

[54] **DEVICES FOR TANKS CONTAINING FLUID MEDIUM**[75] Inventor: **Carsten Dahl**, Minde, Norway[73] Assignee: **Patents and Developments A/S**,
Helldal, Norway[22] Filed: **May 15, 1973**[21] Appl. No.: **360,443**[52] U.S. Cl. **165/108, 165/132, 222/146 HS**[51] Int. Cl. **F28d 1/06**[58] Field of Search **165/132, 108; 222/146 HG**[56] **References Cited****UNITED STATES PATENTS**

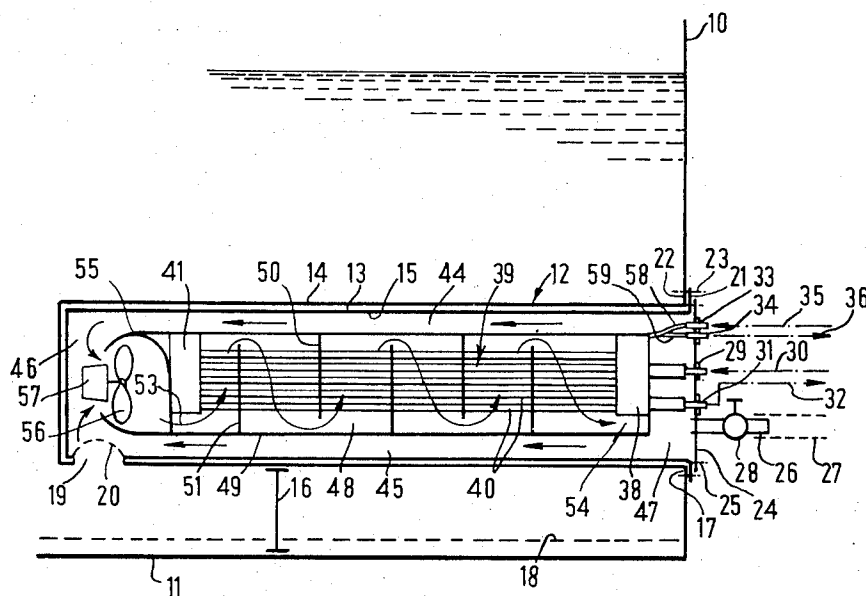
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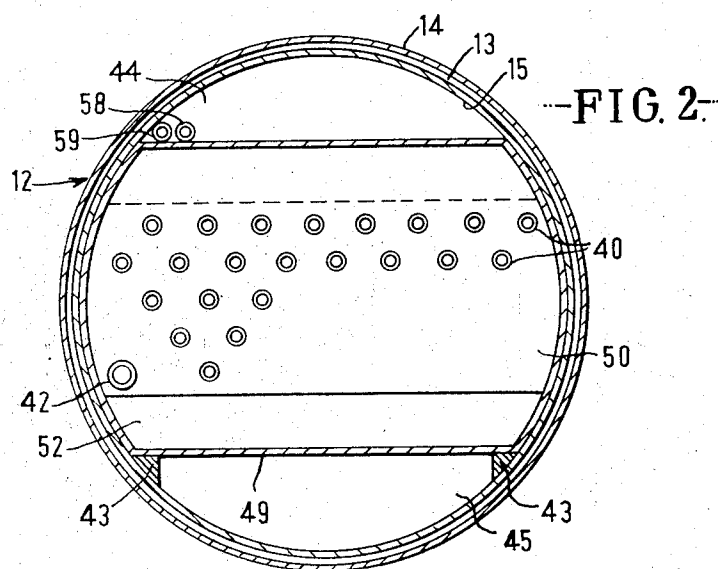
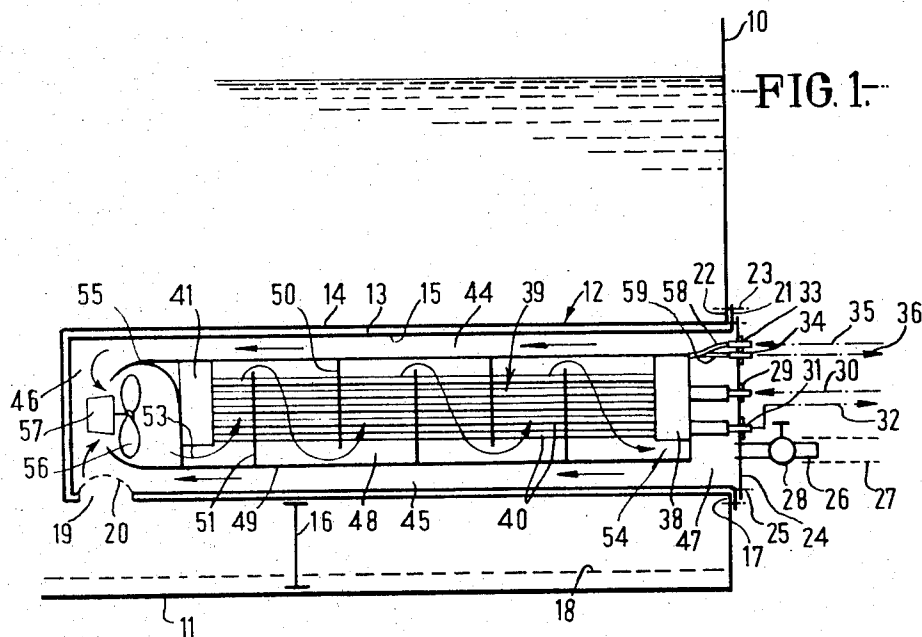
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ABSTRACT

