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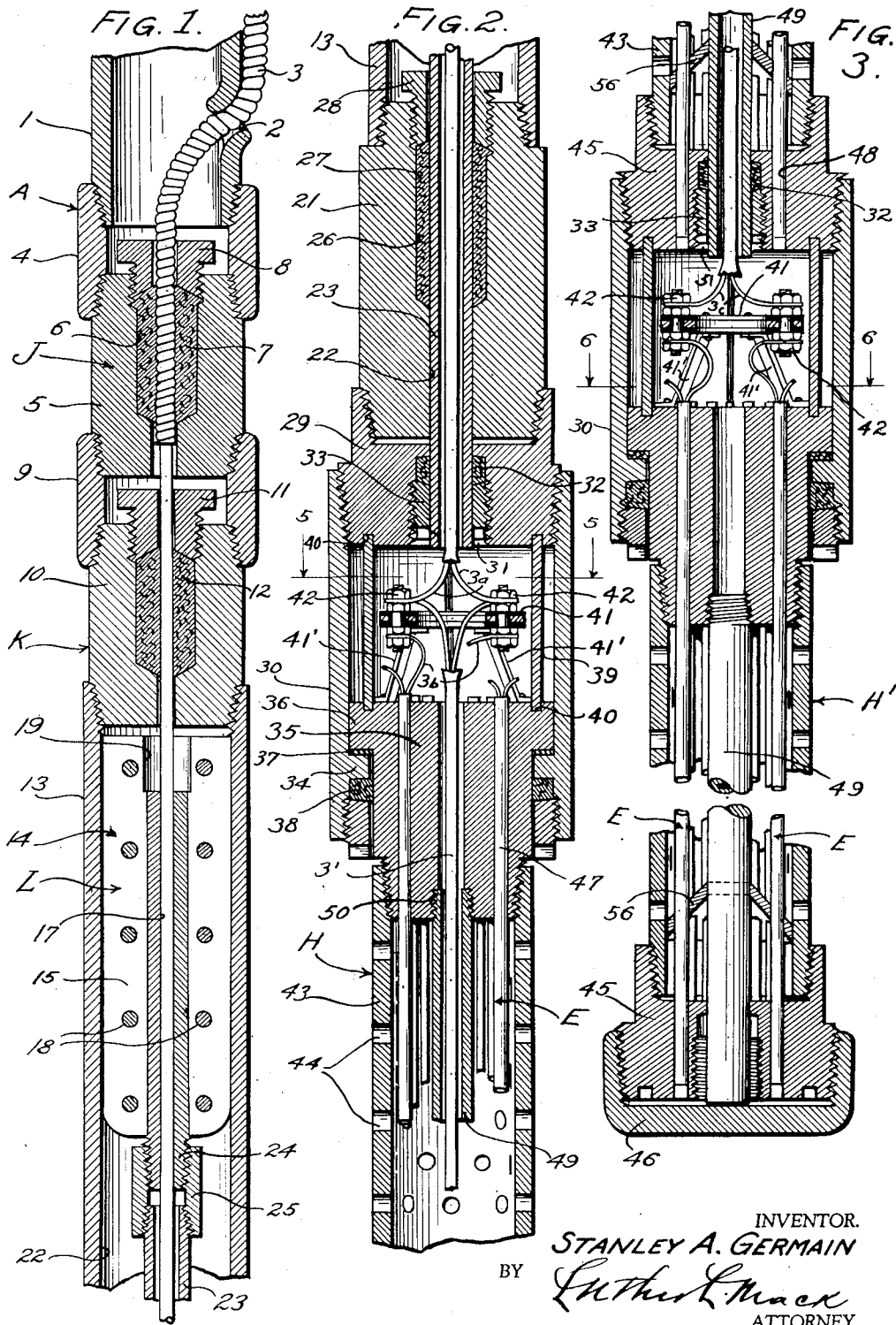
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ELECTRIC HEATER FOR OIL WELLS

