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Minami

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[54] **LUBRICANT SEPARATING MEANS FOR AIR DRIVEN MACHINERY**

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[52] **U.S. Cl.** **55/219;** 55/337; 184/6.24

[51] **Int. Cl.**[2] **B01D 50/00**

[58] **Field of Search** ..... 55/218, 219, 337, 432; 184/6.24, 103 A

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Attorney, Agent, or Firm—George B. Oujevolk

[57] **ABSTRACT**

An oil recovery apparatus to recover lubricating oil from an aerosol mist in an air driven machine where air is driven through an oil storage tank forming an aerosol which is carried to the contacting machine parts to be lubricated and out through a discharge passage comprising a vertical hollow case with an upper gas passage section and a lower storage section, there being an air inlet and outlet in said upper gas passage section, a vane separator in said upper gas passage section with vertical outer blades providing rotary motion to the aerosol-containing gas passing through said upper gas passage separating the heavier aerosol from the lighter gas, a baffle board extending between the upper and lower sections to receive aerosols thereon to enhance the liquid-gas seperation, upper and lower tanks in said lower storage section including a float in said upper tank and a duct between said tanks, valve means for feeding recovered oil from the upper tank to the lower tank across said duct including a valve portion between said upper and lower tanks a first passage extending from said lower tank to said valve portion having switching valve means therein controling said duct, a diaphragm chamber with a diaphragm in said first passage and a first valve rod for reciprocation in said first passage said valve rod being connected with said diaphragm and said switching valve means, a second vertical passage housing, a second valve rod connected to said float and air supply ports in said second vertical passage one of said ports communicating with said diaphragm chamber, a recess in said second valve rod allowing communication between said air supply ports to said diaphragm chamber acting on said first valve rod which in turn acts on said switching valve means to allow flow of oil down said duct, said switching valve means closing said duct flow as the float sinks to a predetermined level.

