June 3, 1969 R. J. BONFILIO 3,447,636

AUTOMATIC OIL EXCHANGING SYSTEM

Filed July 24, 1967 Sheet 1 of 4

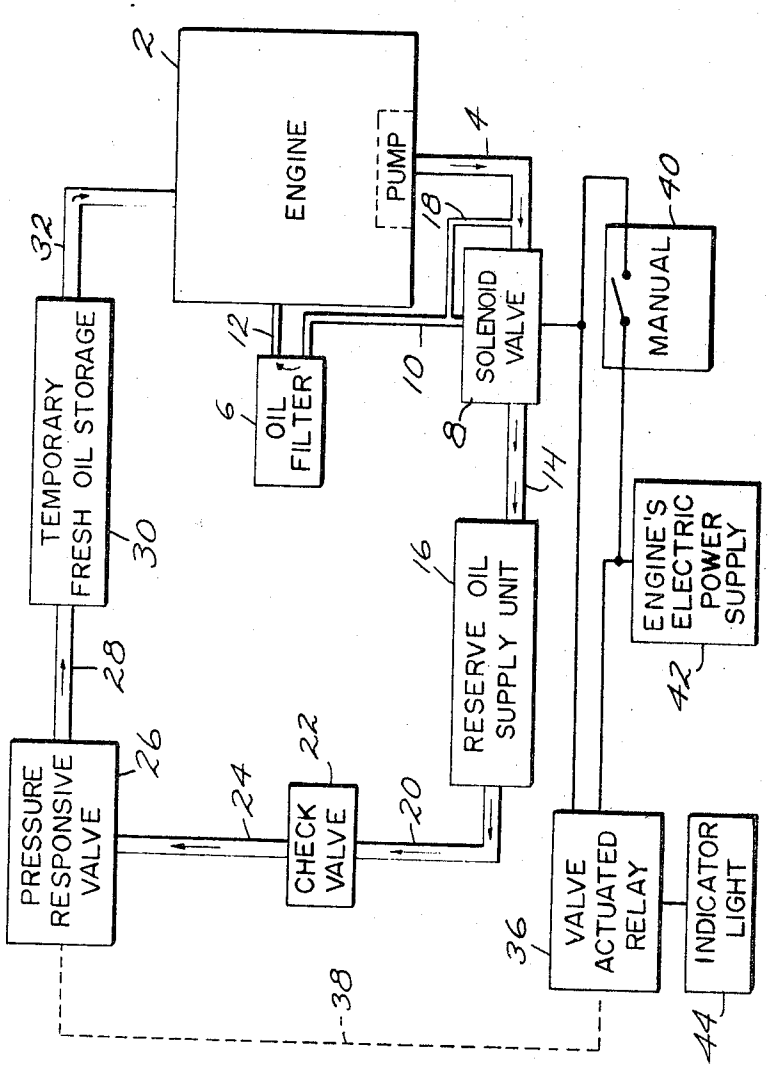

FIG. 1

