

July 15, 1930

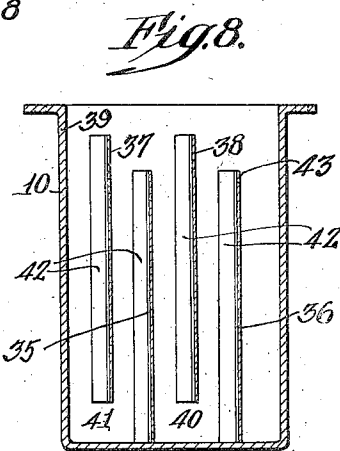
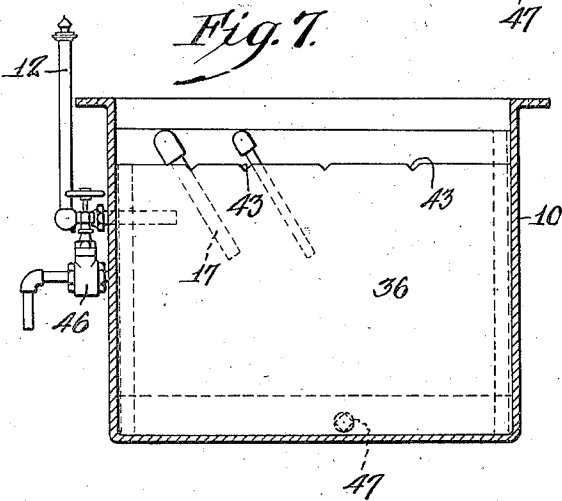
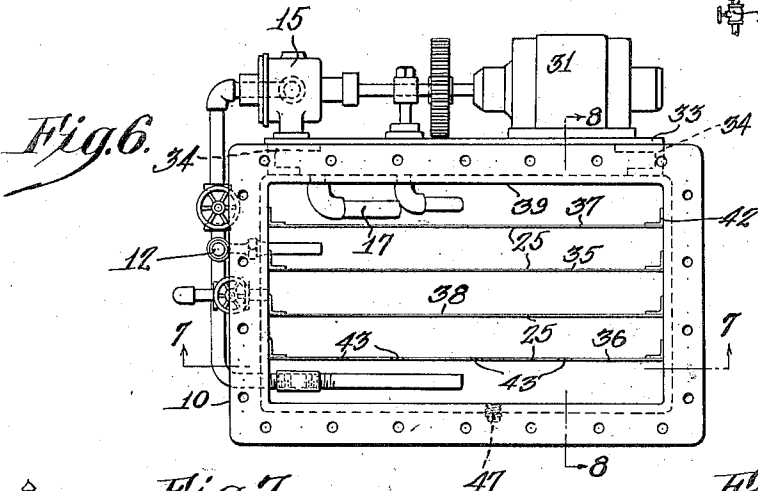
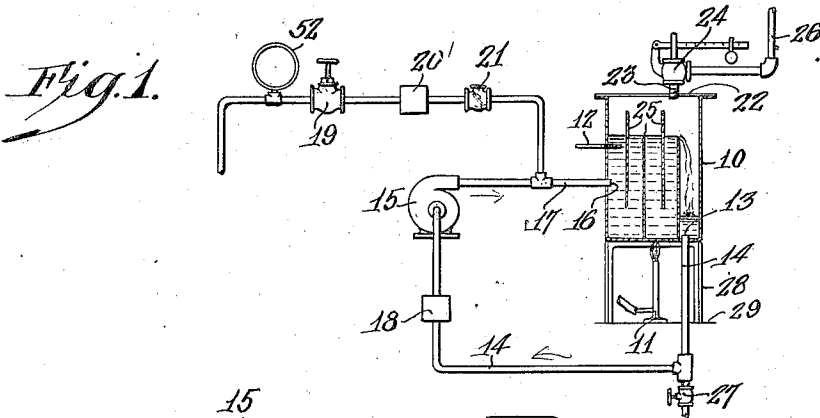
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1,770,735

OIL SLUDGE ACCELERATOR

Filed June 28, 1924

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

Fig. 2.