A device for a tank containing fluid medium, especially so-called heavy oils, which comprises a housing submerged in said medium and thermally insulated therefrom with a heat exchanger disposed therein for heating the fluid medium. The housing has at its opposite ends a first or inlet and mixing chamber and a second or combined circulation and outlet chamber respectively. The first chamber is in open flow connection with the surrounding fluid medium while the second chamber is in valve-controlled flow connection with a discharge conduit. A pump adjacent one end of the heat exchanger is adapted to force fluid medium through a flow passage from the first chamber via the heat exchanger into the second chamber while another flow passage permits circulation from the second chamber to the first chamber so as to maintain the mixing of heated fluid medium from the heat exchanger and unheated fluid medium from the tank in step with the discharge of heated fluid medium from the discharge conduit.

5 Claims, 2 Drawing Figures



DEVICES FOR TANKS CONTAINING FLUID MEDIUM

This invention relates to a device for a tank containing fluid medium, especially so-called heavy oils. More especially, the invention is concerned with stationary storage tanks for heavy oils and similar products which have a high viscosity in the cold state, for example, at normal outside temperatures. There is a great demand for a simple and effective heating device for media of this kind with a view to reducing their viscosities and improving their transportability.

With stationary tank installations, it has hitherto been common practice to heat the total contents of the tank by means of heating elements arranged at the bottom thereof. By employing a discharge device approximately at the level of the heating elements, fluid medium of high heat capacity can be discharged from this level, whereas the contents of the tank at overlying levels are heated only to a limited extent due to the comparatively low heat transfer capacity of the medium. On the other hand, heating of more or less the total contents of the tank which are constantly exposed to cooling via the tank walls and the surrounding atmosphere, is rather impractical especially if discharge is effected after large intervals of time and at low atmospheric temperatures.

By having to heat large amounts of fluid medium in the tank, discharge is dependent upon a longer preheating time in order to bring the medium at the lower level of the tank up to a desired high temperature. A more rapid heating of the fluid medium and a more economical utilisation of the amount of heat supplied can, on the other hand, be achieved by using a heat exchanger with a through-flow passage for the fluid medium to be heated, in combination with a valve-controlled discharge device. However, it can be difficult to achieve an effective heat transfer by means of heat exchangers with a through-flow passage since the medium to be heated must be able to be brought relatively rapidly from a relatively low temperature to a relatively high temperature, that is to say over a large temperature spectrum.

It is an object of the present invention to achieve especially rapid heating of unheated fluid medium by effecting step-wise heating thereof within a locally defined region of the tank. In particular, the object is to effect the heating by initially mixing the unheated medium with preheated medium and subsequently further heating the mixture before discharging the latter through the valve-controlled discharge device.

According to the present invention a device for a tank containing fluid medium, especially so-called heavy oils, comprises a housing submerged in the fluid medium while thermally insulated therefrom, a heat exchanger arranged in said housing for heating said medium, said housing comprising at its one end a first chamber in the form of an inlet and mixing chamber and at its other end a second chamber in the form of a combined circulation and outlet chamber, said one end being in open flow connection with the surrounding fluid medium and said other end being in valve-controlled flow connection with a discharge conduit, said first and second chambers being interconnected via at least two separate flow passages, a pump disposed in the housing adjacent an end of the heat exchanger and adapted to force fluid medium along one

flow passage from the first chamber via the heat exchanger into the second chamber while another flow passage permits circulation from said second chamber to said first chamber so as to keep the mixing of heated fluid medium from the heat exchanger and unheated fluid medium from the tank in step with the discharge of heated fluid medium from said discharge conduit.