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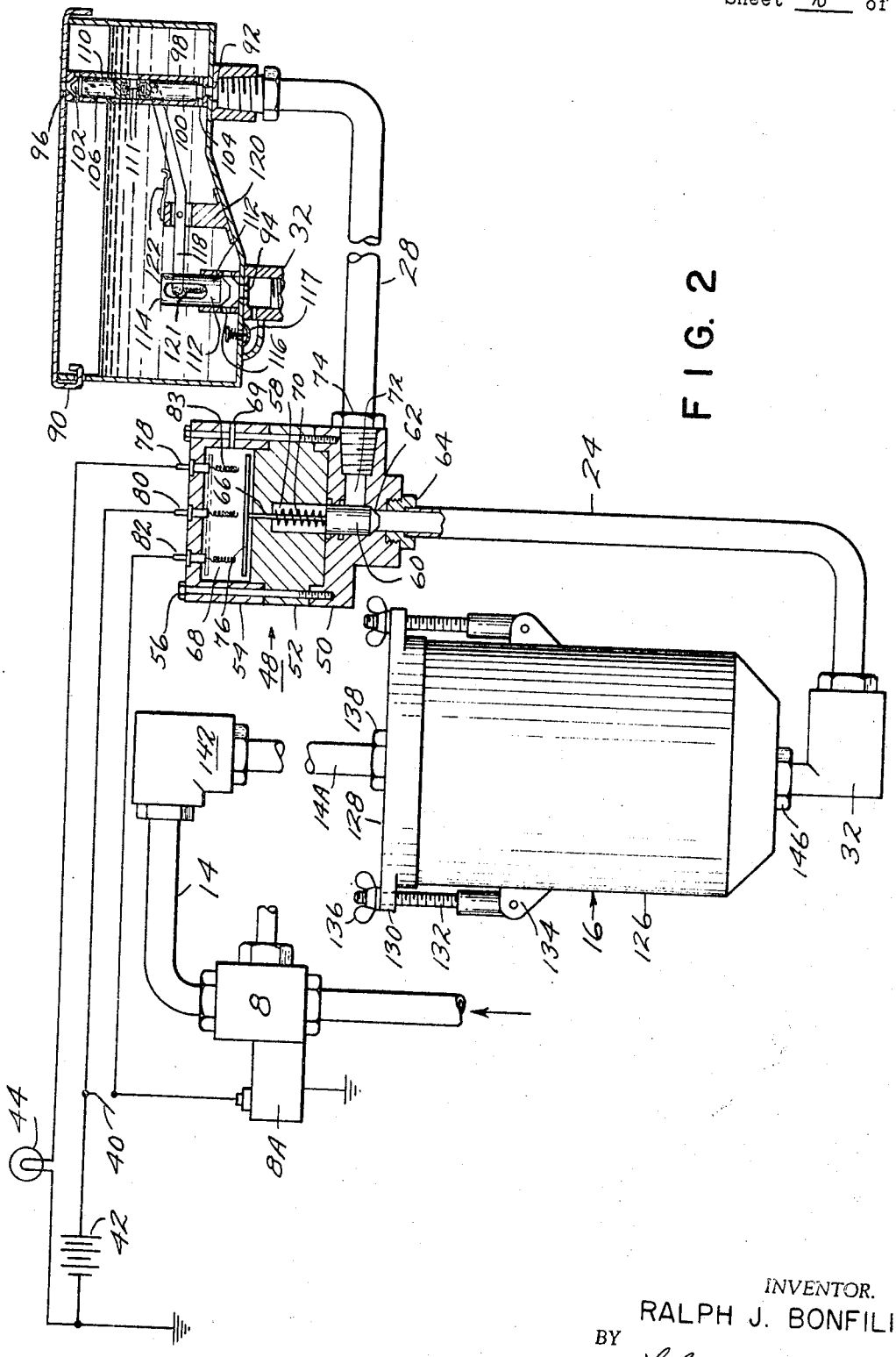

FIG. 2

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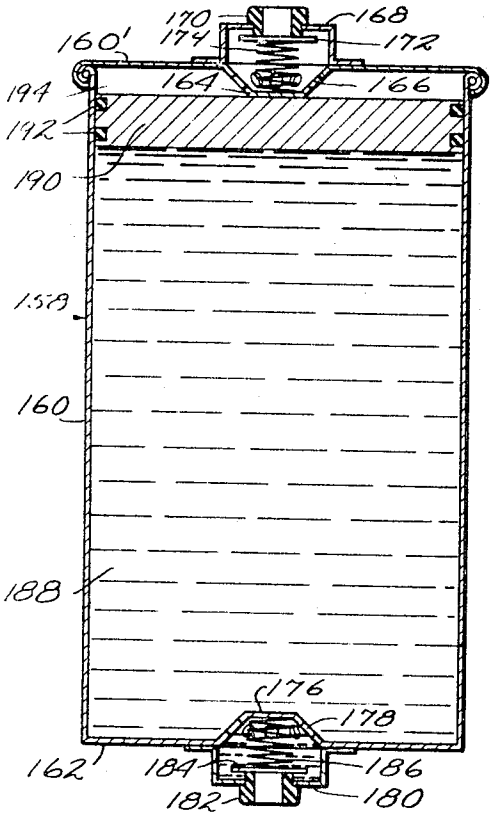

