Jan. 9, 1962 T. L. ABBOTT 3,016,094

PARAFFIN REMOVING VALVE ASSEMBLY FOR TUBING

Filed July 16, 1958 3 Sheets-Sheet 1

Fig. 1

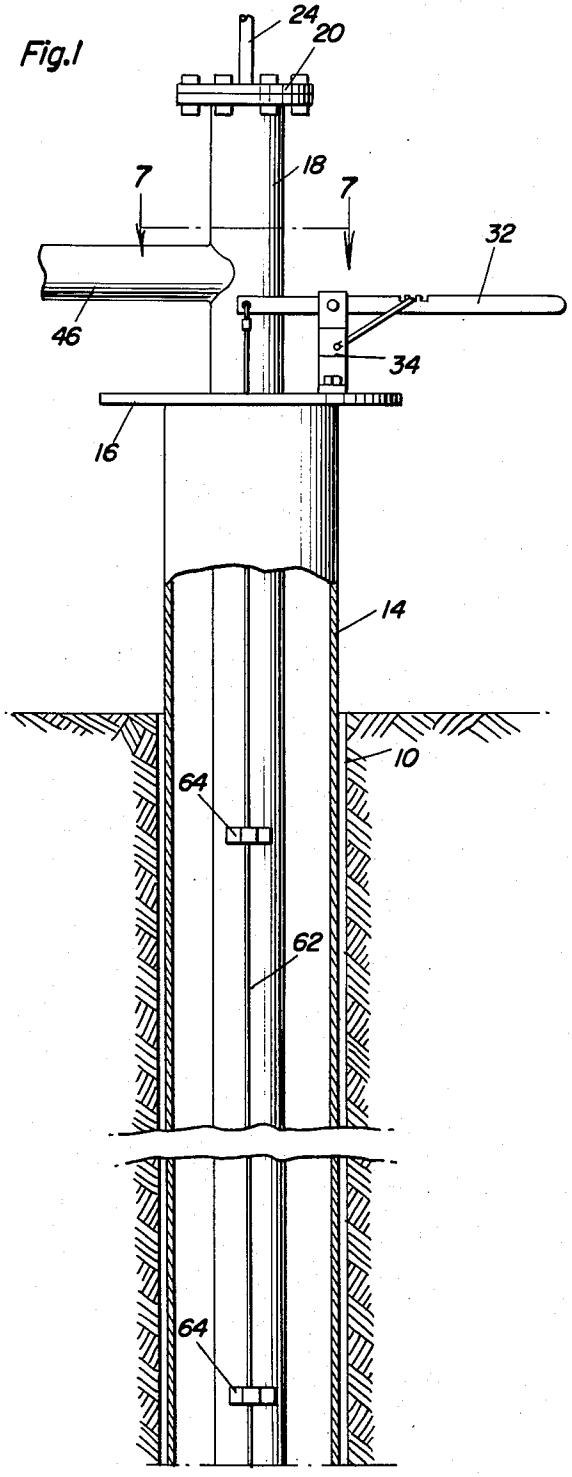
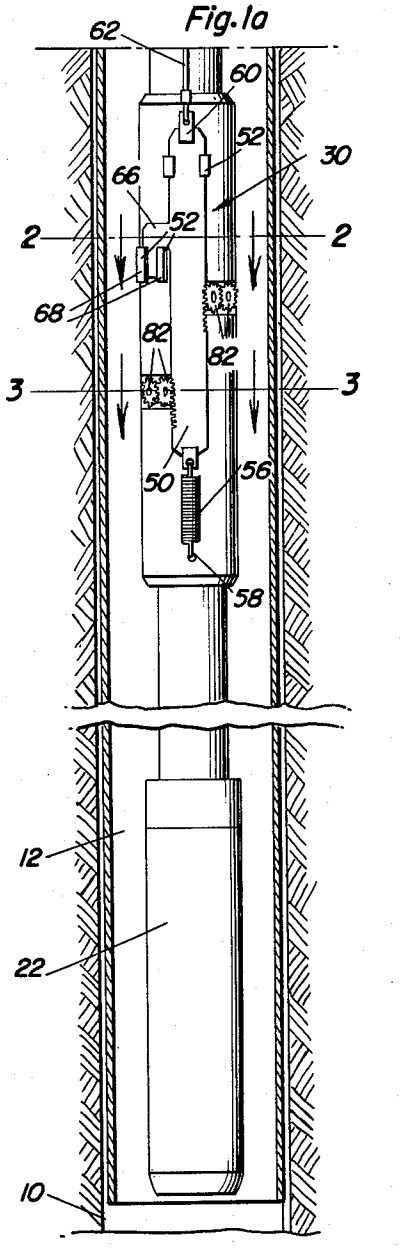