1 Claim, 3 Drawing Figures

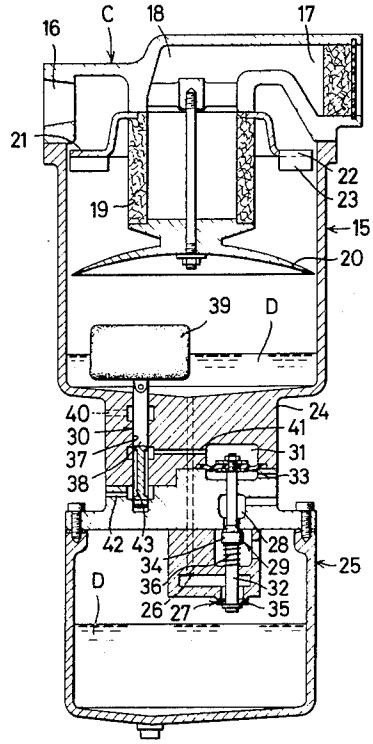


FIG. 1

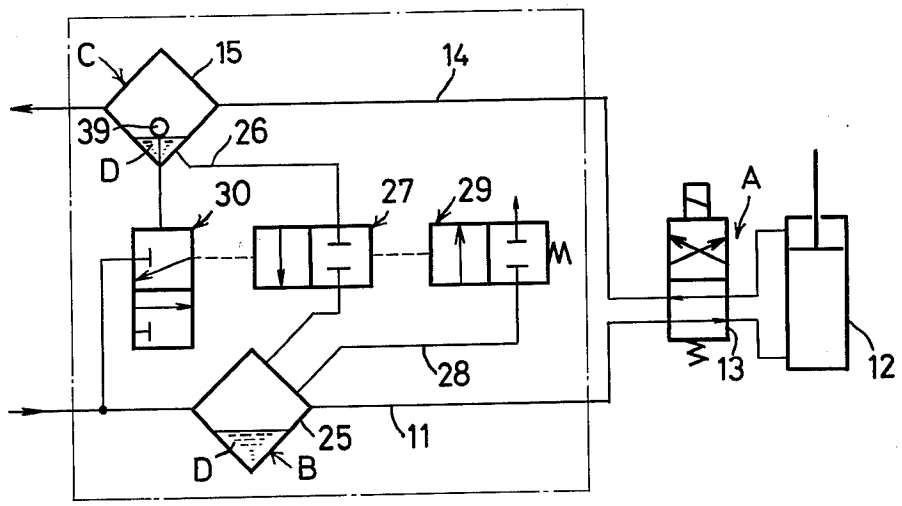

C
15
14
39
26
D
30
27
29
M
A
28
13
12
25
11
D
B

FIG. 3

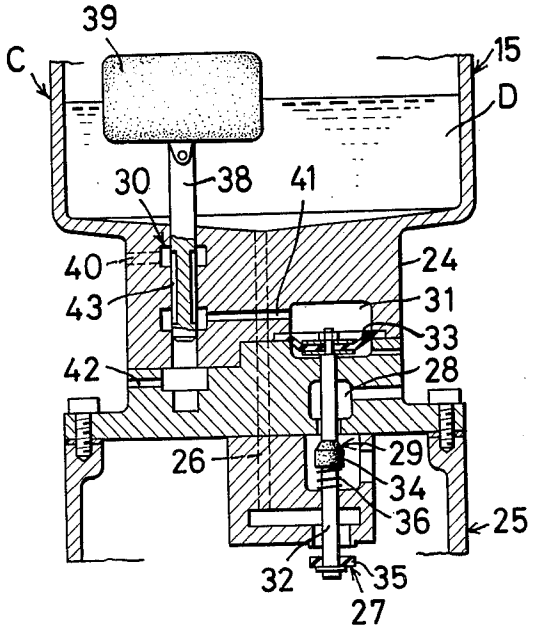
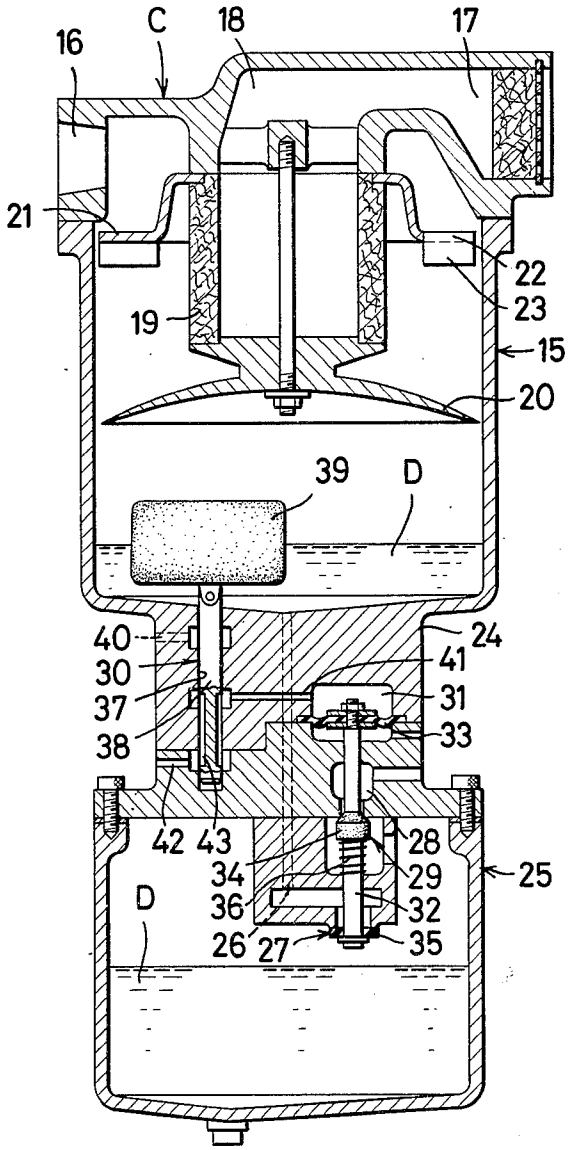

39
C
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D
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FIG. 2


C
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LUBRICANT SEPARATING MEANS FOR AIR DRIVEN MACHINERY

The present invention relates to a means for recovering lubricant which would otherwise be wastefully discharged when used for an air-driven machine and the like, and in particular a means for recovering lubricant mixed in a state of mist in the machine-driving air with the use of an oil separator incorporated therein.

Thus, a first object of the present invention is to provide a means for avoiding the conventional waste of lubricant as described above by incorporating a separator in the air-driven machine for separating the lubricant in the aerosol state from the air therein and to provide a secondary use for the separated lubricant.

A second object of the present invention is to provide a means to separate the lubricant effectively so as to put it to a secondary use.

A third object of the present invention is to provide a means for bringing the separated lubricant automatically into the oiler of the air-driven machine.

These objects can be accomplished by the improvement, combination and operation of every part constituting the present invention, the preferred embodiment of which is illustrated in relation with the annexed drawing as following.

FIG. 1 shows passages arranged in an air-driven machine in accordance with the present invention.

