

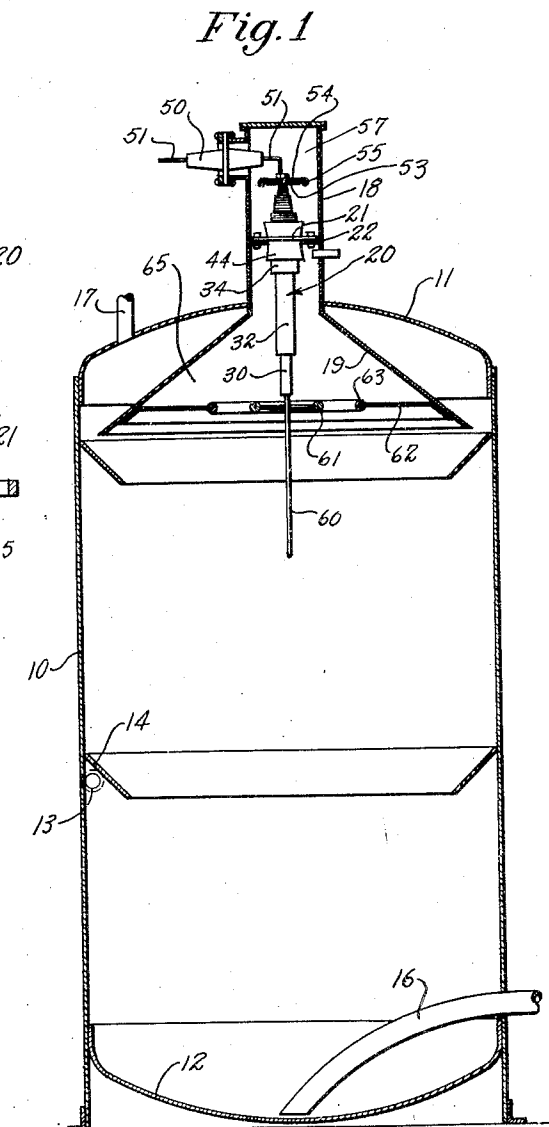
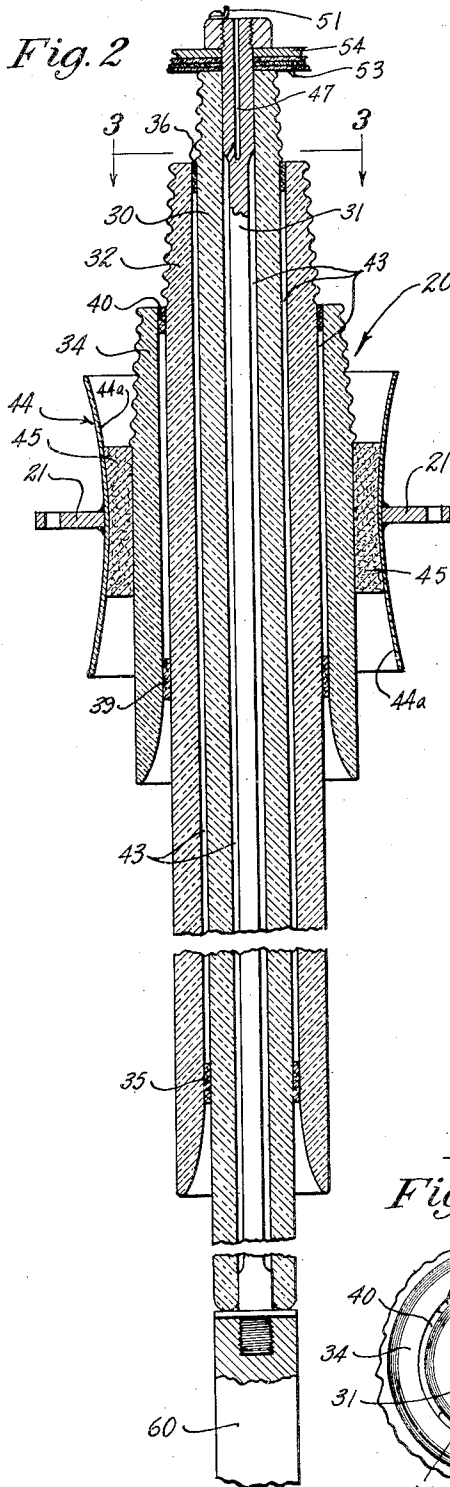
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J. M. CAGE

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INSULATOR BUSHING FOR ELECTRICAL PETROLEUM DEHYDRATORS

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Inventor.
John M. Cage.

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J. T. Threlkett
Attorney.