Fig. 1a



Tom L. Abbott
INVENTOR.

BY Clarence A. O'Brien and Harvey B. Jackson
Attorneys

Jan. 9, 1962 T. L. ABBOTT 3,016,094

PARAFFIN REMOVING VALVE ASSEMBLY FOR TUBING

Filed July 16, 1958 3 Sheets-Sheet 2

Fig.2

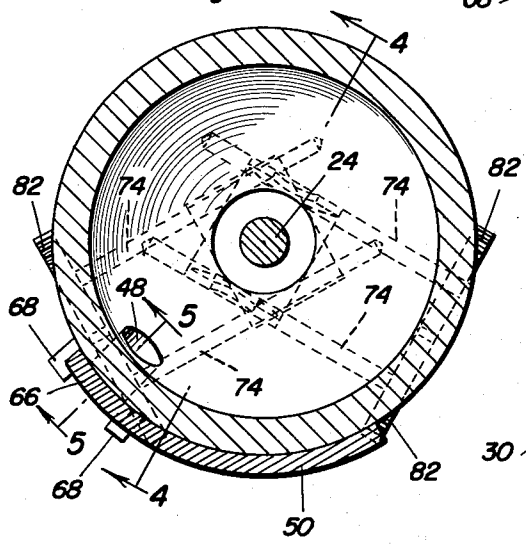


Fig.4

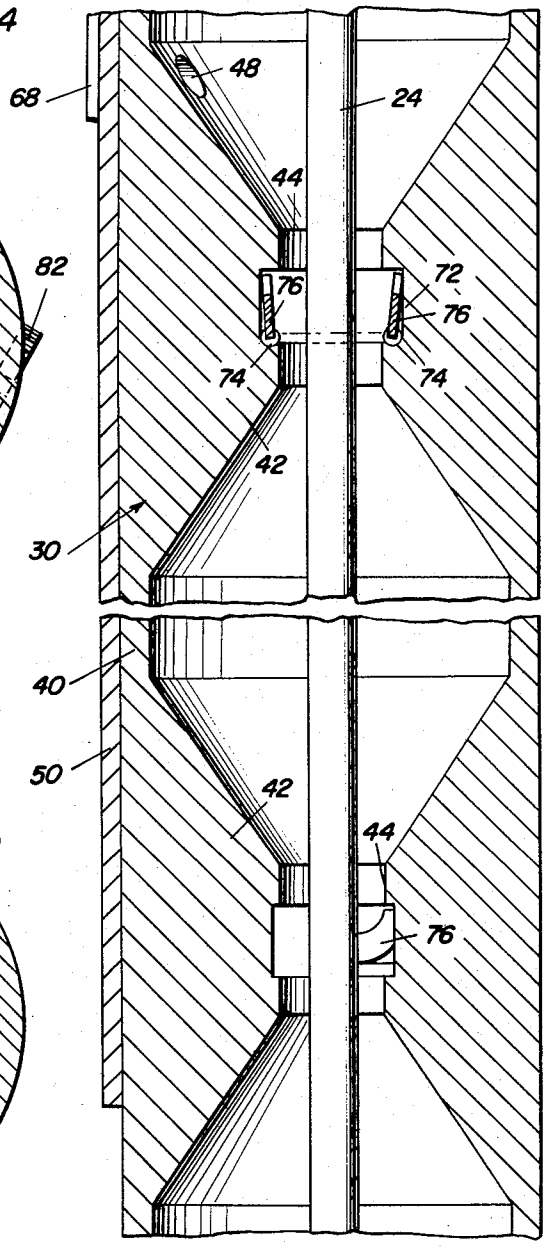


Fig.3

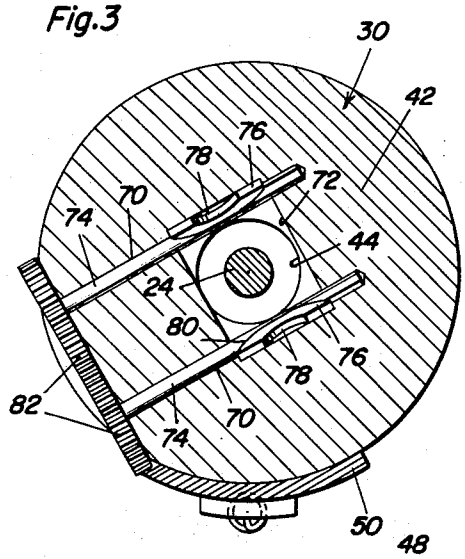
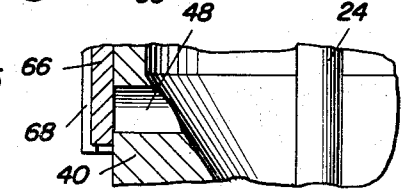


Fig.5



Tom L. Abbott
INVENTOR.

