July 9, 1940. S. V. DILLON 2,207,001

WELL EQUIPMENT

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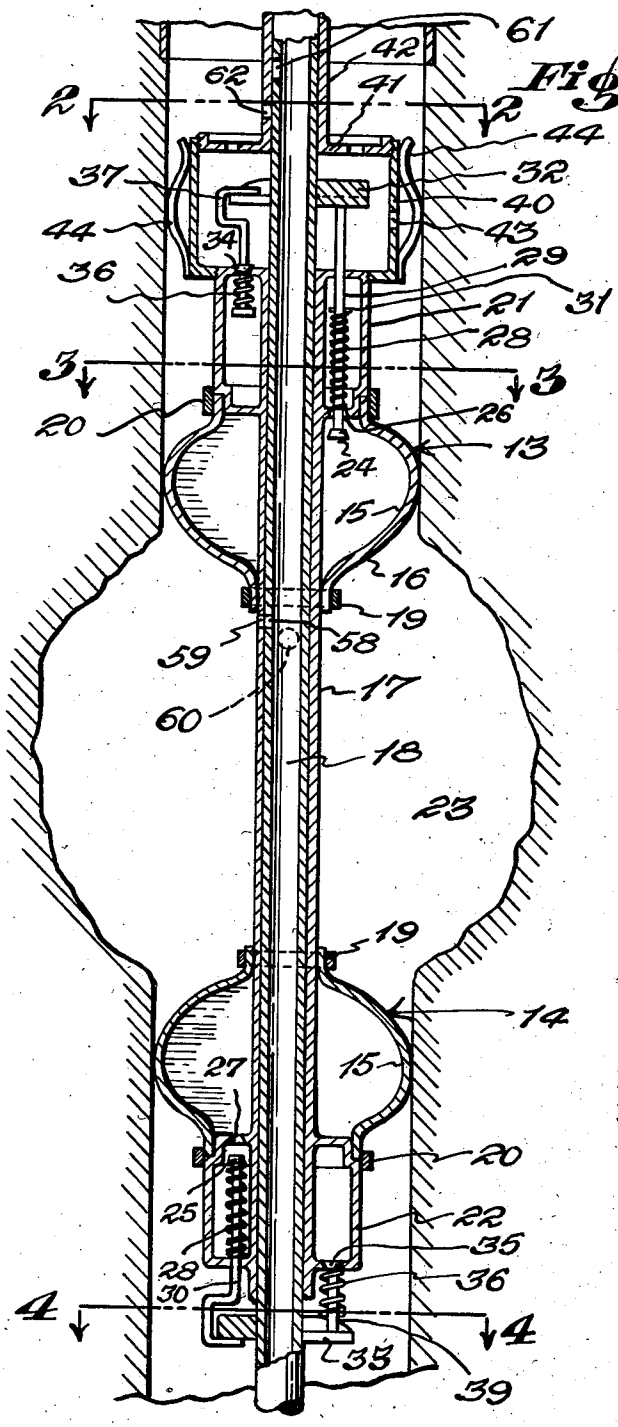


Fig. 1.

Fig. 2.

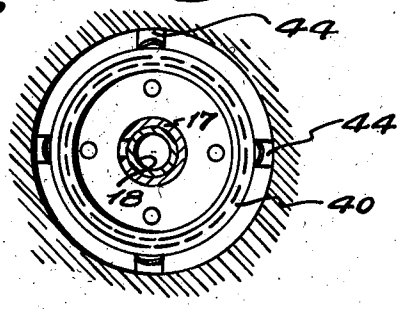


Fig. 3.

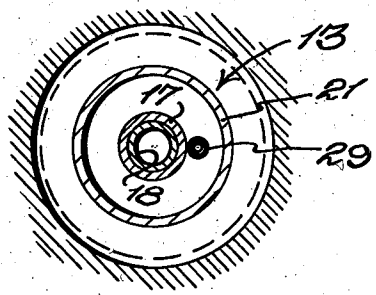
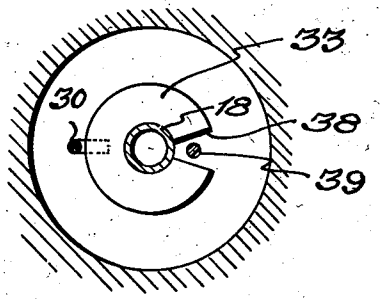


Fig. 4.



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Fig. 5.

