APPROATUS FOR TREATING USED LUBRICATING OIL

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2 Sheets-Sheet 2

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This invention relates to improvements in apparatus for treating used lubricating oil and more especially contaminated lubricating mineral oil taken from crank-cases of internal combustion engines.

The primary object of this invention is not only to separate non-lubricating oil, water and acidity from said used lubricating oil, but to produce highly practical apparatus for the economical treatment of the used lubricating oil with greater facility and at a lower cost than heretofore.

With this object in view, and to attain other objects hereinafter appearing, this invention consists in certain meritorious features of construction, and combinations and relative arrangements of parts, hereinafter described and claimed, and illustrated in the accompanying drawings.

In said drawings, Figure 1 is a top plan, partly in section, of our improved apparatus for treating used lubricating oil. Fig. 2 is a side elevation, partly in section and partly diagrammatic, of said apparatus. Fig. 3 is an elevation, largely in section, of a portion of the apparatus shown in Fig. 2. Fig. 4 is a horizontal section taken along the dashed line 4-4 in Fig. 3, looking downwardly. Fig. 5 is a vertical section taken along the dashed line 5-5 in Fig. 2, looking in the direction indicated by the arrows. Figs. 3, 4 and 5 are drawn on a larger scale than Figs. 1 and 2.

Referring to Fig. 2 of the drawings, the horizontal line A indicates the level of a floor on which our improved apparatus is installed. Said apparatus (see Figs. 1 and 2) comprises a substantially vertical still-tank B spaced upwardly from said level and supported by upright steel channel members 9 which are spaced circumferentially of the tank and rest on the floor. The supporting members 9 are welded or otherwise secured to the still-tank. Our improved apparatus (see Fig. 3) also comprises a substantially horizontal charging tank C arranged at one side of the lower portion of and lower than and spaced from the still-tank B and supported, as shown in Fig. 2, from metal framework 10 resting on the floor. Still-tank B and charging tank C are so relatively arranged that, were the charging tank filled to the top thereof with used lubricating oil, the body of oil supplied to the charging tank would be wholly below the surface level of a body of used lubricating oil to be contained and treated in the still-tank, and the dashed horizontal line 12, in Fig. 3, represents the level of the body of oil to be maintained in the still-tank during the operation of the apparatus.

Piping D (see Fig. 3), is arranged to feed oil from still-tank B to charging tank C and preferably comprises a substantially horizontal lower pipe-section 13, an upright intermediate pipe-section 14, and a substantially horizontal upper pipe-section 15. The lower horizontal pipe-section 13 of piping D is arranged lower than and extends under still-tank B, and said pipe-section is placed in communication at and centrally of the bottom of and with said tank in any approved manner. The upright pipe-section 14 is arranged between still-tank B and charging tank C and placed in communication at its lower end, by an elbow 16, with the lower horizontal pipe-section 13. The upper horizontal pipe-section 15 of piping D is arranged higher than and extends over charging tank C and is placed in communication with the upright pipe-section 14 by a T 17. The upper horizontal pipe-section 15 of piping D is placed in communication at the top of one end portion of and with charging tank C, and said tank is placed in communication at the bottom of its other end portion with piping E shown extending under the lower horizontal pipe-section 13 of the first-mentioned piping D and employed in feeding oil from the charging tank during the operation of the apparatus. Piping E measures preferably considerably less in internal diameter than piping D.

An upright drain-pipe 18 (see Fig. 3) extends between and is connected to piping D and piping E, and said drain-pipe is arranged to discharge into piping E and communicates with piping D preferably at the bottom of elbow 16 and therefore at the bottom of the last-mentioned piping. Said
drain-pipe measures in internal diameter preferably considerably less than piping E and very considerably less than piping D.

The upper horizontal pipe-section 15 and 17 of piping D (see Fig. 3) are preferably arranged about half above and half below the oil-level 12 to be maintained in the still-tank B so that during the operation of the apparatus the top portion of the passage in said pipe-section is not filled with oil, and said portion of said passage, and therefore the charging tank, are continuously in communication with a vent-pipe 20 extending upwardly from and attached to the T 17 and placed in communication through the medium of said T with said passage. The pipe 20 is placed in communication, above piping D, with the still-tank B, and therefore communicates with the vapor space in said tank at a point spaced upwardly from the oil-level 12 to be maintained in said tank during the operation of the apparatus.