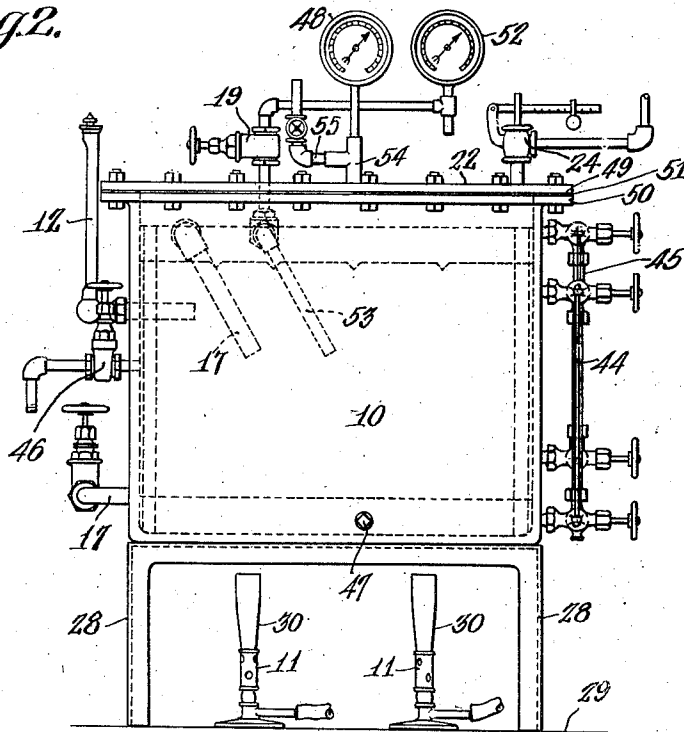
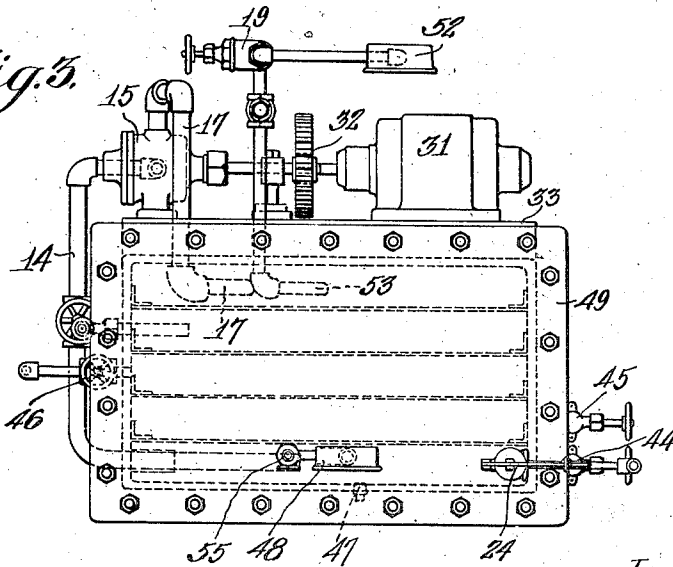


Fig. 3.



