July 7, 1959 J. I. COPAS 2,893,493

TRAVELING SEAL AND PARAFFIN SCRAPER DEVICE

Filed March 17, 1955 2 Sheets-Sheet 1

Fig. 2

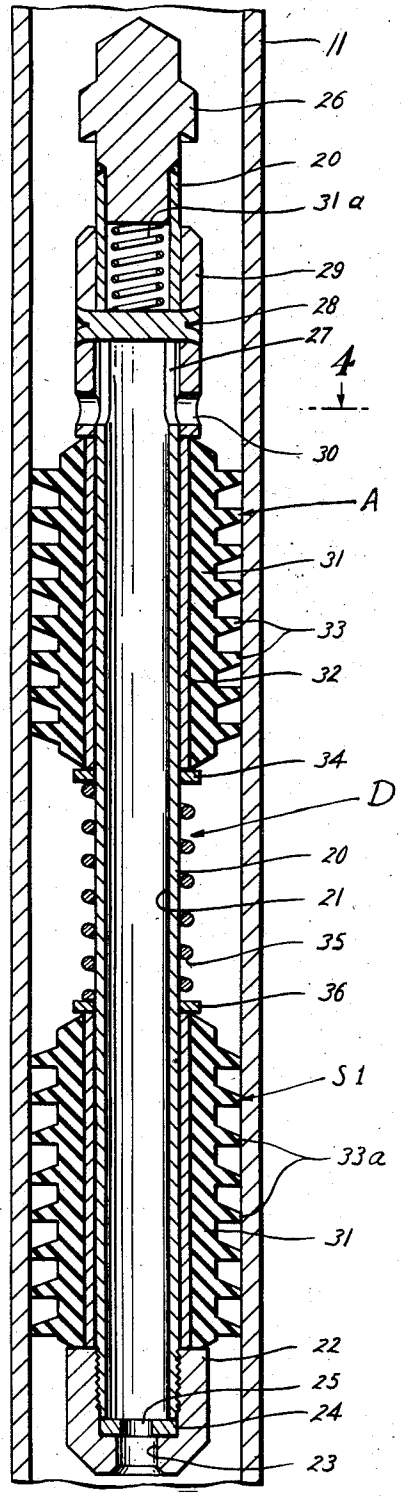

Fig. 1

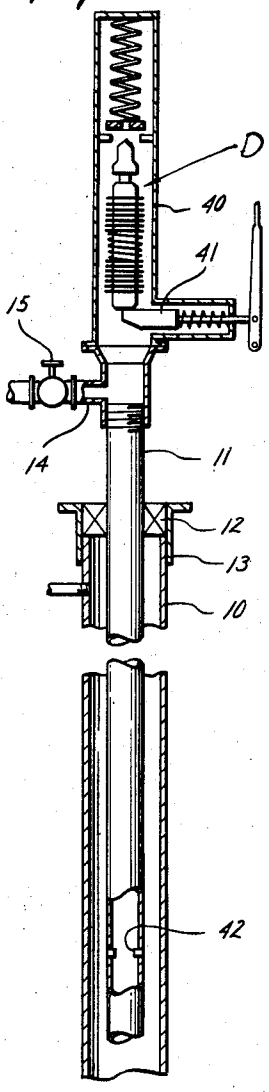

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Fig. 3

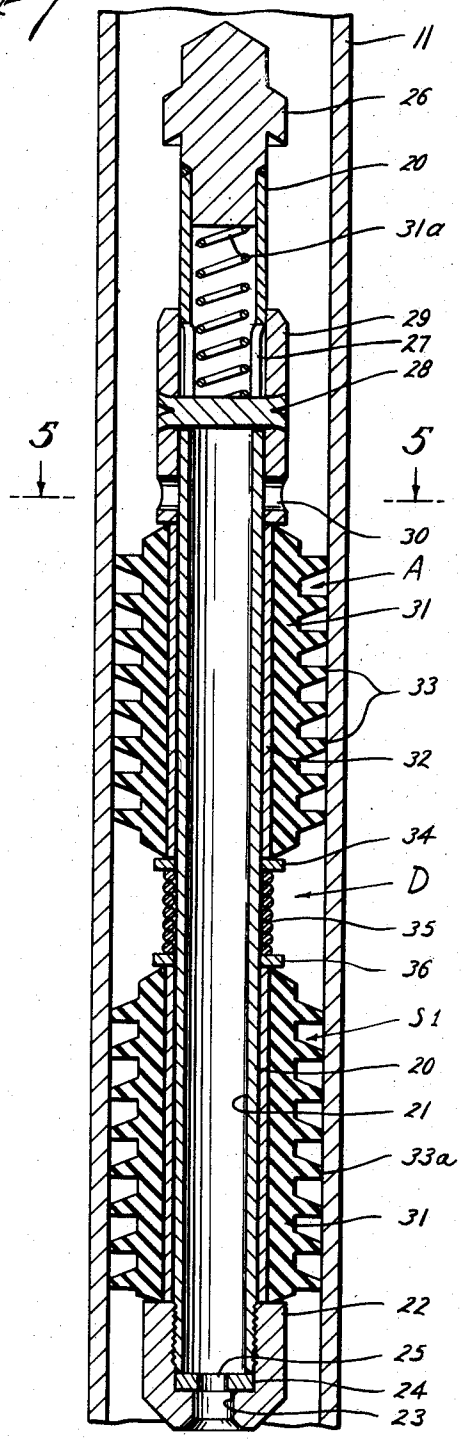


Fig. 4

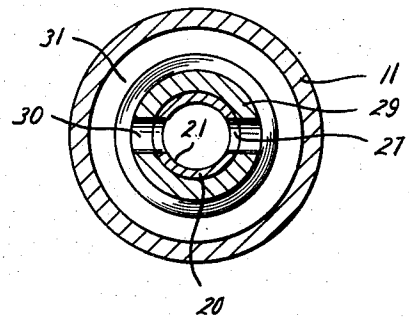
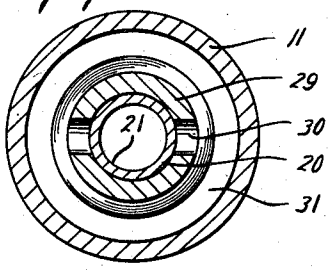


Fig. 5



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2,893,493

Patented July 7, 1959

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TRAVELING SEAL AND PARAFFIN SCRAPER DEVICE

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Application February 17, 1955, Serial No. 488,848

6 Claims. (Cl. 166—170)

This invention relates to new and useful improvements in a combination traveling seal and paraffin scraper device.

In gas lift operations wherein an auxiliary lifting gas is utilized to lift well fluids upwardly within a well tubing, it has been the usual practice to insert a sealing device, generally known as a "traveling rabbit" or piston, into the upper end of the tubing to permit it to fall downwardly through the fluid to be lifted to a point above the elevation at which the lifting gas is introduced. Such device functions to seal with the wall of the tubing bore and upon admission of the lifting gas is raised upwardly to the surface whereby the well fluid above the device is lifted to the surface. The primary purpose of the device is to separate or seal off the lifting gas from the well fluid being lifted to prevent said gas from channeling upwardly through said fluid which results in lessening the efficiency of the lifting operation. Normally the device is dropped into position just prior to the injection or introduction of the lifting gas into the tubing and is moved upwardly upon the subsequent introduction of said lifting gas.

It is one object of the invention to provide an improved device of the piston type for sealing off between the well fluid and the lifting gas which is extremely simple and inexpensive in construction, which has an ample by-pass therethrough on its downstroke to assure proper lowering into position and which is extremely effective in its sealing action on the upstroke, whereby the device not only functions to sealingly separate the lifting gas from the well fluids but also acts as a paraffin scraper to clean the bore of the well tubing.

An important object is to provide an improved sealing device having a sealing element mounted thereon, together with a sleeve type by-pass valve which is automatically actuated in accordance with the direction of movement of the device through the well pipe; said valve being opened upon the downstroke or downward movement of the device and being automatically moved to a closed position upon the upstroke.

A further object is to provide a device of the character described wherein control of the sleeve valve is effected by means of a slidably mounted sealing element which element is moved by the fluid load thereof or by the frictional engagement of the element with the pipe, whereby opening and closing of the valve is controlled in accordance with the direction of movement of the device through the well pipe.

