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Applicants or Agents Ref.

34/Gn/21218.

PATENTS ACT, 1949

COMPLETE SPECIFICATION

(To be furnished in duplicate—one without fee)

Where priority as provided by subsection (2) or (3) of Section 5 is desired in respect of one or more provisional specifications, quote No. or Nos. and date or dates.

No.

Date

(a) Insert title of invention.

(a) "An Apparatus for Determining the Content of Water in Oil"

(b) State (in full) name, address and nationality of applicant or applicants as in application form.

(b) I/~~we~~ Ib Bjarke Dollerup Jensen, Kastanievej 1, DK-2950 Vedbaek, Denmark, a Danish subject,

do hereby declare the invention, for which I/~~we~~ pray that a patent may be granted to me/~~us~~, and the method by which it is to be performed, to be particularly described in and by the following statement:

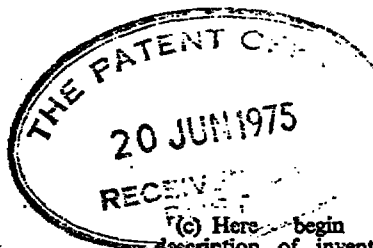
(c) Here begin full description of invention. The continuation of the specification should be upon paper of the same size as this form, on one side only, with the lines well spaced and with a margin of one inch and a half on the left-hand part of the paper. The completion of the description should be followed by the words "What I (or we) claim is" after which should be written the claim or claims numbered consecutively (see note below).

The specification and the duplicate thereof must be signed at the end.

NOTE. The claims must relate to a single invention, must be clear and succinct and must be fairly based on the matter disclosed in the specification. They should define the scope of the invention claimed. Applicants should be careful that their claims include neither more nor less than they desire to protect by their patent. Any unnecessary multiplicity of claims or prolixity of language should be avoided. Claims should not be made for the efficiency or advantages of the invention.

(1) — followed by (a)

T.C.D.



This invention relates to an apparatus for determining the content of water in oil and is of a type that includes means for evaporating the water and ^{means for determining} ~~controlling~~ the quantity of water after condensation of the vapour, ^{the apparatus} ~~and it~~ contains an element of high heat capacity in which is provided an evaporation chamber and means for heating the element, the evaporation chamber having an inlet opening and a bottom drain for oil, a discharge opening for water vapour and an inclined oil flow plate. The known art comprises apparatus adapted to purify the oil of water by subjecting the oil to adequate heating for a period and under the application of adequate forces sufficient to evaporate all the water, but such apparatus ^{has} ~~have~~ been found to be very expensive in operation and lacking in the desired effectiveness. In the operation of larger machines and engines, particularly marine engines and gear, the purity of the oil is of the greatest importance ^{whereas} ~~and it~~ is no problem to filter off various impurities such as metal dust, whereas water cannot be removed from the oil by filtration. And even a quite low content of water in the oil involves a considerable risk of inadequate lubrication causing a total break down of the machinery, so that it is important ~~to control~~ that the content of water in the oil is constantly kept below a given level. U.S. Patent No. 1,901,010 describes an apparatus for the removal of water from oil, but that apparatus is very expensive in operation and, ~~besides~~, larger machine installations normally comprise a centrifuge by means of which the water can be removed completely from the oil and even at a very low consumption of energy. Hence, the invention aims at providing an apparatus

which is not adapted to remove the water from the oil, but to evaporate enough water from the oil to obtain an indication of the content of water in the oil and produce an alarm signal as soon as the water content exceeds a certain value below the limit at which the water content becomes critical, whereupon the centrifuging operation is started. The said limit is very low and the measuring apparatus must therefore be sensitive to quite small quantities of water. U.S. Patent No. 2,571,470 describes an apparatus adapted to measure the content of ^{volatile} ~~volatile~~ substances in a liquid, but this apparatus is based on measurement of viscosity variations, which do not by far produce the sensitivity and accuracy necessary to ascertain with certainty when an oil is unsuitable for use in a lubrication system. ~~It has been found that this result can be achieved by an apparatus of the aforesaid type in which the upper surface of the said oil flow plate has an inlet opening communicating with a feed channel disposed at a lower level than the lower edge of the inlet opening and connected to an oil feed line including a valve and to a discharge opening including an overflow valve controlled in response to the temperature of the element and/or the discharge temperature of the oil so that its opening is increased at falling temperature and vice versa, and where the means for heating the element are adapted to give off a constant effect and the vapour discharge opening of the evaporation chamber is connected to a separate condenser at the outlet of which means are provided for determining the amount of water discharged per unit of time. In an apparatus of this~~

It is an object of the present invention to obviate or mitigate the aforementioned disadvantages.