UNITED STATES PATENT OFFICE

JOHN M. CAGE, OF LOS ANGELES, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO
ELECTRIC SEPARATION COMPANY, LIMITED, OF NEW YORK, N. Y., A CORPORATION
OF DELAWARE

INSULATOR BUSHING FOR ELECTRICAL PETROLEUM DEHYDRATORS

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This invention is concerned with insulator bushings such as are employed to convey a high potential electrical conductor through the wall of a closed treater tank in the electrical dehydration of petroleum emulsions. While the present insulator bushing is not limited in application to dehydrators, it has been especially designed to meet the peculiar problems encountered in suiting an insulator bushing to such use, and will therefore be described in that particular association, but without necessary limitation thereto.

In the art of electrically dehydrating petroleum emulsions of water and oil, the emulsion is flowed through a closed treater tank in which is provided a live inner electrode insulated from the tank and energized by means of an electrical conductor passing through an insulator bushing suitably mounted in a wall of the tank. The wall of the tank may itself form the outer or grounded electrode. The emulsion upon coming within the influence of the charged inner electrode gives up its water, the emulsified water particles tending to coalesce and sinking in relatively large bodies to the bottom of the tank, where the water is withdrawn. The dried oil rises and is delivered from the top of the tank.

One of the greatest sources of trouble in the operation of electrical petroleum dehydrators of this nature resides in the insulator bushing, the dielectric material of which is under constant liability of breaking down under the severe strains exerted upon it. The nature of these bushing failures is often a fracture or complete breaking off of the dielectric tubes of which the bushing is composed. The best bushings produced by the art to date, in fact, last not more than a comparatively few hours under the operating conditions which I have found best in point of dehydration effectiveness. And each time the bushing so breaks down, which is thus at comparatively frequent intervals, dehydration operations must be suspended for several hours while a new bushing is installed. The costs involved in the loss of production forced by relatively frequent shutdowns of this kind

are very great, as are the costs of the bushings themselves.

The bushings now commonly employed embody a plurality of concentric porcelain tubes, usually three, annularly spaced and the spaces filled with layers of solid filling material as cement. The outside tube is provided intermediate its ends with a metal flange through which the bushing is mounted in the tank, and the center tube is hollow to take the electrical conductor. I now prefer to operate my dehydrator at a temperature of around 200° F., and at a potential of 60 to 100,000 volts; and under these conditions breakdown of the best bushing of this type heretofore available may occur in from one to thirty six hours.

As the conclusion drawn from a number of experiments which I have conducted, I attribute the breaking of the bushings to a combination of two separate causes, first, to too high a potential stress being permitted to exist over and through the porcelain tubes, and second, to the inability of the bushing, as heretofore constructed, to expand with the heat of the emulsion without great internal stresses being set up, the action probably being that the porcelain tubes and the intervening layers of cement expand at different rates and therefore cause the porcelain tubes to be subjected to severe internal stresses, which often cause their fracture.

It is the object of the present invention to provide a bushing adapted to withstand severe operating conditions, both as regards heating and the application of high electrical potential.

To prevent the bushings from breaking in the presence of heat, I now fill the annular spaces between the tubes with a fluid such as oil, a small ring portion of cement being provided at the ends of the tubes to space the tubes properly and to seal the oil in at the bottom, but this amount of cement alone not being capable of exerting sufficient force on the tubes to cause fracture thereof. The oil is free to circulate through oil passages provided in the other end of the bushing, so that it can flow back and forth out of and into the annular inter-tube spaces as the bushing ex-

pands and contracts with changing temperatures.

To guard against breakdown due to high potential stresses, I equip the bushing with certain shields which tend to draw the dielectric field away from the surface of the bushing, and also which prevent stress concentration through the dielectric material of the bushing, but these provisions may be discussed to better advantage in the body of the specification. Further, the above described oil filling in the annular spaces between the dielectric tubes increases the dielectric strength of the bushing and therefore decreases the liability of break-down by reason of dielectric failure.

The invention will best be understood from the following detailed description of a present preferred embodiment thereof, reference for this purpose being had to the accompanying drawing, in which:

Fig. 1 is a vertical medial section through a dehydrator typifying the application of my bushing;

Fig. 2 is a longitudinal medial section of my bushing; and

Fig. 3 is a transverse section taken on line 3-3 of Fig. 2.

Referring now to the drawing, and particularly to Fig. 1, I show at 10 a suitable shell or tank closed at the top with a dome 11, and having a bottom 12. Provided in the side of the tank is an emulsion inlet pipe 13, which discharges tangentially below a conical baffle plate 14, the incoming emulsion flowing more or less spirally upward from under its lower edge. A pipe 16 withdraws water from the bottom of the tank. The cleaned oil outlet is located in the dome of the tank, as at 17.

