Dec. 23, 1941. J. D. MORGAN ET AL 2,266,985

ELECTRIC IMMERSION HEATER

Filed March 8, 1941

Fig. 1.

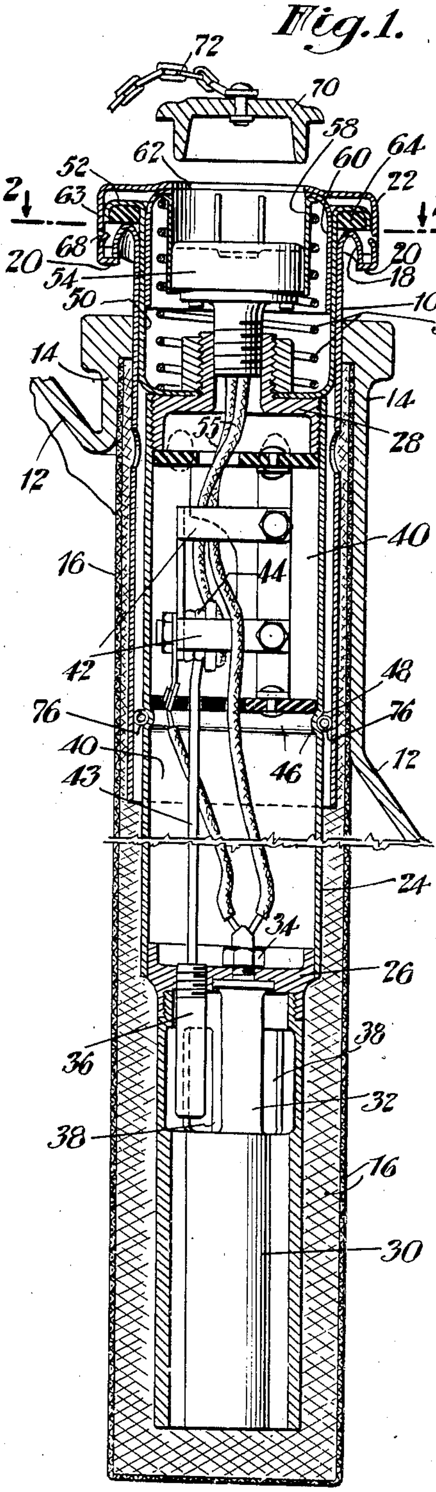


Fig. 2.

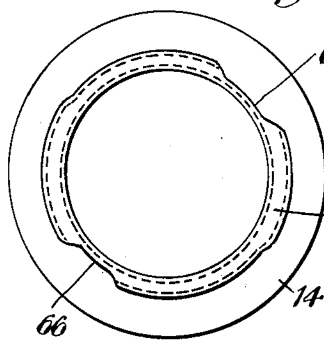


Fig. 3.

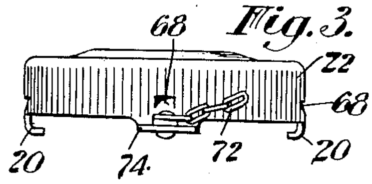
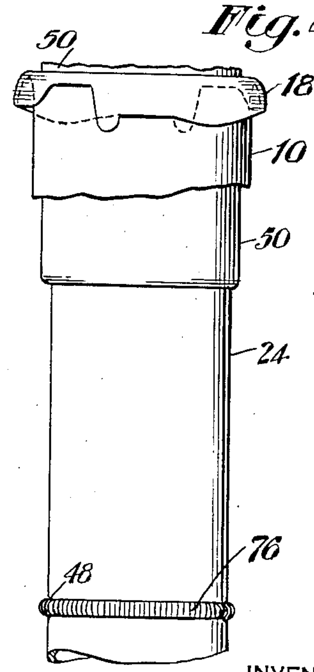


Fig. 4.



INVENTORS
JOHN D. MORGAN
THOMAS ANDERSON
BY Edmund G. Borden
ATTORNEY

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UNITED STATES PATENT OFFICE

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ELECTRIC IMMERSION HEATER

John D. Morgan, South Orange, and Thomas Anderson, Elizabeth, N. J., assignors to Cities Service Oil Company, New York, N. Y., a corporation of Pennsylvania

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4 Claims. (Cl. 219—38)

The present invention relates to electric immersion heaters, and more particularly to an improved immersion heater design adapted for permanent or semi-permanent installation in the filler neck of an aeroplane lubricating oil supply tank.