FIG. 3

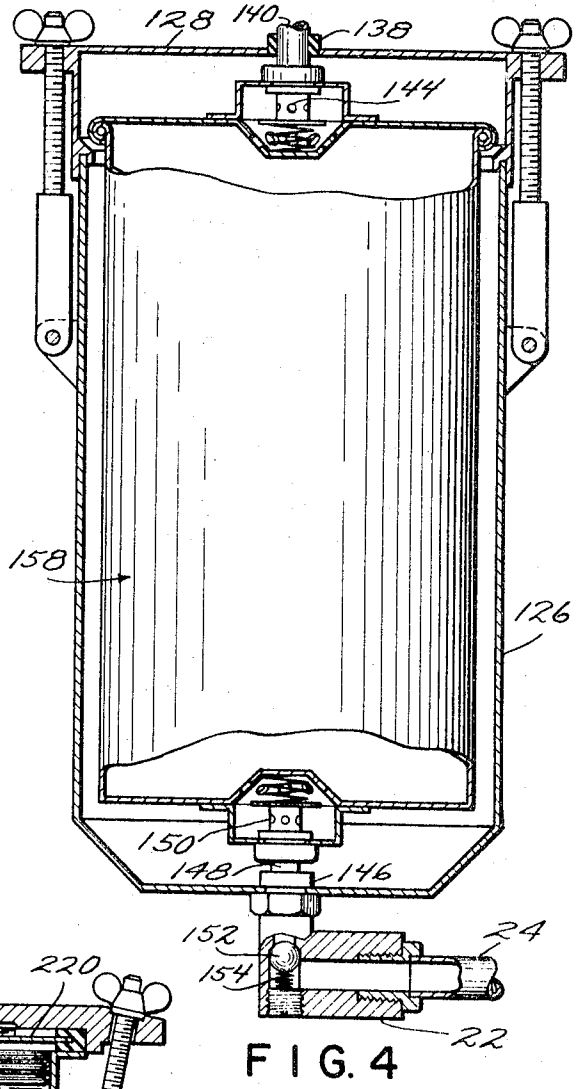

FIG. 4

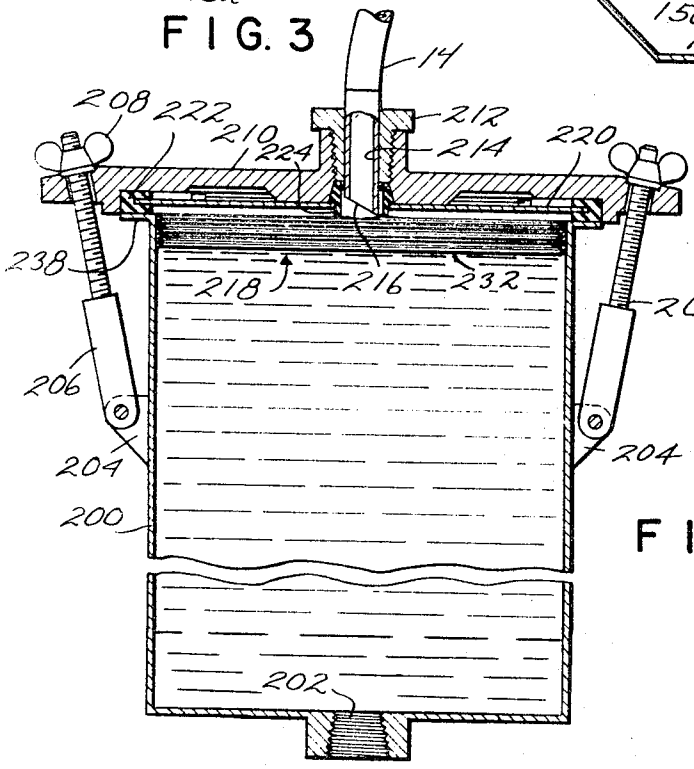

FIG. 5

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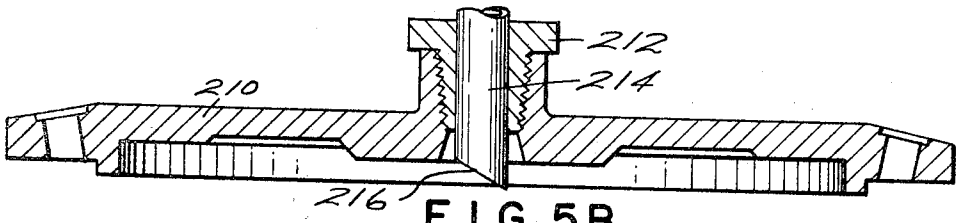