Filed May 6, 1939

2 Sheets-Sheet 1



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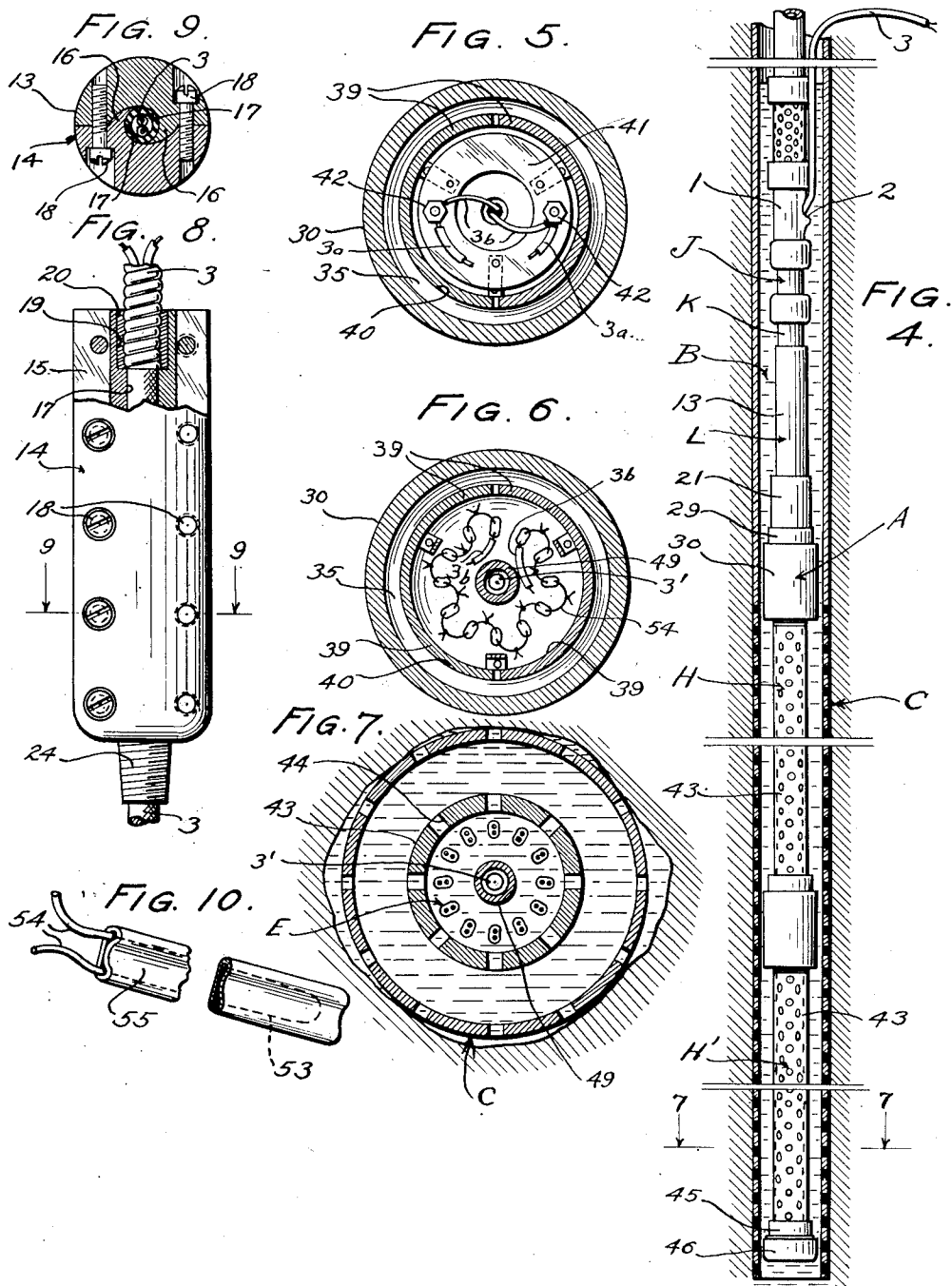
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ELECTRIC HEATER FOR OIL WELLS

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2 Claims. (Cl. 219—33)

This invention relates to improvements in electric heaters which are adapted to be lowered into oil wells for increasing the production thereof through the application of heat to the oil and oil bearing structures of such wells.