Piping E (see Fig. 2) extends not only to the drain-pipe 18 but beyond said pipe to the inlet of a diagrammatically illustrated pump G operated in any approved manner and shown mounted on the floor. An oil-supply pipe 21, having a normally closed valve 22, is connected with and arranged to discharge into piping E at a point intermediate pump G and drain-pipe 18. Piping E is provided, between drain-pipe 18 and oil-supply pipe 21, with a normally open valve 23.

The still-tank B (see Figs. 3 and 4) is provided, at one side thereof and below the oil-level 12 to be maintained in the still-tank, with an oil-inlet 25 at which oil is adapted to enter the still-tank, and said oil-inlet is preferably spaced farther from the bottom of the still-tank than from said level and largely formed in a reinforcing lug 26 with which said tank is externally provided. The oil-inlet 25 of the still-tank is in communication with piping H arranged to discharge through said inlet into said tank, and the discharging end portion of said piping preferably extends into and is tightly embraced by lug 26.

Piping H (see Fig. 2) extends to oil-inlet 25 of still-tank B from a point adjacent the discharging end of piping E, and pump G is arranged to pump oil from piping E into piping H.

As already hereinbefore indicated, charging tank C is spaced laterally from still-tank B in one direction, and it will be observed (see Figs. 1 and 2) that a furnace I is installed on the floor and spaced laterally from the still-tank in the opposite direction. Piping E comprises an oil-heating coil 27 arranged (see Fig. 2) within the combustion chamber 28 of the furnace. The furnace I comprises a heating burner 29 arranged under coil 27, and 30 indicates a pipe for feeding liquid or gaseous fuel to said burner. The coil 27 is therefore arranged to be heated by products of combustion ascending from burner 29 during the operation of the furnace.

The oil-inlet 25 of still-tank B and the discharging end portion of piping H (see Fig. 4) are arranged tangentially to the circumference of the still-tank and therefore arranged tangentially to the circumference of a body of oil having the level 12 and contained in the still-tank during the operation of the apparatus.

Piping H (see Fig. 2) is provided, between pump G and furnace I, with a normally closed valve 32, and an oil-outlet pipe 33 employed in removing reclaimed lubricating oil from the system after the required treatment of a body of used lubricating oil, is connected to and communicates with said piping between said valve and pump and has a normally closed valve 34.

A vapor-conducting pipe 35 leads from the upper end of the still-tank B and constitutes the vapor-outlet of said tank, and said pipe (see Fig. 2) is arranged to discharge into the upper end of worm 36 of a water-cooled condenser comprising a water-tank 37 containing said worm and shown supplied with water 38 and spaced upwardly from charging tank C and supported from framework 10. The water-tank 37 is provided with a water-supply pipe 39 arranged to discharge into the upper portion of said tank, and said tank is also provided with a drain-pipe 40 having a valve 41. The water-tank 37 is placed at the bottom thereof in communication, by a pipe 42, with a distillate-collecting tank K supported from framework 10 and arranged between charging tank C and water-tank 37. The distillate-collecting tank is provided with a drain-pipe 43 for draining distillate from said tank, and said drain-pipe is provided with a valve 44.

The vapor-conducting pipe 35 (see Fig. 2) is provided, between the condenser and still-tank B, with a short air-inlet pipe 45 which communicates with the external atmosphere and has a normally closed valve 46.