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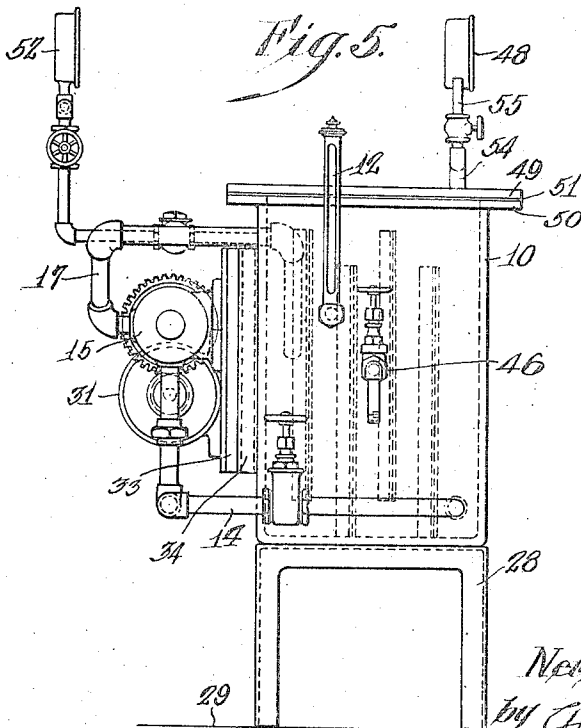
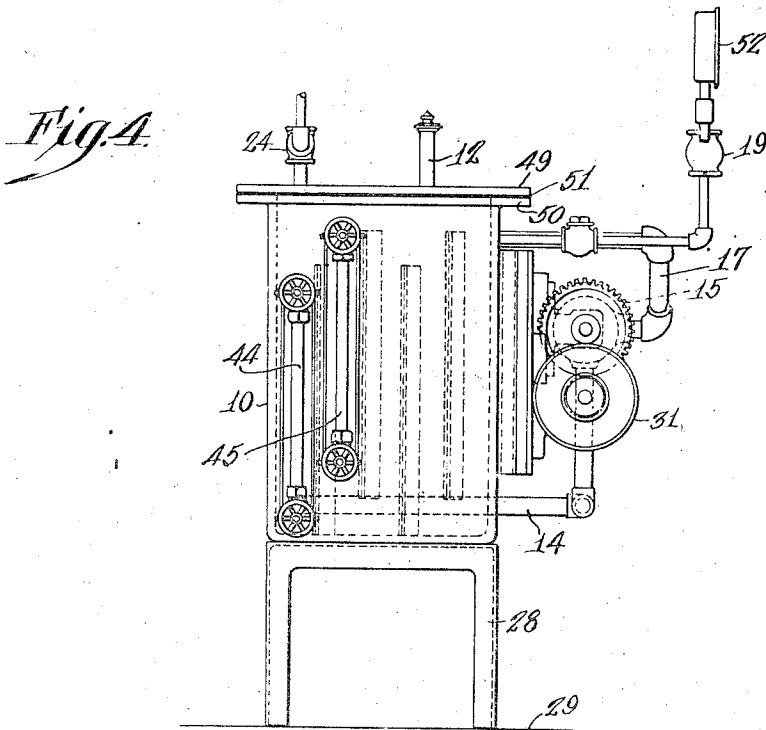
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OIL SLUDGE ACCELERATOR

Filed June 28, 1924

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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OIL-SLUDGE ACCELERATOR

Application filed June 28, 1924. Serial No. 723,057.

My invention relates to appliances for testing lubricating oil, with particular reference to its adaptation to turbine service.

A purpose of my invention is to subject an oil sample intensively to the deterioration influences that exist in turbine service, measuring the adaptation of the oil to turbine service by its ability to resist the deteriorating action of these influences.

A further purpose is to intensively simulate turbine conditions with respect to the action of heat, air, water and contact with metal surfaces, during a laboratory test of oil.

A further purpose is to rapidly circulate an oil sample in contact with metal surfaces while mixed with air and water and heated, tested upon a laboratory scale to determine the adaptation of the oil to turbine service.

A further purpose is to provide a method of test suitable for use in testing samples themselves or for use in verification of the reliability of other tests upon samples as preferred.

A further purpose is to provide a preferred form of apparatus for carrying out my method of testing.

My invention relates to the methods involved and also to apparatus for carrying them out.

Of many different forms of apparatus applicable for carrying out my process I have preferred to show one only, taking a form, however, which has shown itself in practice to be convenient and efficient and which also illustrates particularly well the principles involved.

Figure 1 is a diagrammatic view to illustrate the process.

Figure 2 is a side elevation of one form of sludging apparatus.

Figures 3, 4 and 5 are respectively top plan views and right and left end elevations of the structure of Figure 1.

Figure 6 is a top plan view of the sludging tank without the cover.

Figure 7 is a sectional elevation taken on the line 7-7 of Figure 6.

Figure 8 is a section of Figure 6 taken upon the line 8-8.

