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2,804,149

OIL WELL HEATER AND REVIVER

Filed Dec. 12, 1956

2 Sheets-Sheet 1

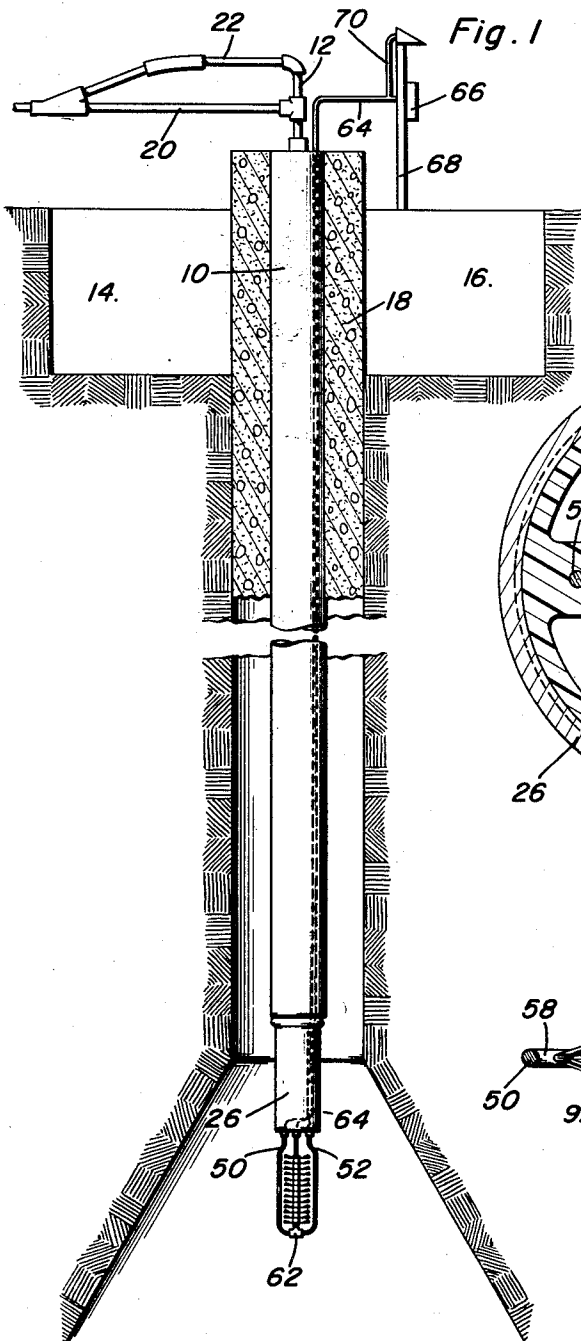


Fig. 1

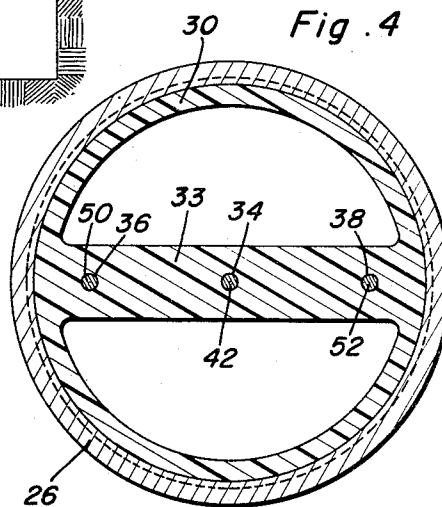


Fig. 4

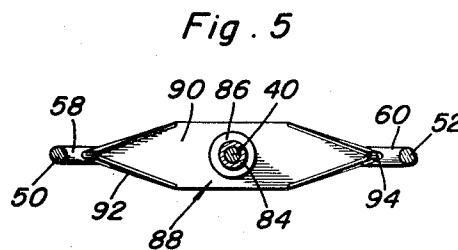


Fig. 5

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Fig. 3

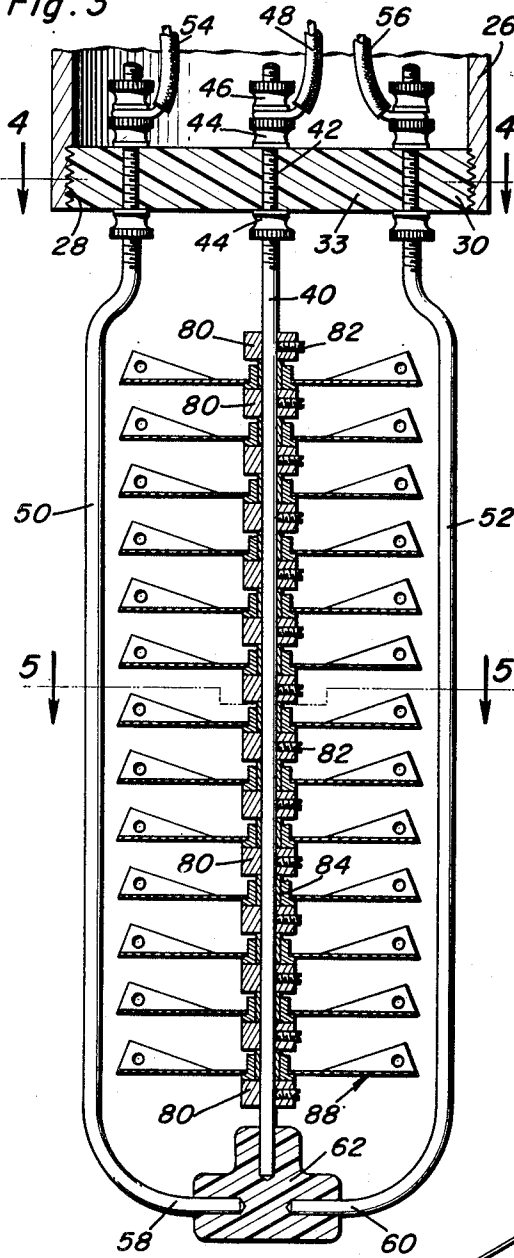


Fig. 2

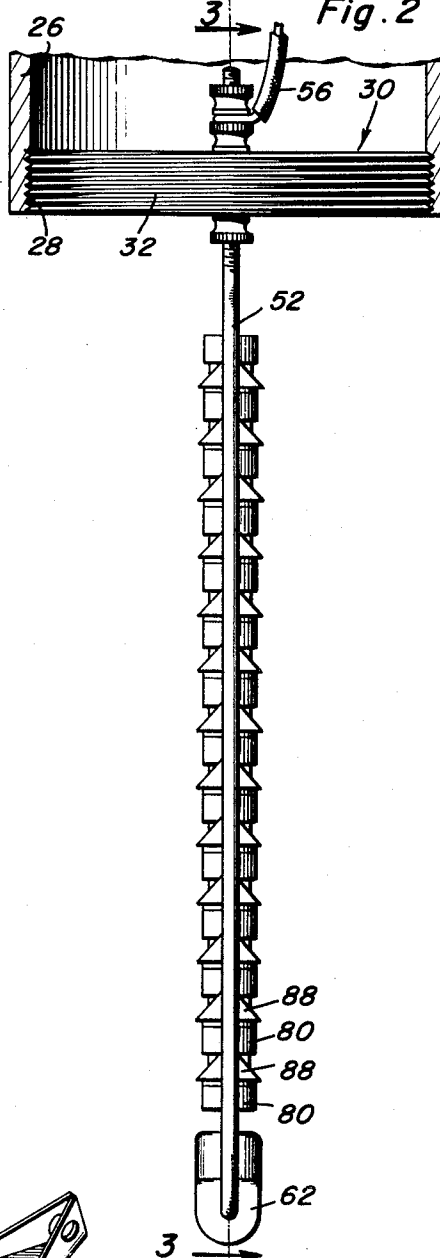
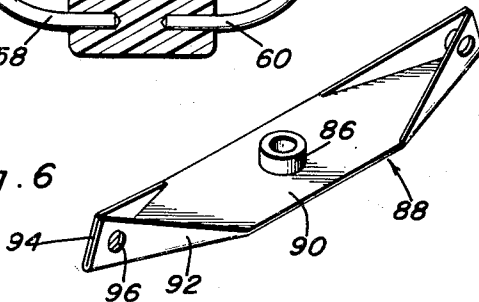


Fig. 6



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## OIL WELL HEATER AND REVIVER

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Application December 12, 1956, Serial No. 627,852

7 Claims. (Cl. 166—60)

This invention comprises a novel and useful oil well heater and reviver, and particularly relates to an electrical heating device for location in an oil well to melt and remove the paraffins, tars, asphalts, and the like therein which block and impede flow of oil from the formation into the well bore.