Means whereby steam may be supplied to piping H at a point between valve 32 of said piping and the lower end of coil 27, or between the upper end of said coil and still-tank B, comprises an upright main steam pipe 47 arranged (see Fig. 2) between said valve and furnace I. The steam-pipe 47 is provided (see Fig. 5) with two vertically spaced and substantially horizontal branch-pipes 48 and 49 and has a normally closed valve 50 between said branch-pipes. Each of the branch-pipes 48 and 49 is provided with a normally closed valve 51. A substantially horizontal drain-pipe 52 is arranged at the lower end of the main steam-pipe 47 and substantially in line endwise with the lower branch steam-pipe 49. The
drain-pipe 52 is employed in effecting the drainage, from the lower end of main steam-pipe 47, of water resulting from condensation of steam in said pipe and connected branches 48 and 49. The drain-pipe 52 has a normally closed valve 53. The upper branch steam-pipe 48 (see Figs. 1 and 5) is arranged to discharge into piping H at a point between the discharging end portion of said piping H and the upper end of coil 27. The lower branch steam-pipe 49 (see Figs. 1 and 5) is arranged to discharge into piping H at a point between valve 32 of said piping and the lower end of said coil. By the hereinbefore described valved main steam-pipe 47 and connected valved branch steam-pipes 48 and 49 steam may be supplied through the upper branch steam-pipe 48 to piping H, or to said piping through the lower branch steam-pipe 49.

The operation of the apparatus is as follows:—The valve 23 (normally open) of piping E is closed and the valve 32 (normally closed) of piping H is opened, and then valve 23 of oil-supply pipe 21 is opened to feed oil into piping E between valve 23 and pump G, and the pump is operated to pump oil from piping E into and through piping H into still-tank B. As soon as the still-tank has been supplied with a body of oil having a surface level higher than the bottom of the passage in the upper horizontal pipe-section 15 of piping D oil begins to flow by gravity from the still-tank through said piping into charging tank C. As said passage in said upper horizontal section 15 of piping D is arranged above as well as below the oil-level 12 to be maintained in still-tank B while purification of oil undergoing treatment in the still-tank occurs during the operation of the apparatus and, as vent-pipe 20 is placed in communication through said upper portion of said passage with the charging tank and placed in communication above said oil-level with the still-tank, venting of the charging-tank into the vapor space in the still-tank at all times is insured, and siphoning of oil through piping D from the still-tank is prevented.

The valve 23 of oil-supply pipe 21 is, of course, closed as soon as the system has been supplied with the desired quantity of oil for purification, and then pump G is operated not only until the desired oil-level 32 in still-tank B is attained but until the charging tank C has been supplied with the desired quantity of oil, and then valve 23 of piping E is opened and operation of the pump is continued to effect a continuous flow of oil from the charging tank through piping E and through piping H into the still-tank from which there is a continuous flow of oil by gravity through piping D into the charging tank. The furnace I is operated to effect the heating of coil 27 of piping H to the extent required to heat the oil flowing through said coil to a temperature of from about four hundred and seventy-five degrees to about five hundred and twenty-five degrees Fahrenheit. When the oil has been heated to a temperature of from about two hundred and forty degrees to about two hundred and eighty degrees Fahrenheit and preferably to about two hundred and sixty degrees Fahrenheit, the valve of the upper branch steam-pipe 48 is opened to supply steam to piping H between the oil-inlet of the still-tank and the upper end of coil 27, or valve 30 of main steam-pipe 47 and the valve of the lower branch steam-pipe 49 are opened to permit the supply of steam to piping H between the lower end of said coil and valve 32 of said piping H, as may be preferred. Low pressure steam is preferably used in the treatment of the used lubricating oil. Preferably, when steam is supplied to piping H through the upper branch steam-pipe 48, the valve of the lower branch steam-pipe 49 is kept closed, and valve 30 of main steam-pipe 47 is not kept closed tight enough to prevent water resulting from condensation of steam to pass to drain-pipe 52. Obviously, therefore, proper manipulation of valve 50 of main steam-pipe 47 and valve 51 of upper branch-pipe 48 enables the desired supply of steam to piping H between the oil-inlet of the still-tank and the upper end of coil 27 without interfering with the passage, to drain-pipe 52, of water resulting from condensation of steam, and the supply of steam to the hot oil fed by piping H results in mixing steam with hot oil and in the discharge of steam and hot oil together into the still-tank.

The hereinbefore described arrangement of the discharging end portion of piping H tangentially in relation to the circumference of a body of oil undergoing treatment in the still-tank results in the discharge of oil and steam into the still-tank tangentially in relation to said circumference during the operation of the apparatus, and said discharge of said oil and steam tangentially in relation to said circumference results in economical stirring of the oil under treatment to such an extent as to break up any oil-foam during the foaming stage of the oil at about from two hundred and forty degrees to about two hundred and eighty degrees Fahrenheit.

