Nov. 19, 1940. R. C. BAKER 2,222,014

WELL PACKING DEVICE

Filed Aug. 9, 1939

Fig. 1.

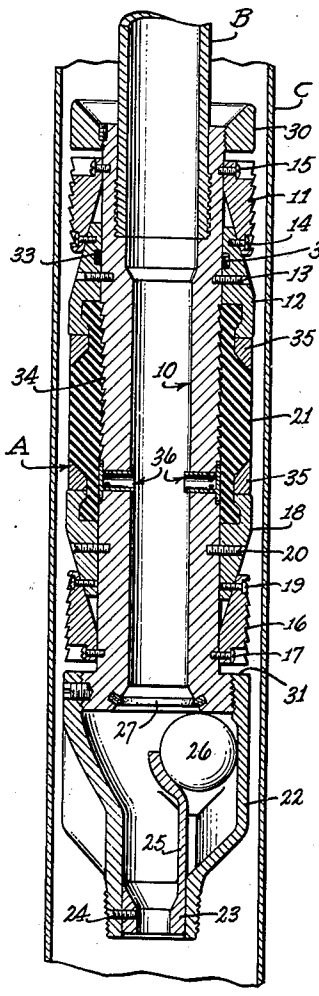


Fig. 2.

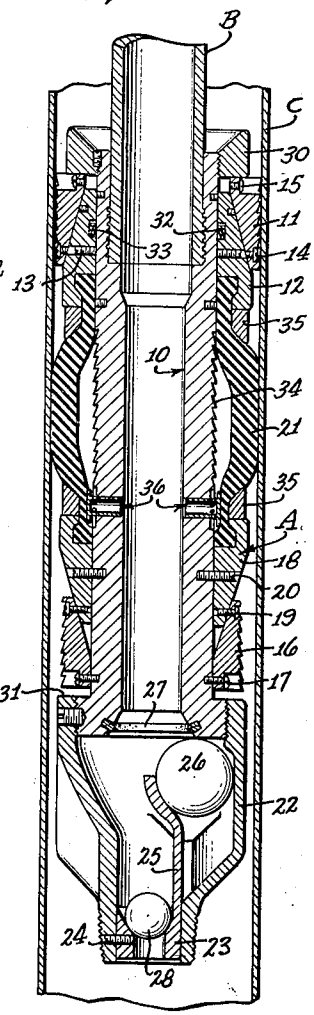
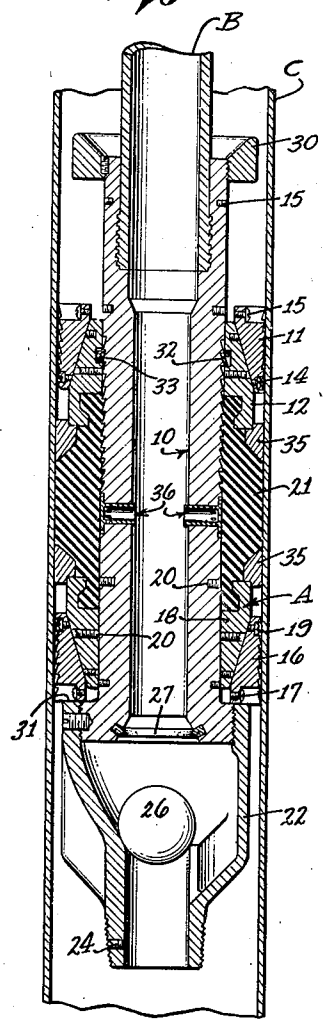
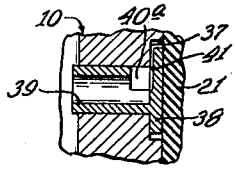


Fig. 3.





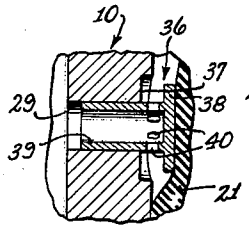


Fig. 4.

Fig. 5.

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UNITED STATES PATENT OFFICE

2,222,014

WELL PACKING DEVICE

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Application August 9, 1939, Serial No. 289,127

13 Claims. (Cl. 166—12)

This invention relates to well packers designed to be lowered within and secured to well casings, for the purpose of performing specific functions therein.