5 The present invention is apparatus ~~apparatus~~ for use in determining the content of water in oil including means for evaporating the water comprising an element of high heat ^{storage} capacity in which is provided an evaporating chamber and means for heating the element, the evaporation chamber having an inlet opening and a bottom drain for oil, a discharge opening for water vapour and an inclined oil flow plate, the
10 inlet opening being provided in the upper portion of the oil flow plate and communicating with a feed channel disposed at a level below that of the lower edge of the inlet opening and connected to an oil feed line including a valve and to a discharge opening including an overflow valve adapted to be
15 controlled in response to the temperature of the element and/or the discharge temperature of the oil so that its opening can be increased at falling temperature and vice versa, the means for heating the element being adapted to give off a constant ^{heat} effect, and the vapour discharge opening of the
20 evaporation chamber being connected to a separate condenser at the outlet of which means is provided for determining the amount of water discharged per unit of time.

In an apparatus of this _____

construction an accurately controlled amount of oil is fed to the evaporation chamber and it has been found that by supplying a constant amount of heat to the element and allowing it to be cooled by the oil an extremely effective stabilization of the temperature of the element will be achieved and consequently a very accurate evaporation of the water in the oil, so that the quantity of water evaporated will present a clear, accurate and unambiguous indication of the content of water in the oil and enable an alarm to be signalled as soon as the amount of water exceeds a given limit, on which the centrifuge may be started to expel the water from the oil. The apparatus is extremely simple in operation; it is, so to speak, self-adjusting in that the overflow valve will regulate the amount of oil flowing through the evaporation chamber so that the cooling produced by the oil will be sufficient to maintain the temperature of the element at a constant level and thus secure the correct evaporation. The temperature of the oil to be controlled is normally about 50°C and to obtain a suitable evaporation the oil should expediently be heated during its passage through the chamber to about 120°C; this can be done in the apparatus described above but, obviously, the oil must be passed in known manner over a relatively long path through the evaporation chamber. It is also important that the evaporated water is passed to a separate condenser that operates independently of the evaporation chamber in order to avoid interaction between the two functions.

The determination of the amount of water discharged per unit of time may be performed in any expedient manner, but according to the invention it will be expedient to provide the apparatus with means for measuring the time intervals between the drops of water falling from the condenser because the amounts of water issuing from the condenser are very small and are discharged in the form of drops so that it is easy to determine the intervals of time between the drops, and these intervals are a direct measurement of the amount of water contained in the oil. To obtain a very simple and safe control of the temperature of the element the said overflow valve may be controlled by a ^{bimetallic strip} ~~bimetal spring~~ which is in heat conductive contact with the said element.

The invention will be described in greater detail below with reference to the drawing, in which

Fig. 1 shows an apparatus according to the invention viewed in side elevation,

Fig. 2 presents a section along the line II-II in Fig. 1,

Fig. 3 a section along the line III-III in Fig. 1, and

Fig. 4 a section along the line IV-IV in Fig. 3.

Fig. 1 shows an apparatus according to the invention comprising a box 1 containing an element 2 of high heat ^{storage} capacity and mounted on the side of a panel which is ~~likewise~~ of a heat-conductive material. Fig. 2 presents a section through the panel 3 which shows that the panel contains a vertical channel 4 opening at the bottom in an oil supply pipe branch 5. At the top the channel 4 is connected to a transverse channel 6

which in turn is connected to a vertical channel 7 having at the bottom an oil discharge branch 8. The transverse channel 6 is connected to a throttle valve 9 from which a delivery channel ¹⁰ extends vertically downwards. The delivery channel 10 communicates with a transverse channel 11 leading through a short insulated tube section 12 (see Fig. 4) to a ~~seed~~ ^{feed} channel 13 in the element 2. From the said ~~seed~~ ^{feed} channel a connection channel ^{or inlet opening} 14 leads to an evaporation chamber 15 at the upper end thereof and the channel 14 further communicates with an overflow valve 16 adapted to be ~~closed more or less~~ ^{influenced} by means of a ~~bimetal spring~~ ^{bimetallic strip} 17 secured to the element 2.

The evaporation chamber 15 comprises an inclined oil flow plate 18 which, as shown in Figs. 3 and 4, is provided with a plurality of transverse members ¹⁹ forming in the center a zig-zag flow path for the oil. At the bottom of the evaporation chamber 15 is an oil lock 28 which blocks the entry of water vapours and terminates in a discharge channel 20 for oil which opens immediately above the lower part of the bimetal ~~strip~~ ^{strip} spring 17 which is thus ~~actuated~~ ^{influenced} by the ~~outflowing~~ ^{Temperature of the} oil.

In the upper portion of the element 2 is a discharge opening 21 for water vapour which is carried through an insulated line 22 (see Fig. 1) to the panel 3 where it opens into two interconnected vertical channels 23 serving as ^a condenser and having a common outlet 24 at the bottom (see Fig. 1 and 3) from which the condensed water may run off dropwise.

Immediately beneath the outlet 24 is mounted a pair of electrodes 25 so that a drop falling between these electrodes will cause a brief leakage between the electrodes and that

leakage may be used in any expedient manner to detect the passage of the drop and thus to measure the time intervals between the drops.

lower walls which converge downwardly to a lower edge,

has

convergent lower walls

The box 1 ^{*lower edge is*} is downwardly ^{*16*} printed, and slightly upwardly of the point it has an outlet 26 for oil which may issue partly

from the overflow valve 16 and partly from the channel 20.