By the hereinbefore described treatment of used lubricating oil non-lubricating liquid matter in the still-tank B is vaporized and removed, and the steam supplied with hot oil to said tank facilitates movement, from the body of oil undergoing treatment to the vapor-conducting pipe 35, of all gases and vapors to be eliminated, and obviously therefore, gasoline vapors and aqueous vapors and accompanying gases are conducted off by said pipe.

Oil is contained in the still-tank, charging
tank and pipe connections between the pump and said tanks during the circulation of oil when the pump is operating while oil is being treated in the still-tank.

When the required treatment of the desired quantity of used lubricating oil in the system has been completed, operation of pump G is interrupted and valve 32 of piping H and valve 51 of upper branch-pipe 48 are closed, and valve 51 of lower branch-pipe 49 is opened and valve 53 of drain-pipe 52 is kept tightly closed, and steam is admitted through valve 50 of main steam-pipe until contents of the oil-heating coil 27 have been blown out by steam into the still-tank. Then valve 50 of main steam-pipe 47 and valve 51 of lower branch-pipe 49 are again tightly closed and valve 46 of air-inlet 45 of vapor-conducting pipe 35 is opened, and then pump G, after opening valve 34 of oil-outlet pipe 33, is again operated as required to pump the treated oil out of the system through said oil-outlet pipe. Preferably the treated oil conducted off by said oil-outlet pipe is filtered in any approved manner before use of the oil for lubricating purposes.

Of vast importance to the successful operation of our improved apparatus for treating used lubricating oil is the drain-pipe 18 extending from piping D to piping E and measuring enough less in internal diameter than piping D and piping E to substantially only function in effecting the drainage, from piping D into piping E, of water that may accompany oil passing from piping D into piping E, and for heating oil being fed to the still-tank, and a drain-pipe placed in communication with the first-mentioned piping and with the second-mentioned piping, said drain-pipe and connected first-mentioned piping and second-mentioned piping being relatively arranged and capacitated to effect the drainage, into the second-mentioned piping, of water that may accompany oil being conducted from the still-tank by the first-mentioned piping.

2. Apparatus of the character indicated comprising a still-tank having a vapor-outlet, a charging tank arranged externally of the still-tank, piping having a lower portion which is placed in communication at the bottom of and with the still-tank and also having an upper portion which is placed in communication at the upper portion of and with the charging tank and comprising an upright section connecting together said upper and lower portions of said piping, a pump, piping arranged to feed oil to said pump from the charging tank and measuring less in internal diameter than the first-mentioned piping, piping arranged to feed oil from said pump to the still-tank and discharging into the lower portion of the still-tank, means for heating oil being fed to the still-tank, means whereby steam may be supplied to oil being fed to the still-tank, and a drain-pipe arranged to drain water at the bottom of the aforesaid lower portion of and from the first-mentioned piping and discharging into the second-mentioned piping and measuring in internal diameter considerably less than said second-mentioned piping and very considerably less than the first-mentioned piping.

3. Apparatus of the character indicated comprising a still-tank having a vapor-outlet and an oil-inlet which is arranged at one side of the lower portion of said tank, a charging tank arranged adjacent the lower portion of the still-tank and lower at its top than said oil-inlet, piping having a lower portion which is placed in communication at the bottom of and with the still-tank and comprising an upper portion which is placed in communication at the top of and with the charging tank and also comprising an upright section connecting together said upper and lower portions of said piping, a pump, arranged to feed oil to said pump from the bottom of the charging tank and measuring less in internal diameter than the first-mentioned piping and arranged lower than the aforesaid lower portion of said first-mentioned piping, piping arranged to feed oil from said pump to the aforesaid oil-inlet of the still-tank, means for heating oil being fed to said oil-inlet, means whereby steam may be supplied to oil being fed to said oil-inlet, and a drain-pipe measuring less in internal diameter than and discharging into the second-mentioned piping and communicating at the bottom of the lower portion of and with and extending downwardly from the first-mentioned piping.