In the drawings like parts are indicated by the same characters.

Referring to the figures and describing in illustration and not in limitation:—

My invention has been directed primarily toward devising means for predicting with reasonable sureness the way in which given lubricating oils are likely to stand up in turbine service.

I have found that hitherto existing laboratory tests for lubricating oils have been inadequate and unreliable in so far as they have been used to determine the adaptation of oils to long life in turbine service.

Deterioration of lubricating oil in turbine service appears to be due to a combination of heat, air, water and contact with metal surfaces, which with a greater or lesser rapidity sludge the oil, that is, precipitate from it a complex combination of hydrocarbon acid radicals. Simultaneously with the sludging action the oil emulsifies with any water present to a greater or lesser extent and rapidly according to the nature of the particular oil. When the oil neither sludges nor emulsifies freely it may still deteriorate by becoming intensively acid.

I have discovered that oils can be subjected intensively to the same character of deteriorating influences that exist in the turbine and that in practice those oils which stand up well when so subjected upon a laboratory scale stand up well in turbine service and, vice versa, those oils that do not stand up well to this character of intensive laboratory test do not stand up in the turbine. I find sludging and emulsification the most general and reliable bases for comparison.

Figure 1 is a diagrammatic sectional elevation of a sludging accelerator in operation.

Broadly the accelerator comprises any means for subjecting a sample of oil to deteriorating influences, which will preferably involve means for maintaining the oil sample at an elevated temperature, as 210° F., and circulating it over a considerable extent of metal surface while in intimate contact with controlling proportions of air and of water. If all of these factors are made and maintained definite, different oils can be reliably com-

pared and their performances in a turbine can be predicted.

In Figure 1 a metal box 10, provided with heater 11 and thermometer 12, is open at one side at 13 to the suction (inlet) pipe 14 of a circulating pump 15, and is open at the other side at 16 to the discharge pipe 17 from the same circulating pump 15. A meter 18 in a pipe 14 offers facility for determining the rate of circulation. A definite air supply is provided from any source of compressed air at valve 19 through meter 20 and check valve 21 into the discharge pipe 17 of the circulating pump. A cover 22 having an outlet pipe 23 closed by an adjustable relief valve 24 adapts the box to operation at any pressure if desired. Longitudinal vertical baffles 25 may be provided, spaced between the inlet at 16 and the outlet at 13 to definitely guide the flow and increase the velocity of flow between these two points and to increase the metal contact.

A sample of oil mixed with a predetermined proportion of water is introduced into the box through the open pipe 26 after raising the relief valve to permit the sample to flow into the box. This oil is now heated to the intended temperature, usually 210° F., and is maintained at this temperature by proper regulation of the heat at the burner 11. The sample is now circulated at the selected rate by means of the pump 15, a controlled stream of air being added at valve 19. The pressure within the box rises to that corresponding to the setting of the relief valve which then opens just enough to maintain this pressure, air continuously escaping out the open pipe 26. Periodically small samples are withdrawn at valve 27 and examined with respect to total sludging and emulsification with the water, the freedom from these being a rough measure of the way in which the oil will stand up in turbine service.

Frequently it is preferable to meter the air after it leaves the box from the pipe 26, it being then at atmospheric pressure. This is particularly true if the meter used, which may be an ordinary gas housemeter, is unsuited for pressures desired within the box. When the air meter is placed on the discharge side of the box it is well to wash the air by bubbling it through water before passing it to the meter to remove fumes from the hot oil which will otherwise soil the meter.

When impairing influences are to be exerted at atmospheric pressure, the cover 22 of the box may if desired be left off. This may be desirable in order to subject the oil under test to the added influence of light, but interferes with control of the quantity of air to which the oil is to be subjected.

Describing the preferred form shown in Figures 2 to 8, the box 10, preferably made of sheet metal, is supported upon suitable legs

28 to stand upon a table or shelf 29 above Bunsen burners 30.