BY Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

Jan. 9, 1962 T. L. ABBOTT 3,016,094

PARAFFIN REMOVING VALVE ASSEMBLY FOR TUBING

Filed July 16, 1958 3 Sheets-Sheet 3

Fig.8

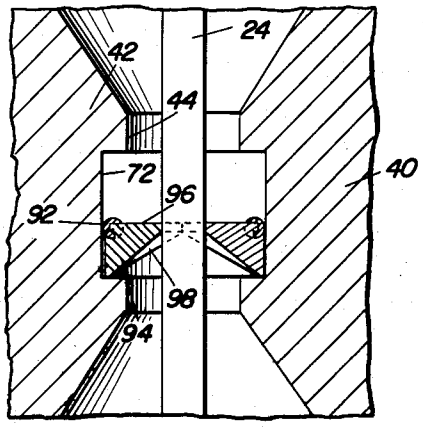


Fig.6

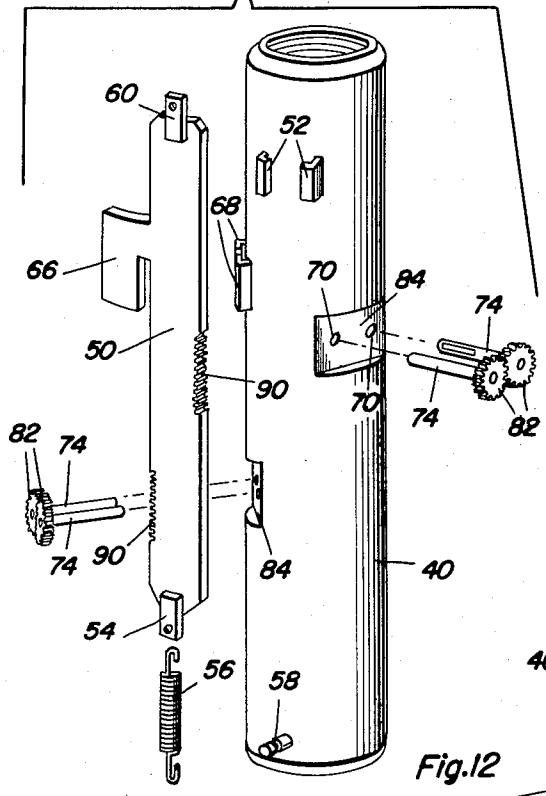


Fig.9

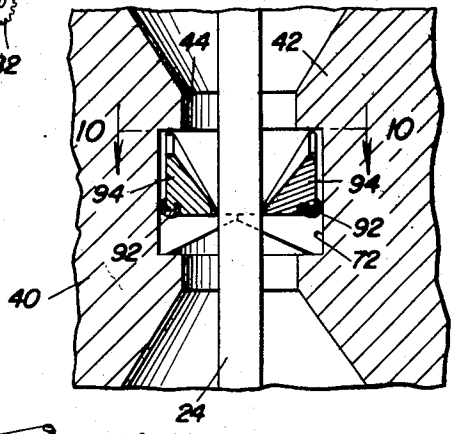


Fig.12

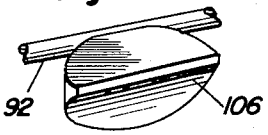


Fig.11

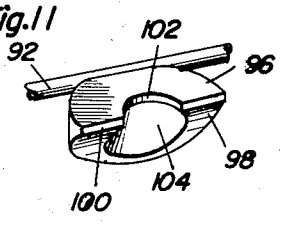


Fig.7

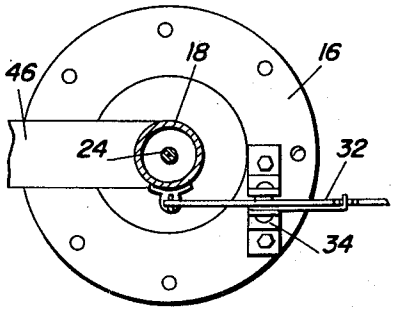
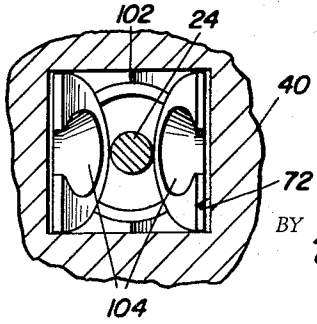


Fig.10



Tom L. Abbott
INVENTOR.

BY Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

United States Patent Office

3,016,094
Patented Jan. 9, 1962

3,016,094

PARAFFIN REMOVING VALVE ASSEMBLY FOR TUBING

Tom L. Abbott, P.O. Box 1002, Whiteface, Tex.

Filed July 16, 1958, Ser. No. 748,974
12 Claims. (Cl. 166—169)

This invention comprises a novel and useful paraffin removing valve assembly for tubing and more particularly relates to a means for more effectively and economically treating a well bore at predetermined regions thereof for removing paraffin deposits accumulating thereon.

In petroleum wells in which the reservoir pressure has been depleted to such an extent that the petroleum must be recovered therefrom by a pumping operation, it frequently occurs that the rate of pumping is detrimentally affected, sharply curtailed and even completely halted by virtue of the accumulation of paraffin deposits either in the well bore which prevents the inflow of petroleum from the oil producing horizon into the well bore, or in the tubing string of the pumping line thereby choking the flow of petroleum through the tubing string or halting the reciprocation of the pump sucker rods therein, or both. When this condition occurs, and in some wells it occurs repeatedly at relatively short intervals, it is usually necessary to pull the tubing string for the purpose of cleaning and removing by various methods the accumulation of paraffin upon the face of the well bore, or in the tubing string or both; or to resort to laborious operations for cleaning the paraffin deposits from within the tubing. In either event, production of the well is halted for periods of varying length, with a financial loss being involved thereby.

It is the primary purpose of this invention to provide an apparatus whereby paraffin deposits thus occurring may be quickly and easily removed without the necessity for pulling the tubing string or sucker rod, and with a minimum delay in the operation of the well.

Inasmuch as paraffin deposits regularly occur at fixed regions in a well bore depending upon various conditions of operation of the well, it is a purpose of this invention to provide an apparatus and a means whereby a paraffin removing agent may be effectively introduced into the well bore at the region of paraffin deposits for thus more effectively and economically removing the latter and restoring the production of the well.

Yet another object of the invention is to provide an apparatus in accordance with the immediately preceding object wherein the paraffin removing agent may be introduced into the well bore through the tubing string and may be effectively and accurately directed from the latter against that portion of the well bore upon which the paraffin deposits customarily accumulate.