In my prior filed application, "Packings for well devices", Serial No. 271,941, filed May 5, 1939, now Patent No. 2,204,648, granted June 18, 1940, of which the present application is a continuation-in-part, I have disclosed a well packer in the form of a cement retainer embodying a packing sleeve of natural or synthetic rubber. This sleeve is initially maintained inwardly from the well casing to permit the retainer to be lowered therethrough without impedance. Upon reaching the desired setting point in the casing, the retainer slips are set and a fluid-tight seal effected by compressing the rubber packing between the main body of the retainer and the casing. While in this compressed state, and particularly where high compressive pressures and temperature are present, the packing sleeve has a tendency to flow through annular spaces existing between the casing and the packer, in some instances being completely dissipated through these spaces and leaving substantially no packing material for performing the requisite sealing action. In the application referred to, such cold or plastic flowing of the rubber packing has been overcome by the provision of annular lead sealing rings which are expanded outwardly upon compression of the packing sleeve to effectively bridge the annular gaps and confine the packing for sealing action at the intended region between the packer body and casing.

Although the provision of the lead sealing rings is an effective instrumentality for preventing cold flowing of the retainer packing, in some forms of packers fluid under pressure is employed for setting the packing slips and also for engaging the sleeve with the casing. This fluid usually passes through side ports or holes in the body and acts upon the interior of the sleeve to stretch or expand it in the proper direction to set the slips. Thereafter, a strain is taken on the packer body to more securely set or embed the slips in the walls of the casing and compress the packing between the body and the confining casing. As stated above, the lead sealing rings prevent cold flowing of the relatively plastic and pliable rubber through the annular spaces between the casing and the packer parts, but heretofore no provision has been made for preventing such cold flowing through the fluid ports establishing communication between the interior of the body and the packing. The packing material has been permitted to be displaced through these ports, and is consequently unavailable for the performance of its intended sealing or packing-off action.

Accordingly, it is an object of the present invention to overcome the aforementioned difficulties by preventing cold flowing of plastic sealing material through fluid ports or other openings in the packer, thereby confining the packing material to the region where it is proposed that an effective seal between the packer and the casing be made.

The invention has other objects that will become apparent from a consideration of the embodiments shown in the drawing accompanying and forming part of the present specification. These forms will now be described in detail, but it is to be understood that such detailed description is not to be taken in a limited sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawing:

Figure 1 is a longitudinal sectional view of a well packer embodying the invention positioned within a well casing;

Figure 2 is a view similar to Figure 1, with the upper slips in set position;

Figure 3 is a view similar to Figure 1, showing the packer in fully set position;

Figure 4 is an enlarged, fragmentary section of one of the valve devices operable within a fluid port; and

Fig. 5 is a view similar to Figure 4 of a modified form of valve device, shown in closed position.

The well packer A is shown coupled to the end of a string of tubing B or the like with its parts in retracted position to permit freedom of passage through the casing C to the desired setting point. The packer includes a main body 10 carrying a set of upper annular segmental slips 11 adapted to be moved into engagement with the casing by an upper expander cone 12 initially retained in retracted position by one or more shear screws 13 attaching it to the main body. The upper slips are similarly retained in retracted or ineffective position by respective shear screws 14, 15 securing them to the cone and main body. A lower set of annular segmental slips 16 is held initially in retracted position and attached to the main body by shear screws 17, and to a lower expander cone 18 through other shear screws 19, this latter cone being initially held in ineffective position by suitable frangible connections in the form of shear screws 20. The upper sets of screws have a lower shear value than the lower sets to permit prior setting of the upper slips.

A packing sleeve 21 of synthetic or natural rubber is positioned between and suitably secured to the ends of the expander cones 12, 18, being retained initially free from contact with the casing walls but being capable of expansion and contraction into engagement therewith and with the main body of the packer.

A valve assembly housing 22 is threadedly secured to the lower end of the main packer body, and contains a tripping ball seat 23 initially secured to it by a shear screw 24. This seat has an upstanding arm 25 for holding a buoyant back pressure ball 26 in ineffective position against the interior of the housing to prevent its seating against a valve seat 27 provided at the lower end of the main body 10. Removal of this arm through a proper operation of the packer device will permit the ball to be positioned on its cooperable valve seat whenever reverse flow of fluid through the body tends to occur.

The packer A is run into the casing to the desired point and circulation established therethrough to remove any undesired foreign matter. Thereafter, a tripping ball 28 is lowered or pumped down through the tubing to seating engagement with the tripping ball seat 23, permitting increase of the pressure of the fluid within the packer body and its passage through ports or holes 29 opening through the body into the interior of the packing 21. This fluid under pressure will elongate the packing sleeve and slide the cone 12 upwardly along the body 10 to disrupt the various shear screws 13, 14, 15 and expand the upper slips 11 outwardly into gripping engagement with the casing. The extent of this upward movement is limited by a setting ring 30 suitably attached to the upper end of the main body.