Electric heaters for oil wells as heretofore used have met with little or no success due primarily to failure resulting from leakage of oil and foreign matter into the heater and consequent impairment of the electrical conductors and heating elements therein, and also due to the practise of enclosing the heating elements in tubes or pipes in such manner that the applied heat is reduced to an extent rendering the heater ineffective or substantially so. Those heaters which have been temporarily effective for increasing production have not been capable of efficient operation for appreciable periods of time without costly and troublesome shut-downs, and too frequent repair and renewal of parts have been necessary due to the eventual leakage of oil as aforesaid as a result of faulty and poorly designed construction, and at best have not proven capable of a worthwhile increase in production of oil in consideration of the costs of the heating equipment and its maintenance and operation.

In consideration of the foregoing, it is a purpose of my invention to provide a highly efficient oil well heater which will prevent the leakage of oil into the heating elements through the electrical conductors or otherwise, and thereby eliminate electrical failures and insure an uninterrupted application of sufficient heat to appreciably increase the production of the well.

Another purpose of this invention is to provide an oil well heater of the character described wherein the heating elements and associated parts are of an especially improved construction and arrangement to insure an application of maximum heat thereby developed directly to the oil in which the heater is increased, and a free circulation of oil around and in contact with the outer surfaces of said heating elements.

A further purpose is to provide a heater such as described which may be advantageously used to increase the fluidity of heavy oils, hydrocarbons and other substances which become fluid when heated, whereby to facilitate the pumping and flow of such fluid into and out of tank cars, storage tanks and the like.

I have shown a preferred form of the invention in the accompanying drawings, subject to modification within the scope of the claims appended hereto, without departing from the spirit of the invention.

In the drawings—

Figures 1, 2, and 3 are fragmentary vertical sectional views respectively showing the upper, intermediate and lower portions of a typical multi-unit oil well heating apparatus embodying my invention;

Figure 4 is a fragmentary vertical section of a well showing a complete heating unit of my invention installed therein;

Figure 5 is a sectional view taken on the line 5—5 of Figure 2;

Figure 6 is a sectional view taken on the line 6—6 of Figure 3;

Figure 7 is sectional view taken on the line 7—7 of Figure 4;

Figure 8 is a fragmentary side elevation of one of the sealing devices;

Figure 9 is a section taken on line 9—9 of Figure 8; and

Figure 10 is a fragmentary perspective of one of the heating elements.

One form of heating apparatus embodying my invention as shown in the accompanying drawings generally includes a multi-unit heating apparatus A which may be suspended in an oil well B from the pump unit C or otherwise disposed in a well so as to apply heat to the oil and adjacent oil bearing strata at the desired points whereby to increase the fluidity of the heavy hydrocarbons and consequently increase the production of the well, it being understood that one or more heating units may be used as desired.

As here shown, a tubular section 1 is connected to the well pump C in any suitable manner and is provided with an opening 2 through which an electric conductor cable 3 is extended, said cable supplying electrical energy to the heater unit from a source (not shown) at the top of the well.

In accordance with this invention, a plurality of sealing devices are interposed between the coupling section 1 and the first heater unit H to prevent the leakage of oil along, on or in the cable and conductors into the heating elements. Any number of sealing devices may be used but as here shown three are employed and are designated J, K, and L, respectively. I may use one or more of any of the sealing devices J, K, and L.

The uppermost sealing device J comprises an internally threaded coupling sleeve 4 threadedly coupled with the lower end of the section 1 and the upper end of a short tubular body 5. The cable 3 extends through the bore of the body 5 and said bore is counterbored as at 6 to receive suitable compressible packing material 7 which

surrounds said cable and is held in place by means of a tubular nut 8 threaded into the upper end of the counterbore 6. In this packing device the packing material engages the armor of the cable and in being tightly held in engagement therewith by said nut forms a leak-proof seal for excluding the passage of oil along the cable.