A further and more specific object of the invention is to provide an apparatus and a means whereby the tubing string may itself be employed as a means for introducing a paraffin removing agent accurately and precisely at the region of paraffin deposits in a well bore without the necessity for withdrawing the tubing string from the well bore and with a minimum loss of time required for the performance of the paraffin removing operation.

A further and more specific object of the invention is to provide a means whereby a desired portion of a tubing string may be opened to the interior of the well bore and simultaneously therewith the passage through the tubing string may be sealed off and closed below this opening in order that a paraffin removing agent may be introduced into the tubing string and then discharged from the latter at the predetermined location in the well bore.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURES 1 and 1A are perspective views somewhat diagrammatic and partly in vertical elevation and partly in vertical section through the upper and lower portions of a well bore showing a tubing string therein and the manner of applying the present invention thereto;

FIGURES 2 and 3 are horizontal sectional views taken upon an enlarged scale substantially upon the planes indicated by the section lines 2—2 and 3—3 respectively of FIGURE 1A;

FIGURE 4 is a vertical longitudinal sectional view taken upon an enlarged scale substantially upon the plane indicated by the section line 4—4 of FIGURE 2 and showing the disposition of the pull sealing means of this invention;

FIGURE 5 is a detail view taken upon an enlarged scale substantially in vertical transverse section upon the plane indicated by the section line 5—5 of FIGURE 2 and showing the manner in which the valve plate of this invention controls the valve port for discharging a paraffin removing agent from the tubing string against a region of paraffin deposit in the well bore;

FIGURE 6 is a group perspective view of the elements forming the valve assembly of this invention;

FIGURE 7 is a horizontal sectional view taken substantially upon the plane indicated by the section line 7—7 of FIGURE 1 and showing the means for controlling the operation of the valve and of the interconnected sealing means of this invention;

FIGURES 8 and 9 are detail views in vertical central longitudinal section showing a modified construction of sealing means in the closed or sealed position and in the open position thereof respectively;

FIGURE 10 is a horizontal sectional detail view taken substantially upon the plane indicated by the section line 10—10 of FIGURE 9;

FIGURE 11 is a perspective view of one of the complementary bodies of a sealing means; and

FIGURE 12 is a perspective view of a complementary body of a modified form of sealing means.

Reference is made first to FIGURES 1 and 1A for an understanding of the manner in which the principles of this invention are applied and the environment for use of this invention. Indicated by the numeral 10 is a well bore which extends into the earth into a productive oil bearing formation, in which the fluid to be produced stands therein as shown at 12. Preferably this well bore is cased as at 14, there being provided the usual casing head 16. As shown in FIGURE 1A, this casing extends into the oil producing region. However, it will be understood that in accordance with conventional practice the casing may terminate above this oil producing region or if extended thereinto, is preferably perforated in accordance with conventional practice to permit the inflow of petroleum 12 into the well bore.

Shown at 18 is a string of tubing having a tubing head or closure 20 in its upper end and which tubing string extends to the lower end of the well bore and carries a conventional form of reciprocating pump as at 22 by means of which fluid 12 accumulating in the well bore may be pumped to the surface through the reciprocation of a conventional sucker rod 24 which is connected to the pump. Inasmuch as the pump itself and its sucker rod are conventional, as well as the association of the

same in the tubing string 18, a further description of the same is deemed to be unnecessary for the purposes of understanding the invention claimed hereinafter.

In wells being pumped and which are subject to periodic accumulations of paraffin therein, it has been noted that such paraffin deposits usually tend to accumulate at the same position or vertical elevation in the well bore or tubing, forming deposits upon the walls of the same. In accordance with the present invention there is provided a valve assembly designated generally by the numeral 30 which comprises a casing or body forming a section of the tubing string 18 and above the pump 22 thereof as shown in FIGURE 1A. A manually operated control lever 32 may conveniently be journaled upon a bracket or support 34 carried by the casing head 16 for effecting operation of the valve assembly 30, when paraffin deposits are to be removed from the interior of the tubing string or the well bore, as set forth hereinafter.