FIG. 5B

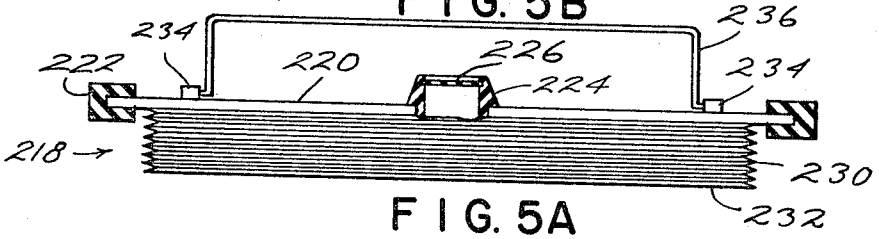

FIG. 5A

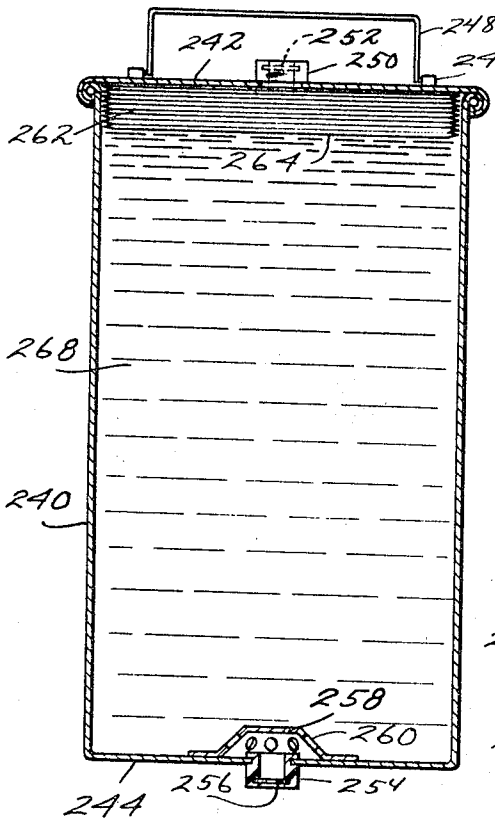

FIG. 6

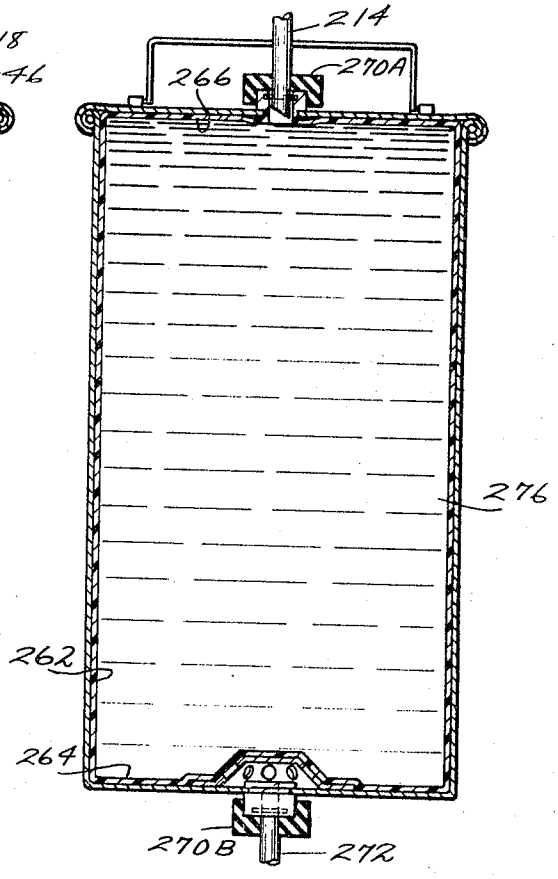

FIG. 6A

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3,447,636

AUTOMATIC OIL EXCHANGING SYSTEM

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Int. Cl. F16m 13/02; F01m 11/00
U.S. Cl. 184—1.5 8 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for automatically exchanging lubricant in an automobile engine. The apparatus includes a reserve supply of lubricant, means for delivering the reserve supply of lubricant to a temporary oil storage unit, means for removing spent oil from the engine, and means for transferring the fresh lubricant from the temporary storage unit to the engine.

The present invention relates to apparatus for automatically exchanging lubricant in the lubricating system of an internal combustion engine or the like.

A primary object of the invention is to provide simple and efficient apparatus for withdrawing spent oil from an internal combustion engine and replenishing it with a supply of fresh oil.

A further object of the invention is to provide lubricant exchanging apparatus of the character described having a control system that is operator actuated.

Still another object of the invention is to provide a lubricant-exchanging system for internal combustion engines and the like which includes a removeably mounted unit that is adapted to contain a supply of fresh lubricant and also to store spent lubricant withdrawn from the engine.

Still another object of the present invention is to provide an automatic lubricant exchanging system for internal combustion engines and the like which includes a lubricant reservoir in the form of a disposable or reuseable container that is adapted to discharge a supply of fresh lubricant and receive spent lubricant without intermixing thereof.