Operation of aeroplanes in territories where low temperatures are encountered presents serious problems as regards engine starting and lubrication because of the rapid increase in viscosity of the lubricating oil as the outdoor temperatures drop much below the freezing temperature. These problems become particularly serious to the operator when the plane is grounded or temporarily out of commission at a point remote from its base. In a situation of this type the only source of energy which may be available for starting the motor and for heating the oil to reduce its viscosity, may be the electric storage batteries with which the plane is equipped.

The primary object of the present invention is to provide an electric immersion heater having a design adapting it as a permanent or semi-permanent part of an aeroplane lubricating oil supply tank.

The walls of lubricating oil supply tanks of aeroplanes are preferably imperforate except for one opening through which the tank is filled. In the case of military planes it is particularly desirable that the tank walls have no more than the one aperture, and that means be provided for sealing said aperture against loss of oil even in cases when the plane is flying upside down.

A more particular object of the present invention is to provide a design of electric immersion heater which is adapted for removable insertion in, and to form a sealing closure for, the filler neck of an aeroplane oil tank.

The heater element of the present invention may embody features of the electric immersion heater which is described in the U. S. Patent No. 2,217,595 of John D. Morgan and Percy B. Levitt, patented October 8, 1940. In any event the heater should be compact in size, light in weight, efficient for developing and transmitting heat to liquid in which it is immersed, and of such construction as to withstand the vibration shocks and jars to which it will be subjected in service. In addition the present heater must embody features of design adapting it to function both as a readily removable heating unit and as a permanent or semi-permanent sealing cap closure for the filler neck of an aeroplane oil tank within which it is mounted.

With the above and other objects and features in view, the invention comprises the improved immersion heater design which is hereinafter described and more particularly defined by the accompanying claims.

The various features of the invention are illustrated by the accompanying drawing, in which:

Fig. 1 is a longitudinal sectional view (with parts shown in front elevation) of an electric immersion heater embodying a preferred form of the invention, the heater being illustrated in operating position within a filler neck of an aeroplane oil tank.

Fig. 2 is a plan view of the top of the filler neck (taken on plane 2—2 of Fig. 1 with the heater removed) showing the cam-like form in which the periphery of the top flange of the filler neck is shaped.

Fig. 3 is a view in front elevation of the locking cap element of the heater.

Fig. 4 is a broken view in front elevation showing the top flange of the filler neck, and that portion of the heater casing which is normally encircled by the filler neck.

Referring to the drawing, Fig. 1 illustrates the heater as mounted in operating position within the filler neck **10** of an aeroplane oil tank having walls **12** and an upstanding cylindrical boss **14** supporting the filler neck. The filler neck is a tubular member the walls of which line a central aperture in the top of the boss **14** and project upwardly and downwardly therefrom, the lower end of the neck extending for several inches into the tank below the top of the boss. A cylindrical oil filter screen **16** is shown as having its upper end attached to the inner wall of the boss **14** in concentric relation outside the filler neck, and as having its lower end extending downwardly below the lower end of the heater. The upper or outer end of the filler neck is provided with an outwardly turned flange **18** which (see Figs. 2 and 4) is cut to form a locking cam surface with which extension fingers **20** on cap **22** of the heater can engage.

The heater design which is illustrated includes a tubular casing **24** which is shown as constructed in three coaxially aligned segments connected by header plates **26** and **28**, for ease of assembly. As previously indicated, the heating element of the present heater may be constructed as described in the aforementioned U. S. Patent 2,217,595. The heating element will normally include a helical resistance wire coil which is supported coaxially within a sealed metal casing **30** and which is insulated from the casing **30** by flexible dielectric heat conductant material such as partially oxidized ferrosilicon powder. The heater casing 30 and the heat conductant dielectric with which it is filled, is designed to afford a highly heat conductant corrosion and leakage proof housing for the resistance coil having sufficient strength and flexibility to protect all parts of the heating element against breakage and injury. The heating element comprising the casing 30 and its lead wire extension neck 32, is mounted by means of a nut 34 in an aperture within the plate header 26. The vaporizing element of a liquid-vapor Sylphon 36 is also mounted within an aperture of plate 26; and both of such aperture mountings in plate 26 are provided with liquid-tight joints.