The present application contains subject matter found in my prior copending application, Serial No. 390,663, filed November 6, 1953, for Oil Well Reviver, and also includes subject matter constituting an improvement thereover.

In the operation of oil wells, it is found that after a period of time the wells frequently become choked by an accumulation of paraffins, tars, asphalts, and the like, which are present in the more volatile petroleum fluids in a productive formation, and which condense out of such fluids during the flow of the latter from the productive formation into the well bore, and which thereby substantially block the pores or interstices of the formation adjacent to the well so that the production of the well is materially decreased.

Various methods have heretofore been proposed for heating and removing these paraffins and removing them from the well so that the production of the well may be restored.

According to the present invention, a heating and agitating device is provided which may be mounted on a collar attached to the bottom of the well casing and extending into the vicinity of the blocked formation so that electrical current, supplied to the heating device and the agitating members or blades thereof may be utilized to produce heat for melting the paraffin or other deposits so that the pressure in the strata adjacent to the well may again cause a flow of petroleum fluid through the formation and into the well bore.

It is accordingly an object of the invention to provide an improved well heater for efficiently and effectively applying heat to a well bore in a manner effective to heat and dissolve paraffin and similar deposits and incrustations which obstruct flow of the fluid from the formation into the well bore.

It is a further object of the invention to provide an electrical heating device in accordance with the preceding objects wherein the electrical heating elements are susceptible of a random rotary movement whereby to prevent carbonaceous deposits and other deposits from the petroleum flowing into the well from forming thereon and thereby detrimentally affecting the flow of heating current through the device.

It is a further important object of the invention to provide a device in accordance with the foregoing objects wherein novel and effective electrical heating elements are provided and which elements are capable of a random rotary or oscillatory movement to thereby contribute to their useful life under the adverse conditions of operation encountered in well bores.

These, together with other objects and advantages which will become subsequently apparent, reside in the details of construction and operation as more fully here-

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inafter 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:

Figure 1 is a fragmentary sectional vertical elevational view of a well bore with parts broken away and shown in section, and showing an embodiment of an apparatus in accordance with this invention operatively applied to the lower end of the casing of the well bore;

Figure 2 is a view in end elevation of the apparatus shown in Figure 3, a portion of the apparatus being shown in vertical section;

Figure 3 is a vertical longitudinal sectional view through the apparatus of Figure 2 taken substantially upon the plane indicated by the section line 3—3 thereof;

Figure 4 is a horizontal sectional view taken substantially upon the plane indicated by the section line 4—4 of Figure 3 and showing the manner in which the heating and agitating elements of the apparatus are supported by a sleeve which is adapted to be secured to the lower end of a well casing;

Figure 5 is a horizontal sectional view taken substantially on the plane indicated by the section line 5—5 of Figure 3 and illustrating the construction of one of the movable electrical heating elements and agitating means of the device; and

Figure 6 is a perspective view of one of the movable heating elements.

In the exemplary embodiment according to the invention, a casing 10 is provided in a well bore with a tubing 12 through which oil may flow or may be pumped as may be desired. The usual pits 14 and 16 are provided adjacent the casing head and a filler of cementitious material 18 is provided adjacent the top of the casing as is well known. Flow lines 20 and 22 are connected to the tubing 12 to conduct the material pumped from the well to any suitable destination. The above described construction is standard and in itself forms no part of the present invention.

The heater and reviver according to the present invention comprises a sleeve 26 of any desired size, but preferably of a suitable size to pass through the casing 10. This sleeve is adapted to be secured to the lower end of the casing 10 and to be supported thereby in a manner which forms no part of the present invention, but which is set forth and claimed in my copending application, Serial No. 677,289 filed August 14, 1957.

At its lower end, it is preferred to provide the sleeve 26 with an internal thread as shown at 28 in Figures 2 and 3 which is adapted to receive and support a dielectric supporting member 30 which is externally threaded, as at 32, whereby the same may be engaged with the threads 28 of the sleeve 26. As shown in Figure 4, the member 30 consists of an annulus having a central opening or passage therethrough, and a diametrically disposed integral bar 33 extends across this passage. This bar is provided with a central aperture 34 and a pair of side apertures 36 and 38 for supporting the heating elements of the device as set forth hereinafter.

At this point, it should be understood that although the above described and herein illustrated manner of supporting the heater from the casing 10 is considered to be extremely effective and possesses numerous advantages, it is within the purview of this invention to employ any other suitable mounting and supporting means as may be desired.