Reference is next made more specifically to FIGURES 4 and 6 wherein it will be seen that the valve assembly 30 consists of a cylindrical body 40 having a hollow passage therethrough which is placed in communication with the immediately adjacent upper and lower sections of the tubing string 18, and which receives the sucker rod string 24 therethrough. As shown in FIGURE 4, the interior of this hollow body 40 is provided with a plurality of longitudinally spaced radially inwardly projecting annular portions each designated by the numeral 42. While two such portions are shown, it will be understood that any desired number of these may be provided for a purpose to be subsequently set forth.

Each of these portions has a centrally disposed generally cylindrical throat 44 through which fluid from the reciprocating pump 22 may pass upwardly through the tubing string upon reciprocation of the sucker rod 24, to be subsequently discharged from the tubing string as by the delivery conduit 46, see FIGURE 1 and FIGURE 7.

Disposed above the uppermost of the annular portions 42 is a discharge port 48 extending through the wall of the section 40. The disposition of this port is also shown in FIGURES 2 and 5. This port constitutes a means whereby a paraffin removing agent such as hot oil, or any other suitable fluid may be discharged from the interior of the section 40 and the interior of the tubing string thereabove to the exterior thereof.

A vertically elongated plate 50 of substantially uniform width and thickness is transversely curved in accordance with the contour of the surface of the pipe against which the same is placed, as shown in FIGURE 2, and is slidable longitudinally of the section 40 between a pair of brackets or lugs 52 which comprise guides therefor and which are mounted upon the casing section 40. Although but two such guides 52 have been provided, it will be understood that additional sets of the same may be provided as desired. At its lower end, the plate 50 is provided with an apertured depending lug 54 which is engaged by a tension spring 56 anchored as upon a pin 58 upon the lower portion of the section 40 to yieldingly urge the plate 50 into its lowered position. At the upper end of the plate there is provided an apertured upstanding lug 60 to which is secured a cable 62, the latter extending through suitable guide brackets 64 upon the exterior of the tubing string and projecting upwardly through the casing head 16 for attachment to the actuating lever 32. It will thus be evident that upon operation of the lever 32, the member 50 will be raised against the resistance of the spring 56, and upon release of the lever will be returned to its original position by the action of this spring.

Projecting laterally from the upper portion of one edge of the plate 50 is an arm 66, see FIGURE 1A and FIGURE 2, and which lies substantially parallel to or in side-by-side relation to the plate 50. The arm 66 constitutes a valve member which overlies and is slidable upon the valve opening or port 48, and there are preferably provided a pair of guide lugs 68 upon the exterior surface of the section 30 for guidingly receiving this valve plate. It will thus be apparent that the previously mentioned guide lugs 52 and the lugs 68 engaging respectively the plate 50 and the arm 66 thereof may serve to confine the plate 50 to rectilinear vertical reciprocation upon the exterior of the casing 30.

Referring now primarily to FIGURES 2, 3 and 6 it will be observed that each of the annular enlargements 42 has a pair of transversely extending bores 70 therethrough which bores are disposed in preferably side-by-side and parallel relation as shown in FIGURE 3 and which bores intersect a laterally enlarged chamber 72 in the throat 44. Journaled in these bores are a pair of axles 74 having fixed thereto semi-annular disks 76. The pair of disks 76 comprise complementary sealing bodies.

As will be observed from a comparison of FIGURES 3 and 4, the disks 76 have arcuate inner and outer sealing surfaces 78 and 80 respectively which respectively engage and establish a fluid tight sealing engagement with the exterior surface of the pump sucker rod 24 and the concave surface of the throat 44 of each projecting portion 42 when the disks are in their closed positions. In their open position, as shown at the upper part of FIGURE 4 as well as in FIGURE 3, the disks are retracted into the chamber 72 thus providing unobstructed flow of fluid through the throat 44. However, when the disks are moved into horizontal alignment with each other they will constitute a partition sealing and closing the throat 44 by engaging the concave internal surface of the throat and the convex surface of the sucker rod 24 therethrough.