The heating element 30 is illustrated as extending below header 26 in position to be completely immersed below the normal level of oil within the oil tank; and the lower segment of the tubular casing 24 is shown as extending downwardly in coaxially spaced relation around the heating element 30 and as having wall apertures 38 in that end thereof adjacent the header 26 communicably connecting the interior of that segment of the tubular casing with the interior of the oil tank. By means of apertures 38 rapid circulation of the oil in the tank may occur throughout the length of the lower segment of casing 24, over and in direct contact with the heating surface of element 30.

The central segment of casing 24 extends between headers 26 and 28 and forms a sealed chamber 40 at the upper end of which there is placed a thermostatic switch 42, the function of which is to limit the maximum temperature to which the liquid in the tank 12 is heated. The mechanism for automatically opening the switch to cut off the supply of electric current to the heating element 30 when the liquid or oil has reached a predetermined temperature has been generally illustrated as a vapor tension Sylphon including vapor expansion chamber 36 and a tube 43 connecting chamber 36 with a diaphragm chamber 44 within the switch 42. As shown in Fig. 1, the switch 42 is held in place in the upper portion of the sealed chamber 40 in the middle segment of casing 24 by a peripheral fold 46 in the inner wall of the casing aligned with a peripheral groove 48 in the outer wall of the casing 24.

The upper segment of heater casing 24 has been illustrated as a centrally apertured cup-shaped element 50 attached to the top surface of header 28 and having an outwardly turned flange 52 at its upper end which overhangs the flange 18 of the filler neck. An insulated electric contact plug 54 is mounted coaxially and centrally within the cup segment 50 and is supported by and attached to an aperture in header 28 through which conductor wires 55 lead downwardly to switch 42 and from the switch to the heating element 30. A helical wire spring coil 56 is shown as supported within cup 50 in coaxial relation with the plug 54 and extending upwardly around the sides of the plug to a point above the level of flange 52. The heater cap member 22 is shown as having three concentrically arranged depending skirt segments, one of which is a short open-ended tube 58 having an outwardly extending flange at its upper end which overhangs the top of coil spring 56. Segment 58 has an inside diameter slightly greater than the outside diameter of the insulating plug 54 and is mounted coaxially therewith. A second segment 60 of the heater cap also comprises a short open-ended tube having an outside diameter only slighly less than the inside diameter of cup 50 for a sliding fit in the top thereof, and having an inwardly turned flange at its upper end which also overhangs the top of spring 56 as well as the top of element 58. The third segment of cap 22 is the top segment which has a central aperture 62 slightly greater in diameter than the plug 54, and which has a downwardly projecting skirt 63 slightly larger in diameter than the flange 52 of the cup 50 and the flange 18 of the filler neck.

An annular gasket 64 is seated in an annular seat formed on the lower side of flange 52 of the cup 50 in position to register with and seat on the top edge of the filler neck flange when the heater cap is forced down against the spring 56 into a position where the fingers 20 can be turned into locking engagement with the cam edge of the filler neck flange 18. As shown in Fig. 2, recesses 66 are formed in the flange 18 of the filler neck at opposite sides thereof, such recesses having a depth sufficient to allow the fingers 20 of the heater cap 22 to be slipped downwardly over the filler neck flange into a position where, by turning, they can be rotated into locking relation with the lower edge of the flange.

As shown in the drawing, the immersion heater of the present invention is assembled from a large number of parts. In fact the cap element 22 of the heater has been shown as made up of three separate parts which may or may not be joined together. The upper segment of the cap 22 need not necessarily be made integral with the other parts of the heater, but, to prevent loss, it is preferably made an integral part of the assembly by notching the walls of the depending outer skirt as at 68 so that the inwardly projecting metal at the notches will engage against the bottom rim of the flange 52 of the heater casing and thus prevent the cap 22 from being separated from the heater casing.