A cylindric shell 18 is carried in the top of the tank, its lower edge extending just below dome 11 and carrying a conical baffle plate 19 extending downwardly into the tank, as shown in the drawing. The insulator bushing, indicated generally at 20, is provided with an intermediate mounting flange 21 which rests upon and is fastened down to an inturned flange 22 provided in shell 18. The bushing and the overlapping flanges 21 and 22 thus close the upper end of the treater tank.

The insulator bushing 20 (see Fig. 2) embodies a plurality of concentric dielectric tubes, preferably of porcelain, and here shown as three in number. The tubes include a hollow inside or center tube 30 adapted to take a rod conductor 31 leading through the bushing, an intermediate tube 32 shorter than the inside tube 30 and annularly spaced therefrom, and a still shorter outside or flange tube 34 annularly spaced from the intermediate tube 32.

The intermediate tube is connected at its lower end to the inside tube by a short layer or ring 35 of some suitable cement, for in-

stance litharge, and at its upper end by another short layer 36 of cement, the upper layer, however, being perforated with a number of oil passages 38 (see Fig. 3). Similarly, the outside tube is connected at its lower end to the intermediate tube by a short layer 39 of cement, and at its upper end by another layer 40 of cement, which is perforated as at 41 for the passage of oil. These short upper and lower layers or rings of cement annularly space the tubes, and there is thus provided between the tubes long annular open spaces 43 closed at the ends by the rings of cement. These open spaces are sealed off at the bottom by the cement, but are open at the top through the perforations 38 and 41, respectively. The rod conductor 31 closely fits the central opening of the inside tube 30 only at the ends thereof, being reduced along its central section 31a to provide another longitudinally extending annular open space 43, which is adjacent the inner surface of the inside tube 30. The upper end of the conductor 31 is then provided with an oil passage 47 whereby oil may flow into the last described annular space 43.

The mounting flange 21 of the bushing is secured to the outer surface of a shield member 44 in the form of an outwardly flared plate, the shielding function of which will be set forth later, and for support of the bushing the member 44 is connected to the outside tube 34 by means of a layer of cement 45.

Referring now to Fig. 1, the portion of the bushing above flange 21 extends upwardly in shell 18, while the portion below the flange extends downwardly into the treater, terminating somewhat short of the lower limit of the conical baffle plate 19. Shell 18 is closed at the top, and has in its side wall an insulator bushing 50 through which an electrical conductor 51 passes to be connected within shell 18 to the upper end of the rod conductor 31 running through the bushing. There is preferably provided on the upper end of conductor 31 adjacent the upper end of the bushing several layers of insulating board 53, and above this insulating material 53 a metal plate 54 having at its outer edge a shield ring 55, which is spaced from the side walls of shell 18 by a determined distance. The function of this insulating material 53 and ring 54 will be set forth later.

The upper bushing compartment 57 provided by shell 18 is filled with a suitable dielectric fluid such as transformer oil, and this oil runs down through the perforations 38 and 41 in the cement at the tops of the insulator tubes, and through the passage 47 in the top of the conductor 31, and thus enters the longitudinally extending annular spaces 43 between and within the said tubes, which spaces the oil fills completely. There is thus provided an oil filling in the spaces between and within the tubes which can flow back and

forth through the oil passages provided at the upper end of the bushing, and in this way internal stresses due to expansion of the inter-tube filling material are positively precluded. The short rings of cement used only at the ends of the tubes are not of themselves capable of setting up sufficient stresses to fracture the porcelain. It will be noted that since the oil passages are at the top of the annular spaces, the oil runs downwardly in originally entering these spaces and displaces the air therein upwardly, which all leaves by way of the oil passages. There is thus provided positive assurance that all of the air originally present within the tubes is displaced by the oil.

Connected to the bushing conductor 31 just below the lower end of the bushing is the inner or live electrode 60, which embodies in the present instance a metal rod of about two and one-half inches in diameter and extending downwardly in the tank to a suitable distance below the lower limit of the conical baffle plate 19. This electrode is energized or charged through the conductor 51 leading through bushing 50 to the conductor 31 which runs through the main bushing 20, conductor 51 being understood to be connected to one side of the secondary of a suitable high-tension transformer, not illustrated. The tank itself is grounded to form the outside or grounded electrode.

A shield ring 61 is carried by the rod electrode 60 just below the insulator bushing and above the lower edge of the conical baffle plate 19, and spaced from ring 61 and carried by a plate 62 extending from baffle 19 is a second ring 63. The manner in which these shielding provisions protect the bushing against electrical stresses will be discussed at a later point in the specification.