The construction designed to carry out the invention will be hereinafter described together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

Figure 1 is a schematic view of a well tubing and illustrating a device, constructed in accordance with the

invention, disposed in a catcher at the upper end of said tubing;

Figure 2 is a longitudinal, sectional view of the combined sealing and paraffin scraper device and illustrating the parts thereof in their respective positions while the device is moving downwardly through the tubing;

Figure 3 is a similar view with the parts in their respective positions during upward travel of the device;

Figure 4 is a horizontal, cross-sectional view taken on the line 4—4 of Figure 1; and

Figure 5 is a horizontal, cross-sectional view taken on the line 5—5 of Figure 2.

In the drawings, the numeral **10** designates a well casing through which a well tubing **11** extends. As is well known, the annular space between the casing and the tubing is sealed off by a suitable packing **12** within a casinghead **13**. The well fluids which are being produced flow upwardly through the well tubing and are discharged therefrom to an outlet line **14** having a suitable control valve **15** mounted therein. When well fluids are produced by means of gas lift it is the usual practice to control the admission of the auxiliary lifting gas into the tubing by means of a suitable flow valve (not shown) which is disposed at some point in the lower portion of the tubing below the normal well fluid level therein. Sufficient time is permitted to elapse between intermittent operation of the flow valve so that well fluids may enter the tubing string and rise upwardly therein to a predetermined level. Upon the admission of the auxiliary lifting gas, said gas functions to lift the well liquids upwardly within the tubing string to effect their discharge through the outlet **14**.

It has been found that the charge of lifting gas tends to channel upwardly through the well fluids whereby the gas lifting operation is interfered with and to overcome this objection it has become the general practice to lower a sealing device downwardly through the well fluids to some point just above the point of admission of the lifting gas. Upon introduction of the lifting gas said device seals with the wall of the tubing and separates the gas from the liquid which is being lifted and in this manner the full effect of the lifting gas is obtained. It has also been found that each head of fluid usually results in the deposit of paraffin upon the wall of the tubing, usually toward the upper end thereof.

The present invention provides an improved device which may be termed a combination sealing and paraffin scraper device and which accomplishes the separation of the lifting gas from the fluid being lifted while at the same time removing any paraffin deposits which may have accumulated on the wall of the tubing.

The device of this invention is generally indicated by the letter A and is shown in detail in Figures 2 to 5. The device includes a central tubular support or mandrel **20** which has an axial bore **21** extending entirely therethrough. An enlarged collar **22** is threaded onto the lower end of the support or mandrel and is formed with an axial opening **23** which communicates with the bore **21** of said support. A choke ring **24** is adapted to be supported upon an internal shoulder provided within the collar **22** and this choke has an opening **25** of predetermined size which functions to determine the rate of downward movement of the assembly through the well fluids in the tubing, as will be hereinafter explained.

The upper end of the support or mandrel **20** has a suitable fishing neck **26** welded or otherwise secured thereto and below the fishing neck said support is formed with a pair of diametrically opposed slots **27**. A transversely extending pin **28** has its ends projecting through the opposed slots **27** with said ends being secured within the wall of a tubular sleeve valve **29**. As is clearly shown in Figure 2, the sleeve valve surrounds the upper portion

of the support or mandrel **20** and is movable longitudinally thereon within the limit of the length of the slots **27**. The sleeve valve is formed with exhaust ports or openings **30** which are located at its lower end. A coil spring **31***a* which is disposed within the bore of the support or mandrel and which is confined between the fishing neck **26** and the transverse pin **28** normally urges the sleeve valve **29** to the position shown in Figure 2, in which position the ports **30**, together with the slots **27**, establish communication between the bore **21** of the mandrel or support and the annular space or area exteriorly of said mandrel. When the sleeve valve is in a lowered position relative to the mandrel, as shown in Figure 3, the ports **30** move below the slots **27** and are in effect closed to shut off communication between the bore **21** of said mandrel and the area exteriorly of the device.