Other objects and many of the advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein:

FIG. 1 is a schematic block diagram of a lubricant exchanging system embodying the present invention;

FIG. 2 is an elevational view, partly in section, showing in greater detail the construction and interconnection of certain of the components of the system of FIG. 1;

FIG. 3 is a sectional view in elevation of the disposable lubricant cartridge that forms part of the reservoir unit of FIG. 4;

FIG. 4 is a sectional view in elevation of the lubricant reservoir unit employed in the system shown in FIG. 2;

FIG. 5 illustrates a second form of lubricant reservoir unit that may be used in place of the preferred embodiment shown in FIG. 4;

FIG. 5A is an elevational view, partly in section, of the expandable bellows unit embodied in the arrangement of FIG. 5;

FIG. 5B is a sectional view in elevation of the cover member employed in the arrangement of FIG. 5;

FIG. 6 is an elevational view, partly in section, of a third form of lubricant reservoir; and

FIG. 6A illustrates how the lubricant reservoir of FIG. 6 is installed in the system of FIG. 1.

The present invention makes it possible to change the lubricant in an internal combustion engine or the like while the engine is running. The invention is designed so that the operator of a vehicle fitted with the lubricant exchanging system, can institute the lubricant exchange operation and be assured that the exchange has been completed without having to inspect the engine per se or even remove himself from his seat.