After setting the upper slips, the pressure of the fluid is increased to shear the pin 24 holding the tripping ball seat 23 to the valve housing and remove the seat together with its upstanding arm 25 entirely therefrom, allowing the back pressure ball 26 to seat whenever reverse flow of fluid tends to occur. The taking of an upwardly directed strain on the tubing B and main body of the packer will compress the packing sleeve between the casing wall and the exterior of the main body, and will then cause failure of the screws 17, 19, 20 holding the lower slips and cone to the body, whereupon engagement of the abutment 31 at the end of the body with the slips 16 will move them longitudinally along the face of the expander cone 18 and radially into engagement with the casing. The various slips, cones, and packing sleeve are held in this position by an annular split dog 32 contained within a groove 33 in the upper cone 12 engaging one-way circular ratchet teeth 34 provided in the body of the retainer (See Figure 3). The packer is now in setting position for the performance of a cementing operation or to function as a bridge plug or otherwise, as explained in United States Patent No. 2,121,051, to which attention is invited.

In the above identified application, cold flowing of the packing 21 through the annular spaces between the expander cones 12 and the casing C is prevented by providing annular seals of lead 35, or other pliable but inelastic material, around the terminal portions of the sleeve. However, the compression of the sleeve 21 still tends to force the packing material through the fluid holes or ports 29. In the instant case, this tendency is offset or prevented by providing flow stop plugs 36 within each port, which function like one-way valve devices. Thus, the exterior of the body is recessed around each port to form a seat 37 for a cooperable valve head 38 extending outwardly from a tubular valve member 39 slidably fitting within each port. The tubular member has holes or openings 40 through its walls below the valve head 38 to permit passage of fluid from the interior of the main body through the tubular member and outwardly therefrom through the openings to the interior of the packing sleeve. Upon seating of the valve head 38, this path of flow is disrupted, particularly in a reverse direction.

It will accordingly be seen that fluid under pressure can pass into the interior of the packing sleeve to produce its elongation and setting of the upper slips. Flow of liquid in this manner will move the valve head 38 from its seat 37 and position the holes 40 in communication with the interior of the sleeve. The release of pressure in the fluid will enable the inherent resiliency or elasticity in the packing sleeve 21 to re-seat the head 38 and interrupt the fluid passage. This resiliency or pressure exerted by the sleeve is at a maximum when it is in a compressed state after the complete setting operation has been performed, and exerts a degree of pressure against the valve head 38 greater than the force of the fluid within the main body produced during the cementing operation, or otherwise. Accordingly, after complete setting of the packer, the flow plugs 36 are held in closed position, allowing no material opening to remain through which cold flowing of the packing sleeve can occur.

A modified form of flow stop plug is disclosed in Figure 5, wherein communication between the interior of the tubular valve member 39 and the interior of the sleeve 21 is established through the provision of a transverse slot 40*a* cut through the wall of the tubular member. In forming this slot, a slight portion of the underside of the valve head 38 is also removed so that upon seating of the head on the seat 37 a small fluid passage 41 still remains between the interior of the tubular member 39 and the interior of the sleeve. This arrangement offers assurance that fluid will not be trapped within the interior of the sleeve upon its being compressed during the packing-off action, since such fluid can readily escape through the slight passage 41 back to the interior of the main body 10. However, it is to be noted that this passage is of insufficient dimensions to allow cold flowing of the elastic packing sleeve 21 through it.

The transverse slot 40*a* is a simple expedient for not only providing a path of flow between the interiors of the tubular member 39 and the sleeve 21, but its use effects a saving in manufacturing cost since the slight recess at the underside of the head can be produced by the same cut that forms the slot. It is to be understood, however, that the same result of permitting escape of fluid could be accomplished in the Figure 4 and Figure 5 valve embodiments by knurling or otherwise roughening the underside of the head, thereby producing an imperfect contact between it and the valve seat 37 and allowing leakage or passage of fluid from the interior of the packing sleeve 21 upon its compression.

It is apparent, therefore, that the pliable packing 21 will be confined to the intended region within the casing C, being prevented from moving into the annular spaces between the casing and the conical retainers 12, 18 by the lead sealing rings 35, and from flowing through the ports 29

by the seating action of the flow stop plugs 36 upon their cooperable valve seats.