4. Apparatus of the character indicated...
comprising a still-tank having a vapor-outlet, a charging tank arranged adjacent the lower portion of the still-tank, piping having a lower portion which is placed in communication at the bottom of and with the still-tank and also having an upper portion which is placed in communication with the charging tank and comprising an upright section connecting together said upper and lower portions of said piping, a pump, piping arranged to feed oil to said charging tank, piping arranged to feed oil from said pump to the still-tank and discharging into the lower portion of the still-tank at a point spaced upwardly from the bottom of said tank, means for heating oil being fed to the still-tank, means whereby steam may be supplied to oil being fed to the still-tank, means for draining water from the aforesaid lower portion of the first-mentioned piping being arranged into the second-mentioned piping, and a pipe placed in communication at the upper portion of and with the passage in the aforesaid upper portion of the first-mentioned piping and communicating above said first-mentioned piping with the still-tank.

5. Apparatus of the character indicated comprising a still-tank, a charging tank, piping comprising a substantially horizontal lower portion which is placed in communication at the bottom of and with the still-tank and also comprising a substantially horizontal upper portion which is placed in communication at the top of and with the charging tank and furthermore comprised of a still-tank and a vapor-conducting pipe leading from the upper portion of the still-tank and provided with a valved air-inlet, the first-mentioned piping also comprising an upright section connecting together the aforesaid upper and lower portions of said piping, the upper portion of said first-mentioned piping being arranged with the passage therein higher than the discharging end of the third-mentioned piping, and the upper portion of said passage being placed in communication with the still-tank at a point between the first-mentioned piping and aforesaid vapor-conducting pipe.

6. Apparatus of the character indicated comprising a still-tank having a vapor-outlet, a charging tank arranged externally of the still-tank, piping leading from the bottom of the still-tank and discharging into the charging tank, a pump, piping arranged to feed oil to said pump from the charging tank, piping arranged to feed oil from said pump to the still-tank, means for heating oil being fed by the third-mentioned piping, means whereby steam may be supplied to oil being fed by said third-mentioned piping, and means for effecting the drainage of water from the first-mentioned piping into the sec-
ond-mentioned piping, the third-mentioned piping being arranged to discharge tangentially in relation to the circumference of the still-tank.

9. Apparatus of the character indicated comprising a still-tank having a vapor-outlet and an oil-inlet which is arranged at one side of the lower portion of said tank, a charging tank arranged lower than said oil-inlet, piping having a lower portion which is placed in communication at the bottom of and with the still-tank and comprising an upper portion which is higher than said oil-inlet of the still-tank and in communication with the charging tank and also comprising an upright section connecting together said upper and lower portions of said piping, a pump, piping arranged to feed oil to said pump from the bottom of the charging tank, piping arranged to feed oil from said pump to the aforesaid oil-inlet of the still-tank, means for heating oil being fed to said oil-inlet, means whereby steam may be supplied to oil being fed to said oil-inlet, and means for effecting the drainage of water from the aforesaid lower portion of the first-mentioned piping into the second-mentioned piping, the aforesaid oil-inlet of the still-tank being arranged to discharge tangentially in relation to the circumference of said tank.

10. Apparatus of the character indicated comprising a still-tank having a vapor-outlet, a charging tank arranged externally of the still-tank and vented into the vapor space in the still-tank, piping leading from the bottom of the still-tank and discharging into the charging tank, a pump, piping arranged to feed oil to said pump from the charging tank and having a valve, piping arranged to feed oil from said pump to the still-tank and having a valve, means for heating oil in the third-mentioned piping between the second-mentioned valve and discharging end of the piping, means for draining water from the first-mentioned piping into the second-mentioned piping at a point between the charging tank and first-mentioned valve, a valved oil-supply pipe discharging into the second-mentioned piping between the pump and first-mentioned valve, a valved oil-outlet pipe leading from the third-mentioned piping between the pump and second-mentioned valve, and means for supplying steam to the third-mentioned piping between the second-mentioned valve and discharging end of said piping.

11. Apparatus of the character indicated comprising a still-tank having a vapor-outlet, a charging tank arranged externally of the still-tank and vented into the vapor space in the still-tank, piping leading from the bottom of the still-tank and discharging into the charging tank, a pump, piping arranged to feed oil to said pump from the charging tank and having a valve, piping arranged to feed oil from said pump to the still-tank and hav-