In the element 2 are provided heating elements 27 which are supplied with constant energy in any expedient manner.

When oil is fed to the apparatus through the channel 4 and the transverse channel 6 part of that oil will pass the throttle valve 9 and thus a controlled amount of oil will pass through the delivery channel 10, the channel 11 and the channel 14, from which it enters the evaporation chamber 15, and after having passed the chamber it passes out through the channel 20 running over the ^{*bimetallic strip*} ~~bimetal spring~~ 17 and into the bottom of the box 1, from where it may run off through the opening 26 when so much oil has been supplied ^{*is supplied at*} that the box 1 is filled up to that level. The oil ~~has~~ a temperature of about 50°C , and the temperature at which water to be evaporated from the oil is about 120°C , which is provided substantially by means of the heating elements 27, and thus the oil will act as cooling agent for the element 2. Thus equilibrium is produced between the cooling and the constant heating, for the ^{*bimetallic strip*} ~~bimetal spring~~ acting in response to the heat from the element 2 and the oil flowing through the channel 20 over the ^{*bimetallic strip*} ~~bimetal spring~~ will control the amount of oil flowing through the overflow valve 16 and correspond-

ingly regulate the amount of oil flowing through the evaporation chamber. If the temperature of the element 2 tends to rise above the desired value the ~~bimetal spring~~ ^{bimetallic strip} 17 ~~will~~ ^{move closer to} ~~cause~~ the overflow valve 16 to ~~close more~~ ^{restrict exit therefrom}, so that a larger amount of cooling oil passes through the evaporation chamber, but these variations are relatively small and do not affect the amount of water which is evaporated from the oil, so the amount of vapour passing through the opening 21 and into the condenser tubes 23 will currently indicate the relative content of water in the oil with adequate accuracy. Conversely, the ~~bimetal spring~~ ^{bimetallic spring} will ~~open more~~ ^{move away from} for the overflow valve 16 if the temperature of the element 2 tends to fall below the desired value ^{and so permit a higher rate of exit through valve 16}. Effective control of the ~~bimetal spring~~ ^{is} obtained partly by good contact with the element 2, partly by the fact that the oil flowing out through the channel 20 has ~~got~~ a temperature corresponding to the temperature of the element 2 and that the oil as described will strike the lower part of the ~~bimetal spring~~ ^{bimetallic strip}. The recording of the issuing drops of water may be performed in any expedient manner, for it is obvious that the mere watching of the frequency of the drops will convey an impression of the relative content of water in the oil and by direct measurement of the time intervals and a suitable control it will be possible to determine the ~~percentage~~ ^{age} content of water for instance in the form of a curve, or the time intervals may be applied directly in an electronic device to generate an alarm signal or possibly for automatic starting of centrifuges for removing water from the oil. The device employed for this purpose does not form part of the invention, but may be of any expedient construction and in accordance with generally known art.

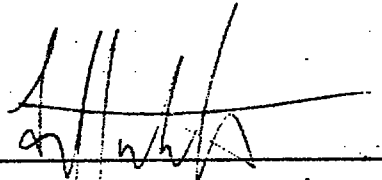
WHAT I CLAIM IS:

use in
1. An apparatus ~~for~~ determining the content of water in oil ~~and~~ including means for evaporating the water ~~and~~ ~~controlling the quantity of water after condensation of the vapour, and containing~~ *comprising* ^{*instead*} an element of high heat capacity in which is provided an evaporation chamber and means for heating the element, the evaporation chamber having an inlet opening and a bottom drain for oil, a discharge opening for water vapour and an inclined oil flow plate, *the inlet opening being provided in* ~~characterized in that~~ ^{*portion*} the upper surface of the said oil flow plate ~~has an inlet opening~~ ^{*and*} communicating with a feed channel disposed at a lower level ^{*below that of*} than the lower edge of the inlet opening and connected to an oil feed line including a valve and to a discharge opening including an overflow valve ^{*adapted to be*} controlled in response to the temperature of the element and/or the discharge temperature of the oil so that ^{*can be*} the opening ~~is~~ increased at falling temperature and vice versa, ~~that~~ ^{*being*} the means for heating the element ~~are~~ adapted to give ^{*heat*} a constant effect, and ~~that~~ ^{*being*} the vapour discharge opening of the evaporation chamber ~~is~~ connected to a separate condenser at the outlet of which means ^{*to*} ~~are~~ provided for determining the amount of water discharged per unit of time.

2. An apparatus according to claim 1, ~~characterized in that~~ ^{*which*} the means for determining the amount of water discharged per unit of time ^{*comprising*} ~~are~~ means for measuring the time intervals between drops of water falling from the condenser.

3. An apparatus according to claim 1 or 2,
~~characterized~~ ^{which} in ~~that~~ the said overflow valve
is controlled by a ~~bimetal~~ ^{bimetallic strip} spring which is in heat conductive
contact with the said element.

4. An apparatus for determining the content of water in oil
substantially as herein described and as illustrated in the accompanying
drawing.


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