I claim:

1. In a well packer, a body adapted to be lowered in a casing, a packing carried by said body for effecting a seal between said body and casing, means providing a fluid passage establishing communication between the interior of said body and said packing, and a device cooperable with said passage and operable by said packing to substantially close said passage upon movement of said packing toward said passage.

2. In a well packer, a body adapted to be lowered in a casing, a pliable packing carried by said body for effecting a seal between said body and casing, means providing a fluid passage establishing communication between said packing and the interior of said body, and a valve device operable by said packing to stop the flow of fluid through said passage.

3. In a well packer, a body having a fluid passage adapted to be lowered in a casing, a packing around said body for effecting a seal between said body and casing, said body having a port establishing communication between said passage and the interior of said packing, and a valve device for said port adapted to be urged by said packing to close said port.

4. In a well packer, a body having a fluid passage adapted to be lowered in a casing, a pliable packing sleeve encompassing said body to effect a seal between it and said casing, said body having a port establishing communication between said passage and the interior of said sleeve, and a one-way valve device slidable in said port and adapted to be urged to closed position by said sleeve when under stress.

5. In a well packer, a body adapted to be lowered in a casing and having a fluid passage, a packing sleeve encompassing said body to effect a seal between it and said casing, said body having one or more ports establishing communication between said passage and the interior of said sleeve, and a one-way valve device in each port and contactable by said sleeve to be urged thereby to a position substantially closing its associated port.

6. A well packer as defined in claim 5, said one-way valve device comprising a hollow stem slidable within said port and having an opening transversely therethrough adapted to be closed by the walls of said port, and adapted to be moved outwardly to open position with said sleeve.

7. A well packer as defined in claim 5, said one-way valve device comprising a hollow stem slidable within said port and having an opening transversely therethrough adapted to be closed by the walls of said port and moved outwardly to open position within said sleeve, and a head on said stem contactable with the exterior of said body to limit inward movement of said stem.

8. In a well packer, a body adapted to be lowered in a casing and having a fluid passage, slips carried by said body for engagement with said casing, means for expanding said slips toward said casing comprising a packing sleeve encompassing said body to effect a seal between it and said casing, said body having one or more ports establishing communication between said passage and the interior of said sleeve, a valve device for each port comprising a stem slidable in each port and a head on said stem engageable with said packing to be urged thereby to seating engagement with said body to substantially close its associated port.

9. In a well packer, a body adapted to be lowered in a casing and having a fluid passage, slips carried by said body for engagement with said casing, means for expanding said slips toward said casing comprising a packing sleeve encompassing said body to effect a seal between it and said casing, said body having a port establishing communication between said passage and the interior of said sleeve, and a valve device for said port engageable with said packing to be urged thereby to close said port.

10. In a well packer, a body adapted to be lowered in a casing and having a fluid passage, slips carried by said body for engagement with said casing, a cone slidable on said body to expand said slips into engagement with said casing, a packing sleeve secured at one end to said cone and encompassing said body to effect a seal between it and said casing, said body having a port establishing communication between said passage and the interior of said sleeve, and a valve device for said port engageable with said packing to be urged thereby to close said port.

11. In a well packer, a body adapted to be lowered in a casing and having a fluid passage, upper and lower sets of slips carried by said body for engagement with said casing, a cone slidable on said body to expand said upper slips into engagement with said casing, a cone carried by said body to expand said lower slips into engagement with said casing, a packing sleeve secured to said cones and encompassing said body to effect a seal between it and said casing, said body having a port intermediate said cones providing communication between said passage and the interior of said sleeve, and a valve device for said port engageable with said packing to be urged thereby to close said port.

12. A well packer as defined by claim 11, said valve device comprising a hollow stem slidable in said port and provided with a transverse opening adapted to be positioned outwardly of said body by fluid under pressure, and a head on said stem engageable with said sleeve to be urged thereby to seating engagement against said body to close said port.

13. In a well packer, a body adapted to be lowered in a casing and having a fluid passage, a packing sleeve encompassing said body to effect a seal between it and said casing, said body having one or more ports establishing communication between said passage and the interior of said sleeve, means for compressing said sleeve to decrease its length and cause it to completely fill the intervening space between said body and casing, and a one-way valve device in each port contactable by said sleeve upon its compression to be moved thereby to a position substantially closing its associated port.

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