The pump which can be a conventional hydraulically operated circulating pump or any other arbitrary appliance for pressing or sucking the medium forcibly through the flow passages of the heat exchangers, can be located at the inlet end or outlet end of the heat exchanger as required. In all instances, the pump is arranged so as to ensure at the same time a forced flow in the circulatory passage from the second chamber into the first chamber. By valve control of the discharge of the fluid medium via the discharge conduit in relation to the flow capacity through the heat exchanger, a sufficient degree of circulation can be achieved to provide a desirably high temperature for the medium mixture at the inlet to the heat exchanger thereby enabling the heat exchanger to provide effective heating with, for example, steam as the heat-producing medium.

In order that the invention can be more clearly understood, a convenient embodiment thereof will now be described, by way of example, with reference to the accompanying drawings in which:

FIG. 1 is a longitudinal section of the device of the invention installed in a schematically illustrated tank portion, and

FIG. 2 is a cross-section of the device of FIG. 1.

Referring to FIG. 1, there is shown a portion of an oil tank with a wall 10 and a bottom 11. A double-walled housing 12 having an insulating layer 13 between an outer wall 14 and an inner wall 15 is arranged at a suitable level above the tank bottom 11. The housing rests at the one end on a tierce support 16 fixed to the bottom 11 and at the opposite end on a support means in an opening 17 in the tank wall. A layer 18 of sediment is shown on the bottom 11 by means of a dotted line and the housing is arranged at a suitable level above the bottom of the tank so as to be untouched by the layer of sediment. At the free end of the housing 12, there is formed a relatively wide opening 19 which is directed downwards and provides an open flow connection between the interior of the housing and the fluid medium which surrounds the housing. Just inside the opening 19, there is located a coarse sieve 20. At the opposite end, the housing 12 is secured to the tank wall 10 by means of a fastening flange 21 having intermediate sealing means 22 by way of associated fixing bolts 23. The housing 12 is provided with a separate detachable end cover 24 which is secured directly thereto by means of fixing bolts 25. To the end cover 24, there is secured a drain nipple 26 for connection to a discharge conduit 27. The drain nipple is provided with a drain cock valve 28. The end cover 24 is further provided with a coupling nipple 29 for a steam feed conduit 30 and a coupling nipple 31 for a condensate discharge conduit 32, together with coupling nipples 33 and 34 for a supply conduit 35 and a return conduit 36 respectively, for hydraulic oil. The nipples 29, 31, 33 and 34 can be mounted on the rear side of the cover and secured with locating nuts on the front side thereof.

The nipples 29 and 31 are rigidly connected to a distribution box 38 in a heat exchanger 39 in the housing

12. A series of parallel branch pipes 40 lead from the distribution box 38 to an opposite collecting box 41 which is connected via a return conduit 42 (FIG. 2) to the nipple 31. As shown in FIG. 2, the heat exchanger 39 is centrally arranged in the direction of height of the housing and is displaceably received on guide rails 43 on the inner side of the housing. The upper and lower sides of the heat exchanger are respectively bounded by two parallel flow passages 44 and 45 providing direct communication between opposite ends of the housing 12 in which there are respectively defined a first chamber in the form of a combined inlet and mixing chamber 46 and a second chamber in the form of a combined circulation and outlet chamber 47. The first chamber 46 is in open flow communication with the fluid medium outside the housing by way of the opening 19, while the second chamber is in valve-controlled flow communication with the discharge conduit 27 by way of the drain cock valve 28.

In the heat exchanger, there is defined a separate flow passage 48 between the first and second chambers within an outer jacket 49 of the heat exchanger. The flow passage 48 runs transversely of the branch pipes 40 in an upwardly and downwardly flowing course between vertical separating plates 50 and 51 which are alternately fixed to upper and lower portions of the jacket 49 and at the respective opposite portions a passage opening 52 is cut out. The inlet opening 53 and the outlet opening 54 of the heat exchanger are located at its lower half. A pump housing 55 with a pump rotor 56 driven by a hydraulic motor 57 is fixed in front of the inlet end. The inlet to the pump housing 55 is directed axially outwards into the chamber 46 and coaxially of the housing 12 and the heat exchanger 39.

The coupling nipples 33, 34 for hydraulic oil are connected to the hydraulic motor 57 via an associated feed conduit 58 and return conduit 59 respectively. The conduits 58 and 59 are shown secured to the heat exchanger as is evident from FIG. 2.