Where the pair of axles 74 extend to the exterior of the casing section 40, they are provided with interconnecting gears 82, and the exterior surface of the casing section 40 is notched or cut away circumferentially as at 84 to receive and house these gears as will be more readily apparent from FIGURE 6.

Each of the annular enlargements 42 has a corresponding structure of the throat 44, the laterally enlarged chamber 72, the set of complementary sealing bodies 76, the axles 74 and the bores 70 therethrough, together with the recess 84 and the interconnecting gears 82.

A connecting means is provided between the plate 50 and the sealing members 76 in order to effect simultaneous operation thereof. It will be observed from FIGURES 2 and 6 that the two annular enlargements 42 as illustrated have their pairs of sealing members circumferentially spaced from each other a sufficient distance to permit the disposition of the plate 50 between the adjacent edges of these two slots 84. The opposite edges of the plate 50 are provided with rack teeth 90 which each engage one gear 82 of a set of the axles 74.

The arrangement is such that when the plate 50 is in its lowered position so that the valve element 66 thereof closes the port 48, the sealing members will be in their open position as shown in FIGURES 3 and 4. This position is the normal position of the device, being retained by the tension of the spring 56, and is the condition prevailing when the well is being pumped by the sucker rod 24. However, when the member 50 is raised by manipulating the lever 32 and cable 62, the plate 50 will be raised thereby causing the valve member 66 to uncover the valve port 48, and simultaneously rotating the sets of axles 74 with their associated complementary sealing members 76 to thereby close and seal each of the throats 44.

When this latter condition prevails, a paraffin removing agent such as hot oil or any other suitable substance may be introduced through the tubing string, and will be prevented by the two or more sets of sealing members from passing downwardly through the tubing string into the pump, and will be discharged through the valve port 48 to the exterior of the tubing string.

It will be understood that the device **30** will be inserted in the tubing string at a proper position therein in order to position the port **48** at a desired location for treating a region in which paraffin deposits tend to accumulate. Thus the paraffin removing agent discharged by this device will be directed specifically and effectively against the paraffin deposits to be removed thereby.

It will also be noted that the port **48** may be located slightly below that region in the pump tubing string at which paraffin tends to accumulate, in order that when the port **48** is open and the sealing members closed, the treating fluid may be caused to circulate down and through the tubing, removing paraffin deposits therefrom, and be discharged into the well bore through the open port **48**.

In the form of the sealing or closure members **76** previously described, these members comprise semi-annular disk-like bodies. However, as shown in FIGURES 8–11, it is possible to form these members as segments of a sphere. Thus, in each of the enlargements **42** and within the throat **44** thereof there is provided the previously mentioned enlarged chamber **72**. However, in place of the axles **74** there are provided axles **92** having secured thereto the complementary bodies **94** comprising the sealing means. The bodies are so shaped that in radial cross-section, as shown in FIGURES 8 and 9, they are triangular, having a substantially flat upper surface **96** and a downwardly and outwardly sloping lower surface **98**, and terminating in edges **100** having semi-cylindrical notches **102** therein. From the notch **102** the body is centrally relieved as at **104**. The arrangement is such, as will be seen from a comparison of FIGURES 8, 9, and 10 that when the axles **92** and their attached bodies **94** are rotated to the position shown in FIGURE 8, the notch **102** of each body will establish a fluid tight sealing engagement with the sucker string **24**, while the semi-spherical exterior surface of these bodies will have a fluid tight sealed engagement in the chamber **72**. Thus, flow of fluid past the sealing members will be effectively prevented. However, when the bodies are in their open position shown in FIGURE 9, and in FIGURE 10, the bulk of the bodies will be retracted into the cubic space or chamber **72** thus providing by means of the cut-away portions **104** an effective open passageway through the throat.

The sealing members **76** are intended for use in a well being pumped. In FIGURE 12, there is illustrated a modified form of complementary body **106** which corresponds to the body **94** and which is intended for use in a free flowing well wherein there is no sucker string. Thus the body **106** has no cut out, such as the notch **102** and the relief **104**.