The circulating pump 15 and its motor 31 with intermediate gearing 32 between the motor and pump, together form a self-contained unit with the box, being supported and carried by the box. These motor and pump units are supported directly upon a suitable motor board 33 bolted at opposite ends to vertical channel members 34 which are in turn fastened (as by riveting) to the box structure.

The baffles 25 are also preferably of sheet metal. They are shown as vertical and as extending longitudinally between opposite ends of the box. Alternate baffles, 35 and 36 respectively in the figures, extend all the way to the floor, forming longitudinal dams the full length of the box. Baffles 37 and 38, respectively between the side walls 39 of the box and the dam baffle 35 and between the two dam baffles, 35 and 36 are spaced above the floor of the box and extend well above the tops of the dam baffles. The dam spaces 40 and 41 should be adapted to suitable drainage, as by avoiding oil tight engagement of baffles 37 and 38 with the bottom.

All of the baffles are bolted to vertical angles 42 which are in turn riveted to the end walls of the box.

Oil passing through the box flows successively over the tops of the dam baffles and the tops of these baffles are advantageously provided with V-notches 43.

I provide gauge glasses 44 and 45 to show the liquid level in the last and in the next to the last passes of the box. These glasses permit the operator to determine at a glance whether or not the oil is circulating through the box.

In Figure 1 I have shown the same valve 27 for use for the double purpose of drainage of the system and of withdrawing periodic small samples for examination as to the extent of sludging and emulsifying. In the preferred form, however, I provide separate connections 46 and 47 respectively, for sampling and for drainage, the sampling connection 46 being conveniently connected with the first pass and well above the floor of the box while the drainage connection 47 is from the floor of the box in the last pass.

The box cover 22 carrying pressure gauge 48 and relief valve 24 has a bottom flange 49 for registry with the corresponding flange 50 around the top of the box.

When the box is to operate under pressure a gasket 51 is placed between the two flanges which then are bolted tightly together. If there be no pressure within the box the cover does not need to be tightly bolted down and the gasket may be dispensed with, or if it be desired to subject the oil to the influence of light the cover may be left off altogether.

It is convenient to have a pressure gauge

in the air supply line and this is shown in the preferred form at 52.

In diagrammatic Figure 1 the air passage supply is shown connecting into the circuit outside of the box, namely into the discharge pipe 17 from the circulating pump, the air and circulating oil going in together into the box from the pipe 17. However, Figures 2 to 8 show a preferred separate pipe 53 for air delivery into the first pass of the box. Pressure gauge 48 is connected into the top of the cover through pipe 54.

A pipe 55 connects with pipe 54 and is used for introducing the charge of sample oil to be sludged, which oil, in Figure 1 is introduced through the automatic relief valve 23. This permits the pressure within the box to be indicated continuously at the gauge. Usually air delivery is measured by a meter placed beyond the box in series with the discharge pipe of the relief valve, as already explained.

The preferred form does not show a meter 18 in the circulating circuit. Its meter function is sufficiently performed by the pump and motor, in well known manner.

When there is little or no water present the oil will acidify with comparatively slight sludging, and oils could be compared to advantage by the extent of acidification. On the other hand when water is present in considerable quantity the oils will emulsify and at the same time sludge, to variant degrees. Comparison of the degrees of either emulsification or sludging might therefore be more desirable than the acidification as a basis of test according to the characteristics shown by the particular oil under consideration.

Either sludge or emulsion is injurious, and prohibitive when in quantity, because either one will cover up the turbine surfaces to prevent free transfer of heat and will clog its passages to prevent free transfer of fluid.

It will be evident therefore that the value of the broader aspects of my invention is not dependent upon any particular characteristic or quality by which the oil has been charged when subjected to the deteriorating influences provided by me, but depends upon the fact that deterioration of whatever character does take place in my test apparatus in the same manner as and to a very much greater extent for the same time than in use in turbines for example, and that with my method, the accelerated deterioration can be determined subsequently by any of a variety of tests independently of my machine.

