is formed of two elements secured together by screw threads or other suitable means. The lower element 51b has the upper portion of its bore enlarged to receive the reduced lower end portion of the upper element 51a. The side inlet opening 70 is formed in the lower element 51b and has its inner portion enlarged to form a valve seat 70a upon which a ball valve 70b is arranged to seat to close said port and shut off flow outwardly therethrough. A slot in the lower end of the upper element 51a permits flow of fluids inwardly from the opening 70 and also prevents displacement of the ball valve 70b from said opening.

Other than the changes described, the parts of the flow device are the same and bear the same numbers as the parts described in the form illustrated in Figure 4.

It is manifest that means have been provided for preventing back-flow of fluids downwardly through the tubing, as well as outwardly through the perforations, and which means may be used either singly or in combination in the same device.

Obviously, the entire assembly, the flow controlling device F and the stop member B, may be removed entirely from the bore of the flow conductor T, if desired, to provide a clear unobstructed and unrestricted passage to the lower end of the flow conductor.

From the foregoing, it will be seen that a novel method and means for establishing controlled admission of fluids into a well flow conductor has been provided, and that such method and means enables the operator to establish such controlled flow in the usual ordinary well tubing string without removing the tubing from the well bore or otherwise disturbing the tubing or any packer which may be installed therewith in the well bore. The provision of the stop member B in combination with the flow controlling device F definitely assures location of said flow controlling device in proper position for positively controlling admission of fluids into the well conductor through a side inlet opening formed in the conductor without removing the same from the well bore.

The above description of the invention is explanatory only, and changes in details of the constructions illustrated may be made by those skilled in the art, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. The method of preparing a well having a flow conductor therein which resides in setting and maintaining a limit stop at any desired position within the conductor in place in the well, forming a fluid passage through the wall of the

conductor at a point in the latter predetermined by the position of the limit stop and without moving the conductor, and then placing a control within the conductor so as to be supported and definitely positioned by the limit stop for positively controlling the flow of fluid through said passage.

2. The method of preparing a well having a flow conductor, which resides in setting a limit stop at any desired position within the conductor in place in the well, forming a transverse fluid passage through the conductor at a point predetermined by the position of the limit stop and without moving the conductor, and placing a control within the conductor at a point predetermined by the position of the limit stop whereby to positively position the control so as to control the flow of fluid through said passage.

3. A method of preparing a well having a flow conductor within a casing and a packer between

the casing and said conductor, which resides in setting a limit stop within the conductor above the packer, sealing the bore of the conductor against downward flow at a point determined by the limit stop, and forming an opening in the conductor at a point determined by the limit stop and seal.

4. The method of preparing a well having a flow conductor within a casing and a packer between the casing and said conductor, which resides in setting a limit stop within the conductor above the packer, forming an opening through the conductor at a point determined by the position of the limit stop, and placing a control in the conductor at a point determined by the position of the limit stop whereby to positively position the control so as to control the flow of fluid through said opening.

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