A valve actuating member A, which is shown as comprising a sealing element, is mounted to slide on the mandrel **20** and may be of any suitable construction. The sealing element is illustrated as constructed of an elastic body **31** having annular sealing rings **33**, which body is moulded or secured to a metallic tube **32**. As will be explained, the member A is subjected to fluid load or has the periphery of the rings **33** in frictional engagement with the tubing bore so that movement of the mandrel **20** relative to the member A results in opening and closing the sleeve valve. Although the sealing element which is illustrated has been found satisfactory, the invention is not to be limited to this exact construction and other types of actuating members may be employed.

The actuating member A is confined between the sleeve valve **29** and a retainer ring **34**, and a coil spring **35** which encircles the support or mandrel has its upper end engaging the ring **34**. The lower end of the spring **35** contacts a ring **36** which engages the upper end of a piston element **S1**. The piston element is preferably in the form of an elongate sealing means comprising a body portion having annular sealing rings **33***a* similar to the rings **33** of the upper member A; however, since the piston primarily functions to raise the device when pressure is introduced therebelow, it is evident that the rings **33** need not engage the wall of the pipe because so long as said rings are in close proximity to the wall, sufficient restriction is created to cause the lifting action to be carried out. To perform the paraffin scraping function it is desirable that the periphery of the ring sealingly engage the pipe wall. The lower end of the piston **S1** rests upon the upper end of the collar **22** which is secured to the lower end of the mandrel and upon movement of the device, said piston substantially prevents the passage of lifting gas upwardly past the device.

In the operation of the device A, said device is normally retained within a tubular housing **40** which is preferably connected to the upper end of the tubing string **11** as illustrated in Figure 1 and is held therein by a retractable plunger **41** which upon retraction will release the device A to permit it to fall downwardly through the well tubing.

When the device A is dropped downwardly through the tubing **11** the parts are in the position shown in Figure 2. In such position the spring **35** is holding the actuating member A upwardly with respect to the piston element **S1** while the spring **31***a* is maintaining the sleeve valve **29** in its lowest position with respect to the support or mandrel. It is pointed out that if the rings **33** of the element which forms the actuating member are in engagement with the wall of the tubing the frictional drag of the rings on the tubing wall assist in maintaining the valve open during downward movement of the device. The opening **25** through the choke ring **24** controls the rate of descent of the device and it is evident that by changing the size of the opening **25** the speed of downward travel of the device as it falls through the liquid in the well tubing may be controlled.

The device A falls downwardly through the tubing until

it strikes a stop or shoulder **42** (Figure 1) which is provided within the bore of the tubing at an elevation which is preferably just above the point of admission of the lifting gas into said tubing. The device remains at this position until lifting gas is admitted or introduced into the tubing and said gas acts against the piston **S1** to move the sealing members **33** of said sealing element into sealing engagement with the wall of the tubing; thereafter the device A as well as the well liquids thereabove begin to move upwardly within the tubing string. As soon as an upward movement of the device begins, the frictional resistance or drag of the rings **33** of the actuating member A as well as the fluid load which is acting upon said rings **33** to urge the same into tight contact with the wall of the tubing, tends to cause the piston **S1** to be moved upwardly with respect to actuating member A, such movement being permitted by collapse of the spring **35**. The parts thus move to the position shown in Figure 3 so that the piston **S1** is moved closer to the actuating member, with said actuating member sliding downwardly on the mandrel. At the same time the coil spring **31***a*, which is constantly acting upon the sleeve valve **29** to urge said valve to its lowermost position moves said valve downwardly on the mandrel, whereby the exhaust ports **30**, which permitted a free by-pass of fluid during lowering, are closed, and thereafter the device A as well as the well fluids thereabove are lifted to the surface.

It is evident that the fluid load acting on the rings **33** of the actuating member maintains said rings in frictional contact with the wall of the bore while the pressure of the lifting gas below the device maintains the rings of the piston **S1** in tight sealing contact with said wall. Thereafter, as the well fluids are lifted and the device D moves upwardly through the tubing, the walls of the tubing are scraped or cleaned of any paraffin which might have accumulated during lifting of the preceding head of fluid. The device functions to separate and substantially seal off the well fluids from the lifting gas and at the same time provides for the removal of any paraffin which may be present on the wall of the tubing bore.