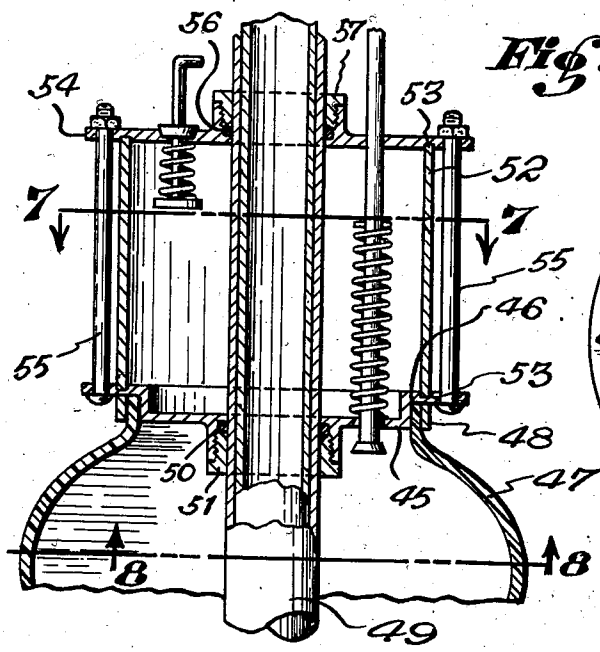


Fig. 6.

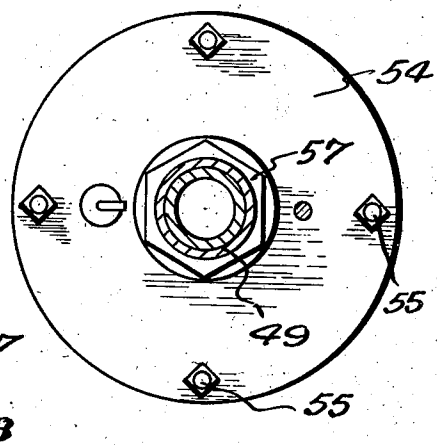


Fig. 7.

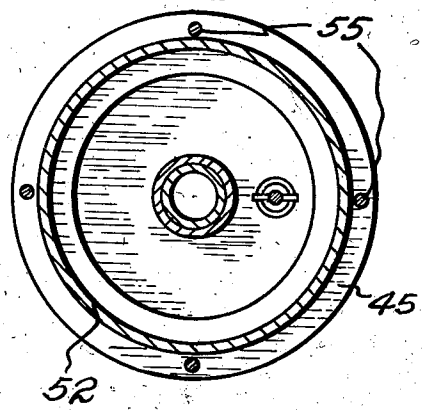
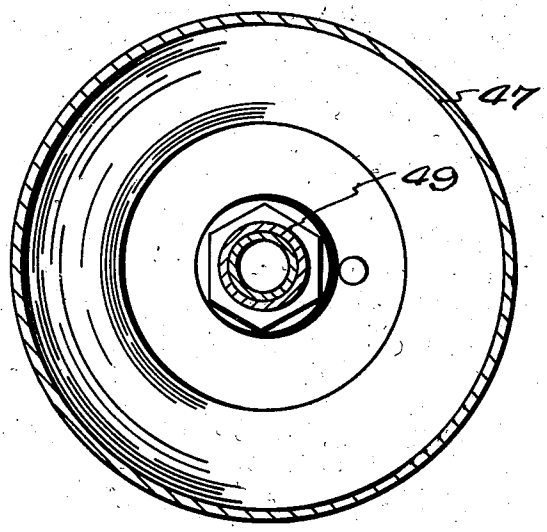


Fig. 8.



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UNITED STATES PATENT OFFICE

2,207,001

WELL EQUIPMENT

Stephen V. Dillon, Tulsa, Okla.

Application October 11, 1937, Serial No. 168,485

6 Claims. (Cl. 166—10)

This application is a continuation-in-part of my application Serial No. 27,788, filed June 21, 1935, Patent No. 2,095,244.

The invention relates to improvements in well equipment and more particularly to novel packing means for obstructing the space between the well string and the bore of a well.

One of the primary objects of the invention is to provide improved packing means comprising a source of pressure fluid arranged in close proximity to an expansible element, for the purpose of inflating such element after the packing means has been introduced by the well string into the well, to obstruct the space between the well string and the bore of the well.

Another object is to furnish means for such purpose comprising a device for controlling the inflation and deflation of the expansible element by movement of the well string relatively to the expansible element.

A further object is to supply packing means of duplex character so that one expansible element may be positioned on the well string above an oil-bearing or gas producing strata and another may be positioned below said strata.

A still further object is to provide a device of the aforementioned kind combined with novel means for controlling the admission of fluids into and the discharge of fluids out of a tubular section of the well string.

With the foregoing objects outlined and with other objects in view which will appear as the description proceeds, the invention consists in the novel features hereinafter described in detail, illustrated in the accompanying drawings and more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is a vertical sectional view of an improved packing means and valve structure forming part of my novel well equipment.

Figs. 2, 3 and 4 are horizontal sectional views taken respectively on the lines 2—2, 3—3 and 4—4 of Fig. 1.