Supported by the insulating bar 33 is a central electrical terminal 40 in the form of a substantially straight rod of bronze or other suitable material and which is externally threaded, as at 42, at its upper end which extends through the previously mentioned central bore or passage 34. Suitable lock nuts 44 serve to clamp this terminal rigidly to the bar 33 in a depending manner,

with the upper portion of the terminal extending above the bar for the reception of a binding post lock nut 46 by means of which an electric conductor 48 may be electrically connected to the upper end of the terminal 40.

A second pair of electric terminals 50 and 52 are similarly connected at their upper ends to the supporting member 32 and extend through the bores or passages 36 and 38, respectively, and in turn are connected to electric conductors 54 and 56.

As will be seen best from Figure 3, the upper ends of the terminals 50 and 52 are offset inwardly towards each other in a parallel relation in order to render more compact the attachment of the three terminals to the support member 33, while their lower ends 58 and 60 are returned towards each other. A substantially T-shaped dielectric block 62 is provided having sockets or recesses for receiving the two returned ends 58 and 60 of the pair of side terminals 50 and 52, and the lower end of the central terminal 40, to hold the same in securely fixed, spaced relation, and out of electrical contact with each other.

The three conductors 48, 54 and 56, as will be apparent from Figure 1, are received within a suitable cable 64 which may preferably be a lead sheathed cable which extends up the casing 10, will extend through a suitable aperture in the top of the casing and be connected to a control panel 66 mounted on a pole or other support 68 adjacent the top of the casing 10 and current will be supplied thereto through a cable 70 from any suitable source of supply. Preferably, the current supplied from the control panel 66 through the cable 64 is a three-phase current such as 220 volts, 440 volts, or the like, in order that there may be a potential or difference between the central terminal 40 and each of the other terminals 50 and 52.

As so far described, it will be understood that the stationary terminals 40, 50 and 52 comprise stationary electrical terminals for the heating device and the latter is provided with movable terminals cooperating therewith in a manner to be now set forth.

Referring now specifically to Figure 3, it will be seen that the central axial terminal 40 is provided with a plurality of spaced collars 80, each provided with a setscrew 82 whereby the collar may be secured to the terminal 40 in a longitudinally adjusted position. A plurality of electrically conductive spacing sleeves 84 are snugly received on the terminal 40 and are abutted at their opposite ends by adjacent collars 80 to thus provide a rigid assembly. Journalled upon each of the sleeves 84 is the tubular hub portion 86, also of bronze or other suitable electrically conductive material, and which carries a blade indicated generally by the numeral 88.

It is important to note at this point that by means of its supporting hub, collar or bushing 86, each of the blades 88 is mounted for free and random rotation or movement upon the spacer sleeve 84 carried by the terminal 40. Also, there is a slight axial movement permissible for each of the blades upon its spacer sleeve, as will be apparent from Figure 3.

Referring now particularly to Figures 5 and 6, it will be seen that the form of blade 88, which blades constitute movable terminals of the heating device, consists of a substantially flat rectangular plate 90 which have the triangular corners 92 at the four corners of the rectangle upturned at their ends along the medial line of the rectangular plate and the meeting edges 94 of the upturned triangular corners are rigidly connected together by any suitable means such as by welding or brazing. Preferably, these turned up corners are provided with apertures 96 therethrough.

The dimensions of the blades 88 are such that when the same are mounted as shown in Figure 3 upon the central terminal 40, the outer edges 94 of the blades will be in slightly spaced relation to the stationary terminals 50 and 52 to thus provide an arc between each blade and the terminals when electric current is supplied to the terminals. These blades are of a sturdy construction

inasmuch as the flat material of the plate 90 is reinforced by the upturned and connected triangular corner portions 92. This form of blade is particularly adapted for use in wells which, during operation, will have a very great rate of flow or be subjected to a very great pressure of the flowing fluid therethrough after they are producing and after the paraffin deposits have been melted from the face of the well bore.