In the illustrated embodiment, the housing 12 is about 600 cm long with a diameter of about 80 cm and a combined oil volume of about 2 m³, and the pump has a capacity of about 200 m³/hour. The heat exchanger has a total surface area for heat transfer of about 50 m². In a case where the oil temperature in the storage tank is 0° C and the oil to be discharged is at a temperature of about 80° C, complete heating can be achieved in the course of 7 to 8 minutes and thereafter continuous (if desired) discharge can be effected at about 40 m³/hour. Starting up is effected in stages, the oil first being heated in the heat exchanger for about 3 minutes after which the pump is actuated. After a further 4 to 5 minutes, the oil contents of the housing have reached a desirably high temperature for discharge to be effected via the conduit 27. Gradually as the discharge takes place from the chamber 47 via the discharge conduit 27, the chamber 46 is refilled, via opening 19, with a corresponding amount of unheated oil from the tank. In the illustrated embodiment, 4/5 of the amount of heated oil is caused to circulate from the chamber 47 back to the chamber 46 via the flow passages 44 and 45, while only 1/5 of the quantity of heated oil is discharged from the discharge conduit 27 and a corresponding small amount of unheated oil is fed to the chamber 46 through the opening 19. In front of the inlet to the pump, the mixture of heated and unheated oil has already reached a relatively high temperature so

that the oil mixture is relatively easy to push through the heat exchanger by means of the pump. In the illustrated embodiment, with the pump arranged in front of the heat exchanger, there is achieved an extra mixing together of the heated and unheated oil. By arranging the pump at the opposite end of the heat exchanger, the oil mixture is sucked through the heat exchanger, but all the same the unheated oil portion can be relatively uniformly mixed with the heated oil portion. In the illustrated embodiment, the heated oil flow from the passage 45 sweeps just above and past the opening 19 so that at the inlet to the mixing chamber 46 there is already a mixing together of the heated and unheated oil. By means of the heated oil flow from the passage 44, there is obtained a further mixing together in that this heated oil flow is mixed together with the partially heated oil mixture so that there is already obtained before the pump an effective step-wise mixing together of oil components of different temperatures.

In the illustrated embodiment, steam can be used with advantage as a heat carrier and the steam supply can be regulated depending upon the discharge speed of the heated oil. However, it is apparent that other heat media can also be used, for example, in the form of a gas or liquid.

By using a heat exchanger and a circulation pump in one unit, a particularly concentrated and effective heating can be achieved in that the high circulation rate caused by the pump in the heat exchanger can lead to a comparatively high heat transfer coefficient. As a result, no large heating surfaces are required in order to achieve the desired heat transfer and the amount of steam supplied to the heat exchanger can be reduced. It is also possible to save on the volume of the heat exchanger so that the heat exchanger housing has a greater volume capacity.

The heating and the strong circulatory movement in the housing 12 may lead to the trapping of air or gas. Deaeration of the housing 12 is recommended for the best possible utilisation of the heating effect. For this purpose, a few narrow air flow openings are provided in the upper part of the housing in order to provide a connection between the interior of the housing and the surrounding fluid medium. These openings may have a diameter of 5 to 10 mm and they may be arranged, for example, at one end of the housing in the chambers 47 where the pressure is higher than in the other parts of the housing.

What we claim is;

1. A device within a tank containing fluid medium, especially so-called heavy oils, which comprise an insulated housing submerged in the fluid medium a heat exchanger having an outer jacket arranged in said housing for heating said medium, said housing comprising at its one end a first chamber in the form of an inlet and mixing chamber and at its other end a second chamber in the form of a combined circulation and outlet chamber, said one end being in open flow connection with the surrounding fluid medium and said other end being in valve-controlled flow connection with a discharge conduit, said first and second chambers being interconnected via at least two separate flow passages within said housing, a pump disposed in the housing adjacent an end of the heat exchanger and adapted to force fluid medium along one flow passage from the first chamber via the heat exchanger into the second chamber while another flow passage permits circulation from said sec-

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ond chamber to said first chamber so as to keep the mixing of heated fluid medium from the heat exchanger and unheated fluid medium from the tank in step with the discharge of heated fluid medium from said discharge conduit.

2. The device of claim 1, wherein said housing has its main axis substantially horizontal with said one end thereof formed with a downwardly directed inlet opening disposed at a predetermined level above the bottom of the tank, said circulatory flow passage having at least one branch passage at the top and bottom of the housing respectively, the branch passage at the bottom passing just by said inlet opening.

3. The device of claim 1, wherein said housing forms

6

a unit which can be separately withdrawn through the wall of the tank and is secured to said wall by means of a seal-forming fastening flange.

4. The device of claim 1, wherein said fluid medium is constantly circulating through said device when said pump is operating.

5. The device of claim 1, wherein said heat exchanger comprises a plurality of pipes within said outer jacket through which heat exchanging fluid passes, said one flow passage being through said outer jacket and around said pipes, said other flow passage being between said outer jacket and said housing.

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