Fig. 5 is an enlarged vertical sectional view of a modification of one of the packing assemblies.

Fig. 6 is a top plan view of the same.

Figs. 7 and 8 are horizontal sectional views taken respectively on the lines 7—7 and 8—8 of Fig. 5.

In the embodiment of the invention shown in Figs. 1 to 4, inclusive, 13 and 14 designate expansible packing elements of the inflatible and deflatible type and each of these elements may be in the form of a hollow ball made of a rubber lining 15 coated on its exterior with any suitable protecting means such as a coat 16 of synthetic rubber or Thiokol.

Each ball surrounds an auxiliary or outer tube 17, the inner surface of which snugly engages the outer surface of a section 18 of the tubing string, and to prevent any leakage, clamping rings 19 and 20 engage the ends of the ball. The ring 19 clamps one end of each ball to the auxiliary tube, while the ring 20 clamps the opposite end of the ball to a casing 21, 22. These casings are reversed in reference to the expansible packing elements and the casing 21 is preferably arranged above its ball while the casing 22 is preferably arranged below its ball. This arrangement permits a shot hole 23 or the like in oil or gas-producing strata to be segregated from the bore of the well above and below the shot hole and consequently if treating acid or the like is introduced into the shot hole, it will be prevented by the expansible packing elements from coming in contact with the casings 21, 22 and other parts which are preferably made of metal.

The casings or chambers are designed to contain sources or supplies of an expansible medium, such as dry ice, and after the tubing string has been lowered into the well, valves 24 and 25 controlling ports 26 and 27 in the chambers can be opened to permit gas released from the gas-producing medium in the chamber, to enter the balls for the purpose of inflating the balls and causing them to form obstructions between the tubing string and the bore of the well.

For the purpose of controlling the valves, each valve may be normally held in closed position by a coil spring 28. These springs surround the stems 29, 30 of the respective valves. As shown in Fig. 1, the spring surrounding the stem 29 may have one end bearing against an abutment 31 on the stem, and its other end bearing against one end of the casing 21, while the spring surrounding the stem 30 may bear at one end upon an end of the casing 32 and at its other end against the head of valve 25.

The valve stems are simultaneously operated to release gas from the chambers 21, 22 into the balls, by means of cam discs 32 and 33 (fixed to the section 18 of the tubing string) and this is accomplished when the tubing string is lowered relatively to the auxiliary tube 17.

As it will be necessary to deflate the balls in order to raise the tubing string, each of the chambers 21, 22 is provided with a release valve 34, 35. Each of these valves is normally held seated by a spring 36 and one of the valve stems has a hook 37 at its outer end. These valve stems cooperate

with the cam discs 32 and 33, and when the cam discs are in certain positions and turned, cam surfaces on these discs will engage the stems of valves 34, 35, and open the release valves. It is necessary at such time that the valves 24 and 25 be held open so as to release gas not only from the balls into the chambers but from the chambers to the atmosphere, and consequently the discs 32 and 33 are so arranged as to hold the valves 24 and 25 open while the cam surfaces on the discs are actuating the valves 34, 35, due to the turning movement of the discs by the well string. Each cam disc has a cut-out sector 38 (Fig. 4) to permit the discs to clear the valve stems 37 and 39 when the tubing string is moved downwardly relatively to the auxiliary tube 17.

Each of the chambers 21, 22 is rigidly secured to the auxiliary tube 17 and in order to prevent this auxiliary tube from moving during the manipulation of the tubing string for control purposes, the auxiliary tube may be rigidly linked to the lower end of a lock wedge block shown in my above-mentioned application Serial No. 27,788. For example, a threaded sleeve 40 can rigidly connect the casing 21 to the flange 41 at the lower end of a sleeve 42 and the upper end of this sleeve can be rigidly secured to said wedge block of the tubing lock by any suitable means not shown. Perforations 43 in the collar 40 permit the escape of gas that is vented through the upper release valve 34.

If desired, bow springs 44 can be positioned on the sleeve 40 to frictionally engage the bore of the well and prevent movement of the surrounding elements while the tubing string section 18 is being manipulated.

In Figs. 5 to 8, inclusive, I have illustrated a much more practical form of the dry ice chamber and expansible element. For example, as shown in these figures, one end plate 45 of the casing may be of stepped formation to form an annular rabbet 4 to receive one end of the ball 47 and this end plate can be clamped to the stepped end plate of the casing by any suitable clamping means 48. The end plate 45 of the casing surrounds the auxiliary tube 49 and a packing gasket 50 and packing gland 51 are used where the joint is located.