A protecting plug cap 70 of rubber or other flexible material has been shown as having a dependent skirt which is dimensioned for insertion as a closure over the aperture in the cap 22 and over the electric contact plug 54. The primary function of the cap 70 is to protect the contact plug from rain and moisture. Cap 70 is shown as equipped with a chain attachment 72 by which it may be detachably connected with an ear 74 on the skirt or rim of cap 22 (see Figs. 1 and 3).

The oil in the lubricating oil supply tank of an aeroplane may be shifted rapidly from one end of the tank to the other while the plane is in flight. Such shifting of the oil within the tank 12 would place an undue stress on the support for the heater of the present invention if the only point of support were at the sealed joint between the filler neck flange and the gasket 64. In order to better distribute the vibration and shock stresses to which the heater is subjected during operation of the plane, a small helical shock-absorbing wire spring 76 has been mounted in groove 48 around the periphery of the heater casing at a point just above the lower end of the filler neck 10. The diameter of coil 76 is such as to fill the space between the bottom of the groove 48 and the inside wall of the neck 10 throughout the entire periphery of the heater casing. Thus the spring 76 takes some of the fulcrum load off the top support for the heater and serves to distribute the vibration stresses over a greater area of the heater casing lying between the spring 76 and the gasket 64.

While the immersion heater herein described is particularly adapted for use in conjunction with the filler necks of aeroplane lubricating oil tanks, it will be understood that the heater is well adapted for immersion heating of other liquids in containers equipped with wall apertures having a construction equivalent to that of the filler neck suitable for forming with the heater cap a lock seal closure.

Having thus described the invention, what is claimed as new is:

1. An electric immersion heater comprising a tubular metal casing dimensioned for insertion within the filler neck of an aeroplane oil tank, an outwardly projecting flange for the upper end of the casing, an insulated electric contact plug mounted coaxially within the upper end of the casing, an annular gasket attached to the under side of the casing flange in position for seating on a flanged top of the filler neck, a compression coil spring mounted coaxially within the outer end of the casing concentrically around the insulating plug, and a centrally apertured cap for the casing having inner depending skirts forming a guide seat for the outer end of the coil spring and having an outer flange skirt dimensioned to closely encircle the flanges of the casing and filler neck, said outer skirt having attached to the lower end thereof a pair of inwardly projecting fingers arranged for rotation into locking relation with respect to cam ears at the bottom edge of the filler neck flange when the cap is pressed down against the spring to a level forcing the annular gasket into sealing engagement with the top of the filler neck flange.

2. An electric immersion heater as defined in claim 1, together with a coil spring encircling the heater casing at a point just above the lower end of the filler neck and dimensioned to form a shock absorbing and centering element between the casing and the lower end of the filler neck.

3. An electric immersion heater as defined in claim 1 together with a flexible plug closure having an annular skirt at its lower side dimensioned for insertion as a sealing cap over the central aperture of the heater cap in position to cover the insulated plug.

4. An electric immersion heater comprising a tubular metal casing dimensioned for insertion within the filler neck of an aeroplane oil tank, an outwardly projecting flange at the upper end of the casing, a pair of header plates disposed as transverse longitudinally spaced partitions dividing the inside of the casing into three segments, wall apertures in the lower segment of the casing below the bottom header forming a liquid circulating chamber therein, a sealed electric heater attached to said bottom header and extending coaxially into said circulating chamber, an insulated electric contact plug mounted coaxially within the upper end of the casing above the top header, an annular gasket mounted below the underside of the casing flange in position for seating on a flange top of the filler neck, a helical coil spring mounted coaxially within the upper end of the casing concentrically around the contact plug with its lower end supported by the top header, and a centrally apertured cap for the casing having inner depending skirts dimensioned to form a guide seat for the upper end of the coil spring and having an outer flange skirt dimensioned to closely encircle and overhang the flanges of the heater casing and filler neck, said outer skirt having attached to the lower end thereof oppositely disposed inwardly projecting fingers dimensioned to slip downwardly past recessed portions of the neck flange and to be rotated into locking relation with respect to locking ears at the bottom edge of the filler neck flange whenever the cap is pressed downwardly against the coil spring to a level forcing the annular gasket into sealing engagement with the top of the filler neck flange.

JOHN D. MORGAN
THOMAS ANDERSON.