The sealing device K includes a coupling sleeve 9 corresponding to the one 4, and threaded onto the lower end of the tubular body 5 of sealing device J. A tubular body 10 identical with the one 5 is threadedly engaged in the lower end of the sleeve 9 and by means of a tubular nut 11, holds packing material 12 around the cable 3. With this device, the portion of the cable extending through the body 10 thereof is free of armor and the packing 12 is pressed tightly around the insulated unarmored portion of the cable to form another effective seal preventing the passage of oil down or along the cable.

The sealing device L is intended for use in relatively deep wells but may be employed as desired either exclusively of the devices J and K or in combination therewith. As here shown, device L comprises a tubular body 13 threaded into the lower end of the body 10 or to a coupling member such as the one 4 if the devices J and K are omitted.

The tubular body 13 receives the unarmored portion of the cable except as shown in Figure 8 wherein the armor extends partly into the body as will be hereinafter described.

In the body 13 is a longitudinally divided packing member 14 of elongated and plug-like form, fitting snugly in the bore of said body. Each of the sections or halves 15 of said member 14 has a hook-shaped or arcuate rib or extension 16 on its inner face extending substantially the full length thereof and these extensions cooperate as shown in Figure 9 to form a bore 17 for reception of the cable.

Cap screws 18 are employed for clamping the section 15 tightly upon the cable so as to form a leak-proof seal. At its upper end, the member 14 is counterbored as at 19 for reception of packing. As shown in Figure 8 when the cable armor is extended in the counterbore 19 solder is poured therein as at 20 to form a leak-proof soldered joint for the cable and member 14.

The lower end of the body 13 is internally threaded and coupled with a cylindrical member 21 having a bore 22. A pipe or conduit 23 is threadedly coupled with a tubular projection 24 of member 14 by means of a sleeve 25 and extends through the bore 22 of member 21. The cable 3 is extended through the projection 21, sleeve 25, pipe 23 to the heater section H.

The member 21 is formed with a counterbore 26, for reception of packing material 27 which surrounds the pipe 23 and is held tightly in place by means of a tubular nut 28. This arrangement provides an oil proof seal as to the pipe 23.

At its lower end the member 21 is externally threaded and screwed into the top fitting or closure 29 of the heater coupling tube 30. The pipe 23 extends through an opening 31 in the member 29 and said opening contains packing 32 held seated by a nut 33 whereby to provide a leak-proof seal at this point.

Adjacent but spaced upwardly from the lower end of the tube 30 and interiorly thereof is an annular flange 34 which supports within said tube a cylindrical head 35 of the heater, said head 35 having a flange 36 overlying flange 34, there being a gasket 37 between said flanges.

The lower end of tube 30 is internally threaded and a threaded ring or nut surrounding the head 35 is operable to retain a packing ring 38 between it and the flange 34 to prevent leakage of oil into member 30.

As a further sealing means and to strengthen this structure a cylindrical spacer member 39 is disposed in and circumferentially spaced from the member 30 between the opposing faces of the members 29 and 35 as shown in Figure 2, said opposing faces having annular grooves 40 for reception of the ends of the spacer.

An annular member 41 of insulation material is supported in the spacer member 39 on legs 41' fixed to the head 35 and carries suitable binding posts 42 on upper and lower sides thereof, whereby conduits 3a of cable 3 may be secured to said posts and heating element conductors 3b likewise secured thereto.

Referring to Figures 2 and 3 it is seen that the head 35 is provided with a threaded lower end coupled to a heater tube 43 which is provided with perforations 44 to allow a free circulation of oil therein. The heater tube is closed at its lower end by means of a combined closure and coupling member 45 shown in Figure 3 and which is similar in construction to the member 29 shown in Figure 2. As shown at the top of Figure 3, the member 45 may be also used for coupling a second heater unit H' into the string. The lowermost heating unit is closed by a flanged cap 46 threaded on the member 45 as shown at the lower end of Figure 3.

Referring to Figure 2, it is seen that a circular series of relatively long and upright heating elements E are arranged in the heater tube 43 with the ends of said elements frictionally anchored in openings 47 and 48 in the head 35 and lower closure member 45 respectively. In the center of the heater tube 43 is a pipe or conduit 49. This pipe is threadedly coupled with the head 35 as at 50 and secured in an opening 51 in the closure member 45, so that line conductors 3c from the binding posts 42 may be extended for connection with a second heater unit as shown in Figure 3. If but one heater is used the flanged cap 46 is employed as shown at the lower end of Figure 3 to close the lower end of the unit.