In the operation of the dehydrator, the wet emulsion is delivered to the tank in heated condition through the inlet 13 below baffle 14. From there the emulsion passes upwardly and into the zone about the electrode 26, where it is subjected to electrical influence and separates into comparatively dry oil and water. The separated water sinks to the bottom of the tank, where it is withdrawn by means of pipe 16; while the cleaned oil rises and is discharged from the top of the tank at 17. A body of inert gas trapped within the open-bottomed compartment 65 provided by baffle plate 19, prevents rise of the emulsion therein and in this way maintains the surface of the bushing in a clean and non-conductive condition.

The shield ring 61 which I provide on the rod electrode just below the insulator bushing, is described and claimed in my copending application entitled Dehydrator construction, filed August 8, 1928, Ser. No. 289,174. As there set forth, its function is to provide a path for the dielectric field from

the live electrode to the grounded tank, which is of lesser resistance than that directly over the surface of the bushing to the tank. Thus, the spaced rings 61 and 63 providing a path through which the electrical stress is accordingly heavily concentrated, the stress over the surface of the bushing and the liability of conduction thereover is reduced to a minimum. The upper ring 55 which is provided on the conductor 31 just above the bushing, has a similar function, providing a path from the conductor through the transformer oil in the compartment to the shell 18 which is of lower dielectric strength than the path over the surface of the bushing to the shell. The insulating material 53 increases the length of the latter path, and hence decreases the liability of current flow thereover. The result of this provision is again that the dielectric stress between the live conductor and the grounded shell is heavily concentrated in a path removed from the surface of the bushing, which is thereby greatly relieved of stress.

The outwardly flared shield 44 to which the mounting flange 21 of the bushing is secured, has a smooth interior surface 44a within which the bushing is cemented. The shield is comparatively wide, and being of smooth contour distributes the dielectric stress between the flange 21 and the porcelain tubes of the bushing over a relatively wide area, thereby decreasing materially the dielectric stress density through the porcelain, and decreasing in a like measure the liability of the bushing to break down at this point.

Thus it will be seen that my shielding provisions largely relieve the bushing of the high-density dielectric stresses to which it has heretofore been subjected.

Moreover, the oil filling in the annular spaces between the tubes increases the dielectric strength of the bushing, and therefore, decreases the liability of the bushing failing under the potential stresses to which it is subjected.

One of the chief advantages of the present bushing, however, resides in the means for relieving the porcelain tubes of internal stresses set up due to thermal expansion. The oil that fills the annular inter-tube spaces is free to be expelled from the bushing as the oil increases in volume with increased temperature, and there is therefore no possibility of a pressure exerted upon the tubes due to expansion of the filling material therebetween, as in prior bushings.

The bushing provided by the present invention stands up indefinitely under the most severe operating conditions, and has done away entirely with the frequent shut-downs heretofore necessitated by frequent bushing failures.

It will be understood that various changes in the design, structure and arrangement of

my herein described provisions may be made without departing from the spirit and scope of my invention, which is only to be limited as defined in the following claims.

I claim:—

1. In combination in an electrical petroleum dehydrator involving a treater tank, vertical walls defining a compartment opening into the upper end of said treater tank, an insulator bushing connected near its center portion, and forming a barrier, in the lower portion of said compartment, said compartment adapted to contain insulating oil above said bushing, said bushing involving annularly spaced dielectric tubes, and the annular spaces between said tubes being closed at the end of the bushing extending downwardly in the tank but open at the end of the bushing extending upwardly into said compartment, whereby oil in said compartment may circulate into and out of said annular spaces, an insulator bushing in the wall of said insulating oil containing compartment, and an electrical conductor passing in turn through the last mentioned and first mentioned insulator bushings to reach the interior of the tank.

2. In combination in an electrical petroleum dehydrator involving a treater tank, vertical walls defining a compartment opening into the upper end of said treater tank, an insulator bushing connected near its center portion, and forming a barrier, in the lower portion of said compartment, said compartment adapted to contain insulating oil above said bushing, said bushing involving annularly spaced dielectric tubes, and the annular spaces between said tubes being closed at the end of the bushing extending downwardly in the tank but open at the end of the bushing extending upwardly into said compartment, whereby oil in said compartment may circulate into and out of said annular spaces, and an electrical conductor passing through said insulating oil containing compartment and said insulator bushing to reach the interior of the tank.

In witness that I claim the foregoing I have hereunto subscribed my name this 22d day of January 1930.

JOHN M. CAGE.