The operation of the device is as follows: After a well has ceased to flow or has had its flow diminished by the forming of paraffin or like deposits upon the face of the formation in the well bore, this apparatus is lowered through the well casing, the tubing 12 being removed for that purpose, and secured in place at the lower end of the tubing in any suitable manner. Thereafter the tubing is replaced and electrical energy is supplied by the conductors 48, 54 and 56 to the stationary terminals 40, 50 and 52. Owing to the presence of the fluid in the well bore, there will be sufficient conductivity to permit the electric current to jump from the ends of each of the blades 88 to the adjacent terminals 50 and 52. Thus, there are provided a large number of arcs between the central terminal and the two outer terminals, which, passing through the fluid in the well, will quickly and effectively heat the same, this heat melting and dissolving the paraffin or similar obstructing deposits on the face of the formation in the well bore. As soon as these deposits begin to be dissolved or removed, the pressure of the fluid in the productive formation will force the gas and oil from the interstices of the formation into the well bore and, rising upwardly in the same, will pass upwardly through the flow line for recovery. Owing to the journaling of each of the blades for free rotation or pivotal movement upon the central terminal 40, there will be a random movement imparted to these blades by the flowing fluid from the well. This in turn will oscillate, turn and/or rotate the blades, and during such movement each time the blade registers with the electrodes 50 or 52 current will flow therebetween, thereby continuing the heating effect.

While the precise operation of the electrical heating is not definitely and completely understood, it is contemplated that owing to the random movement of the blades which form the movable electrical contacts of the apparatus, that arcing of various lengths and at irregular and varying intervals will be set up by the random movement of the blades.

If the blades were held stationary, carbonizing of the petroleum under the heat of the device would soon set up deposits between the blades and the stationary terminals which would effectively prevent the flow of current and the heating effect of the arcs. The random movement of the blades serves to prevent the same and thus to maintain the effectiveness of the electrical heating arcs for substantially indefinite periods of time. In addition, the agitation or movement of the blades tends to set up a turbulence or swirling movement of the oil, thereby facilitating the melting of paraffin by contact of the heated oil therewith, and still further accelerating the removal of paraffin from the formation.

As will be readily understood, the dissolved paraffin will pass upward through the flow tubing 12 with the restored flow of oil and thus be removed from the well bore.

It will be understood that the principles of this invention comprehend within their scope such obvious modifications as the omission of the conductor 48 and the supply of current to the central electrode 40 whereby the current will flow between the electrodes 50 and 52 by means of the interposed rotary blades 88. In such instance, the member 40 will serve solely as an axle or spindle for rotatably supporting the members 88.

It is also within the purview of this invention to omit one of the stationary electrodes 50 or 52, whereby current will flow from the remaining side electrode to the central electrode 40 by means of the rotary blades 88.

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. An oil well heater comprising a support, a pair of electrodes and a central electrode secured to said support and insulated from each other, means for supplying electric current to said electrodes, a plurality of electrically conductive movable terminal members each journaled upon said central electrode for random rotary movement thereon and in electrical contact therewith, said movable terminal members being in spaced operative relation to said pair of electrodes whereby to establish electric arcs therebetween, the random movement of said terminal members intermittently making and breaking said arcs and preventing the forming of deposits of paraffin and the like between said movable members and said pair of electrodes.

2. An oil well heater comprising a support, a pair of electrodes and a central electrode secured to said support and insulated from each other, means for supplying electric current to said electrodes, a plurality of electrically conductive movable terminal members each journaled upon said central electrode for random rotary movement thereon and in electrical contact therewith, said movable terminal members being in spaced operative relation to said pair of electrodes whereby to establish electric arcs

therebetween, the random movement of said terminal members intermittently making and breaking said arcs and preventing the forming of deposits of paraffin and the like between said movable members and said pair of electrodes, means for securing said heater to a well casing in a well bore.

3. The combination of claim 1 including a dielectric member securing the lower ends of said electrodes in rigid and electrically spaced relation.

4. The combination of claim 1 wherein said terminal members comprise flat blades having their side edges adjacent their ends upturned and rigidly secured together.

5. The combination of claim 4 including spacer sleeves on said central terminal, said blades being each journaled upon one of said spacer sleeves.

6. The combination of claim 1 wherein said central electrode comprises a shaft, a plurality of spaced collars secured to said shaft, each of said terminal members being journaled upon said shaft between a pair of adjacent collars.

7. The combination of claim 1 wherein said movable terminals each comprises a blade consisting of a flat rectangular body, the corners of said body having portions upturned and meeting on a medial plane of said body whereby to provide vertical edges and side surfaces inclined to the surface of said body.

References Cited in the file of this patent

UNITED STATES PATENTS

2,213,950 Crites ----- Sept. 10, 1940