When the device reaches the surface it moves past the spring-pressed plunger **41** and into the housing **40** where it is retained until the next operation. It is pointed out that the device is extremely simple in construction and provides the sleeve valve control which permits large exhaust ports to be provided, whereby rapid lowering of the device through the well fluid may be accomplished while at the same time providing a tight shut-off of fluid during the upward travel. Attention is called to the fact that both the piston element **S1** and the actuating member A are shown as slidable upon the mandrel in which event the spring **35** is necessary to hold these elements apart; however, if the piston is secured to the mandrel the spring **35** may be omitted and in such event the frictional drag on rings **33** of the member A or the pressure or load acting thereagainst as the device moves through the pipe will effect the sliding movement of the member A on the mandrel to open and close the valve.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim is:

1. A combined sealing and paraffin scraper device adapted to be inserted within a well pipe and including, a tubular mandrel having an external abutment on its lower end and a radially-directed opening at its upper end, the upper end of the mandrel being closed, a piston element supported on the abutment, an annular actuating member slidable on the mandrel and spaced above said piston element, said member having means engageable with the wall of the pipe in which the device is

disposed for creating a frictional drag, a sleeve valve encircling the mandrel above the actuating member element and engageable by said actuating member, said sleeve valve co-acting with the opening in the mandrel to open and close the same in accordance with the position of the valve on the mandrel, and stop means for limiting the upward movement of both the sleeve valve and actuating member on the mandrel, the sleeve valve being in open position when in its uppermost position on the mandrel, the piston element being acted upon by pressure from below, a higher pressure below the piston element moving the device upwardly in the well pipe and causing the piston element and mandrel to be moved upwardly relative to the actuating member and sleeve valve to effect a downward movement of the sleeve valve to close the opening in the mandrel.

2. A device as set forth in claim 1, wherein the piston element includes annular sealing members which are urged into contact with the wall of the well pipe by the pressure acting thereagainst during upward movement of the device within the well pipe, whereby said members remove paraffin accumulation from the wall of the pipe.

3. A device as set forth in claim 1, together with a choke means mounted in the lower end of the tubular mandrel for controlling the rate of descent of the device when the same is dropped through well fluids in the well pipe.

4. A sealing device adapted to be lowered into a well pipe for sealing the bore thereof, including, a tubular mandrel having a closed upper end, a piston element mounted on the mandrel, an annular member slidably mounted on the mandrel above the piston, resilient means for normally urging the annular member away from the piston element, whereby the annular member normally assumes a first position spaced from the piston, said annular member being movable against the pressure of the resilient means toward the piston to a second position which locates said member closer to said piston, valve means mounted on the mandrel and having a part engageable by the upper end of the annular member, said valve means being movable relative to the mandrel and adapted to control communication between the bore of the mandrel and the area exteriorly thereof above the annular member, said part on said valve means coacting with the annular member so that the valve means is open when the annular member is in its first position spaced from the piston and said means is closed when the annular member is moved toward the piston to its second position closer to said piston.

5. A sealing device as set forth in claim 4 wherein the resilient means normally holds the annular member spaced from the piston so that said annular member coacts with the part on the valve means to maintain said valve means open and also wherein the pressure below the device which acts upon the piston moves said piston toward the annular member to effect a closing of the valve means.

6. A sealing device adapted to be moved through the bore of a well pipe including, a support having a closed upper end and also having a fluid bypass passage therethrough, valve means slidable on the support for controlling flow through said bypass, an actuating member slidable on the support below the valve means and engageable therewith, said member having means frictionally engaging the wall of the pipe to retard movement of the actuating member through the pipe, a piston element mounted on the lower end of the support and exposed to the pressure below the device, and a spring means disposed between the actuating member and the piston element and normally urging these parts away from each other to a first position, the actuating member and element being movable toward the piston element to a second position which locates said member closer to said element, the actuating member located on the mandrel to maintain the valve means in open position when the member and piston are spaced farthest from each other in said first position, said actuating member and piston element being moved toward each other to said second position by the pressure acting upon the piston and moving said piston and support upwardly relative to the actuating member, movement of the piston element toward the actuating member to said second position permitting the valve means to close the bypass passage through the support.

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