The variation of acidity may be determined by ordinary A. S. T. M. tests and the relative quantity of sludge and emulsion may be determined volumetrically by centrifuge, the two being separated by treatment with benzol and a second centrifuging.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless

become evident to others skilled in the art and I, therefore, claim all such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. The method of testing lubricating oil which consists in subjecting a sample to circulation in the presence of the deteriorating influences that it has to meet in service outside of its path of normal use and to an extent much more intense than it would meet in use, thus causing deterioration, in determining the extent of the deterioration and in comparing the resultant deterioration with that of other oils similarly used, thus determining its relative adaptation to lubrication service.

2. The method of testing lubricating oil which consists in subjecting a sample outside of its path of normal use to an extent much greater than it would meet in use, to heat and to contact with air, while positively circulating it, thus causing the deterioration in determining the extent of the deterioration and in comparing its resultant deterioration with the deterioration of other oils under similar circumstances, thus determining its relative adaptation to lubrication service.

3. The method of testing lubricating oil which consists in subjecting a sample intensively to heat and to contact with air and water free from the machine in which the oil is normally used, in determining the extent of the deterioration and in comparing its ultimate deterioration under these conditions with the deterioration of other oils under similar conditions, thus determining its relative adaptation to lubrication service.

4. The method of testing lubricating oil which consists in subjecting a sample intensively to pressure, heat, and to contact with air and water free from the machine in which the oil is normally used, in determining the extent of the deterioration and in comparing the resultant deterioration with the deterioration of other oils similarly used, thus determining its relative adaptation to lubrication service.

5. The method of testing lubricating oil which consists in subjecting a sample intensively to heat and light and to contact with air and water free from the machine in which the oil is normally used while positively circulating it, in determining the extent of the deterioration and in comparing its resultant deterioration with the deterioration of other oils subjected to the same conditions, thus determining its relative adaptation to lubrication service.

6. The method of testing lubricating oil which consists in rapidly circulating a sample outside of its path of normal use across metal surfaces while maintaining the sample heated and in intimate contact with

- air and water, in determining the extent of the deterioration and in comparing its resultant deterioration with the deterioration of other oils subjected to the same conditions, thus determining its relative adaptation to lubrication service. 70
- NEVIN E. FUNK.
7. The method of testing lubricating oil which consists in subjecting a sample to the deteriorating influences of air and water while positively circulating it free from the machine in which the oil is normally used, in determining the extent of the deterioration and in comparing its resultant deterioration with deterioration of other oils subjected to the same conditions, thus determining its relative adaptation to lubrication service. 75
8. In apparatus for testing lubricating oil, a box having metal surfaces therein, means for rapidly circulating an oil sample over the surfaces in the presence of air and moisture, and other means outside the box for heating the oil free from the mechanism in which the oil is normally used. 80
9. In apparatus for testing lubricating oil, an oil deterioration accelerator comprising a box having metal surfaces therein, means for circulating the oil, means for passing air into the oil, and means for heating the box. 85
10. In an oil deterioration accelerator, a box having bottom and side walls, spaced baffles therein alternately extending to one of the walls and stopping short of it, forming a continuous channel alternating in direction, following the baffles between them and turning about the ends of the baffles, a circulating pump having inlet from one end of the channel and discharge into the other, means for discharging air into the circulating stream, and means for heating the box. 90
11. In apparatus for testing lubricating oil, a box having a metal-walled passage therein artificially extended to a greater length than the box length occupied, to give metal surface contact and means for circulating the oil through the passage repeatedly under predetermined conditions of heat to artificially and intensively deteriorate the oil. 95
12. In apparatus for testing lubricating oil, a box having a metal-walled passage therein artificially extended to a greater length than the box length occupied, to give metal surface contact and means for circulating the oil through the passage repeatedly under predetermined conditions of heat, air and moisture. 100
13. An oil testing device comprising a casing having a metal-walled passage therein, artificially extended to a greater length than the casing length occupied, a heater for the passage and a pump connected to the ends of the passage to circulate the oil through the passage. 105
14. An oil testing device comprising a casing having a metal-walled passage therein, artificially extended to a greater length than 110
- 115
- 120
- 125
- 130