The body of the chamber in this example may consist of a short section 52 of pipe, the ends of which will extend into annular grooves 53 in the end plates 45 and 54. Bolts 55 which pass through apertures in the end plates may be employed to hold the parts in assembled relation, and a packing gasket 56 and packing gland 57 can be used where the plate 54 surrounds the auxiliary tube.

For the purpose of permitting well fluid to readily flow into the tubing string while the tubing string in my equipment is being lowered into the well, the tubing string is preferably provided, as shown in Fig. 1, with a port 58 that may register with a port 59 in the auxiliary tube 17. The auxiliary tube has a second lower port 60 positioned below the port 59 and at a point spaced about forty-five degrees from the port 59. Consequently when the tubing string is turned to set a tubing catcher or tubing lock (not shown) or both of them, and the tubing is then lowered so as to lock the tubing against either downward or upward movement, the port 58 will be brought into register with the port 60 with the result that well fluid can then travel into the tubing string through the ports 60 and 58.

When the ports 58 and 60 are in registration, well fluid can not only enter the tubing string but treating agents or the like can be introduced into the well through the tubing string and even though this treating medium is introduced under relatively high pressures, it will not disturb the position of the tubing string, as the tubing stop and tubing lock (shown in application Serial No. 27,788) will prevent upward or downward movement of the tubing string, and the expansible packing elements 13 and 14 will confine the treating medium to the shot hole or the like, and will prevent it from moving upwardly or downwardly in the bore of the well.

As it sometimes happens that liquid will gather in the well above the packing means and interfere with the removal of the parts, I provide the tubing string with a second port 61 (Fig. 1) which is adapted to cooperate with a port 62 in the pipe 42. When the tubing string is lowered relatively to the auxiliary tube 17 without being turned, the ports 61 and 62 come into register and this permits liquid gathering in the well above the upper packing element 14 to be pumped up the well through the tubing string.

From the foregoing it will be understood that I have combined with a tubing string, a novel packing means controlled by relative movement of the tubing string. If the improved packing means is employed in combination with the tubing stop and lock, shown in my application Serial No. 27,788, the tubing string will be locked against either upward or downward movement, and consequently the packing means will be held stationary and pressure conditions within the well will not disturb the position of the tubing string.

For purposes of illustration, I have shown the well string as a string of tubing, but it is obvious that the packing means can also be employed with a rod string or a well string partially of rod string and partially of tubing.

From the foregoing, it is believed that the construction, operation and advantages of the invention will be readily understood by those skilled in the art. I am aware that changes may be made in the details disclosed without departing from the spirit of the invention as expressed in the claims.

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

1. Packing means for wells, comprising an inflatable and deflatable element adapted to surround a well string, a container positioned in the well and adapted to store a source of pressure medium, a passageway placing the interior of the container in communication with the interior of the inflatable and deflatable element, a valve for controlling said passageway, a vent port for said container, and a valve controlling said vent port.

2. The combination with a well string arranged in the bore of a well, of a plurality of packing means surrounding the well string and adapted to obstruct the flow of fluid between the well string and the bore of the well, each of said means comprising an inflatable and deflatable element, each element being provided with a passageway for introducing a pressure fluid into the same, pressure fluid generating and storing means arranged on the well string and communicating with the interior of the elements through said ports, and means for controlling said ports.

3. The combination with a well string arranged in the bore of a well, of an inflatable and deflatable element surrounding the well string and obstructing the passage of fluid between the well string and the bore of the well, means for gener-

ating and storing a pressure fluid arranged on said well string, and controllable means for introducing the pressure fluid into said element and for discharging the pressure fluid from said element.

4. The combination with a well string arranged in the bore of a well, of a pressure fluid generating and storing means arranged on the well string and including a container having a plurality of discharge ports, an inflatable and deflatable packing element surrounding the well string and adapted to obstruct the passage of fluid between the well string and the bore of the well, one of said discharge ports leading into said element for inflating the latter, and means for controlling the passage of said pressure fluid through said ports.

5. In equipment of the character described, a rod like element adapted to be inserted in a well, an inflatable and deflatable member surrounding said element and adapted to close the space in the well between said element and the bore of the well, a pressure medium storage member carried by said element, means for leading pressure medium from the storage member into said inflatable and deflatable member, means for controlling the last mentioned means, said control means being actuated by relative movement between said element and one of said members.

6. In equipment of the character described, a rod-like element adapted to be inserted in a well, an inflatable and deflatable member surrounding said element and adapted to close the space in the well between said element and the bore of the well, a pressure medium storage reservoir carried by said element, means for leading pressure medium from the reservoir into said member, means for anchoring the member in the well to allow the rod-like element to be moved relatively to said member while the latter remains in stationary position, a valve for controlling the passage of fluid from the reservoir to said member, and means actuated by relative movement between said element and member for controlling said valve.

STEPHEN V. DILLON.