FIG. 2 shows a longitudinal section of a separator incorporated in an air-driven machine for separating lubricant from the air therein in accordance with the present invention.

FIG. 3 shows a longitudinal section of main parts of the above-described separator in a state of operation.

In the FIG. 1, numeral 11 designates an air inflow passage wherein an oil storage tank B is disposed in between both ends thereof. Air passage 11 is linked at one end with an air supplying device such as an air compressor and the like and at the other end thereof with an air inflow port provided in an air-driven machine A.

Lubricant contained in oil storage tank B is absorbed by the air as the air flows through passages 11 so that the lubricant in an aerosol state is supplied to portions of the air-driven machine A, which are in friction contact, the air-driven machine A comprising a cylinder 12 and a transfer valve 13, said transfer valve 13 controlling the movement of said cylinder 12, the above-mentioned functions and organization of said machine A being common to conventional machines of this kind.

A separator C is incorporated in the air-driven machine A in between an air discharging passage 14 which is connected to an outflow port.

Said separator C shown in detail in FIG. 2 comprises a hollow case 15 which has at the upper outer periphery thereof an air inlet 16 which communicates with the air discharging passage 14 shown in FIG. 1 and an outlet 18 at the corresponding position thereof, said case 15 being provided for the separation of the lubricant from the air, below which is a tank 25 for storing lubricant D.

In the hollow portion of case 15 at the upper center thereof are disposed a cylindrical member 19 built so as to allow the passage of air therethrough, said cylindrical member 19 communicating at the upper end thereof with the outlet 17 via the passage 18, and a baffle board 20 disposed therebelow closing cylindrical

member 19 at the lower terminal thereof, said baffle board 20 projects like a flange so as to abut at the outer periphery thereof on the inside wall of said case 15.

Also inside the hollow portion of said case 15, a vane separator 21 is arranged around said cylindrical member 19 at the upper outer periphery thereof, said cyclone collector 21 having at the outer periphery thereof numerous recess notches 22 arranged side by side at a predetermined interval, said recess notches 22 each being provided at one side thereof with a blade 23 projecting therefrom downward in a clockwise slanting direction. The cyclone collector 21 gives a rotary movement to the air flown into case 15 from inlet 16 with the use of blades 23 so as to separate the lubricant from the air taking advantage of the specific gravity of the lubricant which is heavier than that of the air.

Also as shown in FIG. 2, a valve portion 24 is formed under said case 15, below valve portion 24 is a tank 25 to store lubricant both "new" and "recovered," the recovered lubricant D automatically turning back from within the case 15 by the operation of valve portion 24. Valve portion 24 comprises a switching valve 27 for switching passage 26 which communicates with case 15 at the lower inside thereof and tank 25 at the upper portion thereof. A switching valve 29 for said passage 28 communicating with a tank 25 at the upper inside thereof and the outside atmosphere, and there is an operation valve 30 for operating said switching valves 27 and 29.

Switching valves 27 and 29 are constructed so that they may function in a unity, said construction providing a diaphragm chamber 31 in passage 28 at the upper portion thereof, said passage 28 communicating with said tank 25 and the outside atmosphere, the lower end of said passage 26 which communicates with the case 15 and the tank 25 and the upper end of a valve rod 32 which penetrates through passage 28 being fixed to a diaphragm 33 in the diaphragm chamber 31, said valve rod 32 being provided at a position in between both ends thereof with a valve member 34 for switching the passage 28 and at the lower ends thereof with another valve member 35 for switching the passage 26, said valve rod 32 further incorporating a spring 36 which affords an elasticity to said valve members 34 and 35 for closing the passages 28 and 26, respectively.

The operation valve 30 is provided at a position below case 15 with a valve hole 37 wherein another valve rod 38 is movably inserted, valve rod 38 at the upper end thereof which projects into case 15 being fixed to a float 39. Valve hole 37 incorporates an air supply port 40 which opens at the outer periphery of valve portion 24. A passage 41 communicates at a spot in between both ends thereof with diaphragm chamber 31, and another passage 42 communicates with the outside atmosphere at the lower portion of said valve hole 37.

Valve rod 38 is provided at the lower periphery thereof with a recess 43 for allowing the air supply port 40 to communicate with passage 41.

At the lower periphery of valve rod 38 is formed a recess 43 which allows passage 41 to communicate with another passage 42 when the valve rod 30 descends and allows the air supply port 40 to communicate with the passage 41 when valve rod 38 is lifted up in proportion to the rise of float 39 as the result of increased storing of the recovered lubricant reaching a predetermined level in case 15.