Each heating element E is shown in Figures 7 and 10 comprising a U-shaped loop of suitable high resistance or heating element wire or tape 53 terminating in suitable leads 54 for connection with the conductors 3b leading from the proper binding posts 42 to form a closed circuit. Around this U-shaped wire or element 54 is a thin layer or covering of suitable insulation material such as mica and this unit is pressed tightly in flat thin copper tubes 55 which are somewhat oval in cross section and free from dead air spaces whereby a direct and quick application of heat to the oil will be provided without heat loss or dissipation as would be the case if heavy metal tubes or like when employed to cover or enclose the elements themselves. The heating elements are protected by the perforated tube 43 in which they are housed and as the oil is circulated freely in said tube in contact with said elements it will be quickly heated to the boiling point and maintained at such heat as desired by suitable control means not shown, and operable at the top of the well.

It is now seen that apparatus of my invention whether made up of one or more heaters, may be readily positioned in a well at the point desired and then operated in a most efficient manner to

increase the production of the well by the application of heat directly to the oil. Heavy and low gravity hydrocarbons in the well and in adjacent oil bearing structures will be thinned out and rendered fluid so that it will readily respond to pumping. Moreover, heavy hydrocarbons and paraffin clogging perforation in the well casing will be "melted out" by the action of my heater.

With reference to Figure 3, it will be noted that I may use a conical sand deflector 56 placed in the bottom of the heater 2 or housing 43 so that sand gravitating to the bottom of the housing will be directed outwardly through perforations adjacent the lower edge of said deflector.

I claim:

1. An electrical heater for oil wells including a housing having closures at upper and lower ends and being open between its ends to permit of circulation of oil therein when lowered into a well, metal enclosed electrical heating elements mounted in said housing and having ends of the metal enclosures thereof extended into openings in and retained by said closures, the terminals of the heating elements being exposed above the uppermost closure, a tubular coupling member telescoping the upper end of the uppermost closure and having an internal annular flange for supporting said uppermost closure, said uppermost closure having an annular flange overlying the flange of said tubular coupling member, packing between said flanges a sealing gasket mounted in the lower end of the tubular coupling member and surrounding said uppermost closure, a ring threadedly engaged with said tubular coupling member and holding said packing ring in place, a member for closing the upper end of said tubular coupling member having an aperture therein, a cable having conductors connected with said terminals of the heating elements and extending therefrom through the aperture in said last-named closure member, an insulation ring mounted within said tubular coupling member, means supporting said insulation ring upon the

upper end of said uppermost closure and binding posts on said ring for electrically connecting the conductors of the cable with the heating elements.

2. An electrical heater for oil wells including a housing having closures at upper and lower ends and being open between its ends to permit of circulation of oil therein when lowered into a well, metal enclosed electrical heating elements mounted in said housing and having ends of the metal enclosures thereof extended into openings in and retained by said closures, the terminals of the heating elements being exposed above the uppermost closure, a tubular coupling member telescoping the upper end of the uppermost closure and having an internal annular flange for supporting said uppermost closure, said uppermost closure having an annular flange overlying the flange of said tubular coupling member, packing between said flanges a sealing gasket mounted in the lower end of the tubular coupling member and surrounding said uppermost closure, a ring threadedly engaged with said tubular coupling member and holding said packing ring in place, a member for closing the upper end of said tubular coupling member having an aperture therein, a cable having conductors connected with said terminals of the heating elements and extending therefrom through the aperture in said last-named closure member, an insulation ring mounted within said tubular coupling member, means supporting said insulation ring upon the upper end of said uppermost closure and binding posts on said ring for electrically connecting the conductors of the cable with the heating elements, and a sectional tubular spacer mounted in the tubular coupling member in circumferentially spaced relation thereto and enclosing said ring and associated elements and being engaged at its ends with said uppermost closure and the closure member for the upper end of said tubular member respectively.

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