It will thus be apparent that there is provided by this invention a valve assembly which is always present in the tubing string which can be readily rendered operative to permit the introduction of a paraffin removing agent by merely manually manipulating the lever **62** on the casing head. When the cleaning operation is completed, the lever can be released, the valve plate **50** will move to its closed position by the spring **56** and the tubing string will again be ready for pumping operation.

Although there has been disclosed an apparatus for effecting the above mentioned paraffin removing operation, the present invention embodies a method of utilizing a tubing string which may form a part of a reciprocating pump assembly for effectively applying a paraffin removing agent to a predetermined region in a well bore; and which effectively closes the tubing string below the area to be treated to prevent the escape or loss of a paraffin removing agent therethrough.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A paraffin removing device for well bores having a string of tubing including a reciprocating pump therein together with a sucker rod reciprocable in said tubing and connected to said pump comprising, a section of tubing having a discharge port therein at a region of paraffin deposit in said well bore, a valve carried by said section controlling said port, movable sealing means in said section below said port and movable between a closed position obstructing fluid flow through said tubing and an open position permitting fluid flow therepast, means connecting said valve to said sealing means for simultaneously opening of said port and closing of said sealing means.

2. The combination of claim 1 wherein said valve comprises a plate slidable upon and conforming to the surface of said section at said port.

3. The combination of claim 1 wherein said valve comprises a plate slidable upon and conforming to the surface of said section at said port, guide means on said section and engaging said plate.

4. The combination of claim 1 wherein said valve comprises a plate slidable upon and conforming to the surface of said section at said port, guide means on said section and engaging said plate, said plate having a laterally offset arm overrunning and controlling said port.

5. The combination of claim 1 wherein said valve comprises a plate slidable upon and conforming to the surface of said section at said port, said plate being mounted upon the exterior of said section.

6. The combination of claim 1 wherein said sealing means comprises a body mounted in said section for oscillation about an axis extending transversely of the passage through said section, said body having sealing surfaces engaging the inside surface of said section and said sucker rod.

7. The combination of claim 1 wherein said sealing means comprises a pair of bodies each mounted in said section for oscillation about an axis extending transversely of the passage through said section, said pair of axes being in spaced side-by-side relation, said bodies having complementary inner and outer surfaces respectively establishing fluid tight sealing engagement with the sucker rod and the inside surface of said section.

8. The combination of claim 7 including gears connecting said bodies to each other for simultaneous rotation oscillation.

9. The combination of claim 1 wherein said sealing means comprises a pair of bodies each mounted in said section for oscillation about an axis extending transversely of the passage through said section, said pair of axes being in spaced side-by-side relation, said bodies having complementary inner and outer surfaces respectively establishing fluid tight sealing engagement with the sucker rod and the inside surface of said section and being connected to each other, said connecting means comprising a rack on said valve and a gear secured to one of said bodies.

10. The combination of claim 1 wherein said sealing means includes a body mounted in said section for oscillation about an axis extending transversely of the passage through said section, said body having sealing surfaces engaging the inside surface of said section and said sucker rod, said connecting means comprising a rack on said valve and a gear secured to said body.

11. The combination of claim 1 wherein said valve comprises a longitudinally straight plate which is transversely curved for sliding and seating engagement with the exterior of said section, said sealing means comprising a plurality of pairs of complementary bodies each mount-

ed in said section for turning about an axis transverse to the passage through said section, each pair of complementary bodies having sealing surfaces respectively engaging the inside of said section and said sucker rod to establish a fluid tight seal therebetween, means interconnecting the bodies of each of said pairs for simultaneous movement.

12. The combination of claim 11 wherein said connecting means comprises a rack on each edge of said plate and a gear engaging said rack and secured to one body of each pair of complementary bodies.

References Cited in the file of this patent

UNITED STATES PATENTS

1,360,053	Stumpf	Nov. 23, 1920
1,500,400	Larsen	July 8, 1924
2,300,348	Dana	Oct. 27, 1942