The recovered lubricant D stored in case **15** may also be taken out through a cock-covered outlet provided therebottom.

The lubricant recovering process in the air-driven machine is described as following.

The air supplied by an air supplier device flows through passage **11** into the oiler B thereby absorbing the lubricant D therein, thence the lubricant-containing air passes through the transfer valve **13** to reach the cylinder **12** so that said air gives a back-and-forth movement to cylinder **12** with the operation of transfer valve **13.** Thus the aerosol mist-like lubricant is fed to portions of transfer valve **13** in frictional contact to cylinder **12.**

The air after having been used for driving the cylinder **12** is discharged through the passage **14** by way of switching transfer valve **13.** The discharged air flows into the case **15** through the inlet **16** of the separator C, said air thereby being brought to a rotary movement by the cyclone collector **21** resulting in the separation of the aerosol lubricant due to the difference of specific gravity between the air and the aerosol lubricant, the separated aerosol mist-lubricant thence sticking to the cylindrical member **19** and the case **15** on the inside walls simultaneously with the discharging of the lubricant-separated air outward through the outlet **17** via the cylindrical member **19.**

The separated lubricant is brought into the case **15** dropping through the inside wall therein and outer periphery of the baffle board **20.**

With the increase of said lubricant to reach a predetermined level in the case **15,** and floating of the float **39** and lifting of said valve rod **38** as the result, recess **43** begins to communicate with the port **40** and the passage **41** thence the air supplied through the air supply passage **11** into the port **40** flows into the diaphragm chamber **31** thereby letting the diaphragm **33** depress the valve rod **32** and putting into operation the switch valves **27** and **29** for opening the passages **26** and **28** respectively, the opening of said passages **26** and **28** resulting in the flow of said lubricant D from the case **15** into the tank **25** without facing the obstacle of the air pressure.

As the surface level of the lubricant in the case **15** drops, the valve rod **38** together with the float **39** descends thereby blocking the communications between the port **40** and the passage **41,** simultaneously the recess **43** allows the passage **41** to communicate with another passage **42,** so that the switch valves **27** and **29** are brought by the spring **36** back to a state of closing the passages **26** and **28** thereby making it possible to feed the recovered lubricant in the tank **25** into the oil storage tank B, the afore-mentioned movement being repeated every time the lubricant is filled to a predetermined level in the case **15.** Thus allows the lubricant to be reused.

What is claimed is:

1. An oil recovery apparatus to recover lubricating oil from an aerosol mist in an air driven machine where air is driven through an oil storage tank (B) forming an aerosol which is carried to the contacting machine parts to be lubricated and out through a discharge passage (**14**) comprising in combination:

a. a vertical hollow case with an upper gas passage section and a lower storage section, there being an air inlet (**16**) and outlet (**17**) in said upper gas passage section;

b. a vane separator (**21**) in said upper gas passage section with vertical outer blades (**23**) providing rotary motion to the aerosol-containing gas passing through said upper gas passage separating the heavier aerosol from the lighter gas, a baffle board (**20**) extending between the upper and lower sections to receive aerosols thereon to enhance the liquid-gas seperation;

c. upper and lower tanks in said lower storage section including a float (**39**) in said upper tank and a duct (**26**) between said tanks;

d. valve means for feeding recovered oil from the upper tank to the lower tank across said duct (**26**) including a valve portion (**24**) between said upper and lower tanks a first passage (**28**) extending from said lower tank to said valve portion having switching valve means (**27, 29**) therein controlling said duct (**26**) a diaphragm chamber (**31**) with a diaphragm (**33**) in said first passage and a first valve rod **932**) for reciprocation in said first passage said valve rod being connected with said diaphragm (**33**) and said switching valve means (**27, 29**), a second vertical passage housing, a second valve rod (**38**) connected to said float (**39**) and air supply ports (**40,41**) in said second vertical passage one of said ports (**41**) communicating with said diaphragm chamber (**31**) a recess (**43**) in said second valve rod (**38**) allowing communication between said air supply ports at certain positions of the float, and spring means holding the switching valve means in certain positions so that the raising of the float above a certain level raises said second rod providing communication between said air supply ports (**40, 41**) to said diaphragm chamber (**31**), acting on said first valve rod (**32**) which in turn acts on said switching valve means (**27, 29**) to allow flow of oil down said duct (**26**), said switching valve means closing said duct flow as the float sinks to a predetermined level.

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