Turning now to FIG. 1, an internal combustion engine of conventional design is illustrated diagrammatically at 2. The engine may be of the gasoline or diesel type and may be part of an automobile, truck, tractor, bulldozer (or other earth moving equipment), forklift truck, motorized railroad vehicle, marine craft, etc. or may be part of a stationary unit such as a gasoline or diesel type power plant. It is to be understood that the regular lubricating system of the engine comprises a crankcase or oil sump from which oil is supplied to the various moving parts of the engine, and usually includes an oil filter and an oil pump designed to assure circulation to various lubricant-containing chambers of the engine.

For the purposes of this invention, the engine has an outlet port fitted with a conduit 4 that connects to one side of an oil filter 6 through a three-way solenoid valve 8 and a conduit 10. The other side of oil filter 6 is connected back to an inlet port in the engine via a conduit 12. The outlet port to which conduit 4 is connected is located at a point in the engine, e.g., the crankcase, at which the lubricant pressure is higher than at the inlet port. Accordingly, the inlet port of valve 8 (connected to conduit 4) is at a higher pressure than its two outlet ports. In its normal deenergized state the valve is open to the outlet port connected to conduit 10 and closed to its other outlet port which is connected by a line 14 to the inlet end of a reserve oil supply unit 16. A small diameter bleeder line 18 connects line 4 to the inlet line 10 of oil filter 6. The outlet end of the reserve oil supply unit 16 is connected by a line 20 to one end of check valve 22. The outlet end of check valve 22 is connected by a line 24 to the inlet port of a pressure responsive valve 26. The outlet port of pressure responsive valve 26 is connected by a line 28 to the inlet port of a temporary fresh oil storage unit 30. The outlet end of the temporary oil storage unit 30 is connected by a line 32 to a return port communicating with the engine's lubricating system. It is to be appreciated that line 32 connects with a point in the regular engine lubricating system where the oil pressure is lower than the pressure of the oil leaving the engine via conduit 4. Thus, for example, it could be connected to the oil filter tube or, in the case of an engine having overhead valves, to the chamber defined by the valve lifter cover. It is further contemplated that, if necessary, a check valve may be inserted in line 32 to prevent backflow of lubricant from the engine to the temporary oil storage unit 30.

Also forming part of the system of FIG. 1 is a relay 36 that is mechanically coupled to and actuated by pressure responsive valve 26. The mechanical coupling is indicated schematically by the dashed line 38. The relay 36 is connected into a circuit comprising a manually-operated control switch 40 that is normally open, the engine's battery power supply 42, and the solenoid 8A of valve 8. The manual switch is of the type whose moveable contact is spring biased and will remain closed only so long as the operator holds it closed. Preferably but not necessarily a push-button switch is used. Also forming part of the circuit is an indicator lamp 44 that may be mounted next to switch 40 in any suitable location, e.g., on the dashboard of a vehicle. As is customary in conventional automotive electric systems employing a battery power supply, the circuit is completed through the vehicle body as ground.

Turning now to FIG. 2, the pressure responsive valve 26 and the relay 36 are embodied in a single unit 48. The

latter comprises a housing formed of three members **50**, **52** and **54** secured together in fluid sealing relation by a plurality of tie bolts **56**. The sections **50** and **52** have aligned bores the define a chamber **58** for a valve member **60**. The bore in member **50** has a reduced diameter so as to form a seat **62** for valve member **60**. The outer end of this same bore is fitted with a bushing **64** to which is connected the line **24**. The upper end of valve member **60** is provided with a non-conductive stem **66** that extends through a hole in the upper end of member **52** into a relay chamber **68** formed by members **52** and **54**. Relay chamber **68** is provided with a vent port **69**. The stem **66** is surrounded by a compression spring **70**. The latter acts between the upper end wall of chamber **58** and valve member **60** to hold the valve member on its seat. The member **50** is also provided with a radially extending bore **72** fitted with a bushing **74** to which is connected the line **28**.

The upper end of valve stem **66** is fitted with a contact plate **76** made of a conductive metal. The upper end wall of member **44** is provided with three insulated electrical terminals **78**, **80** and **82**, each fitted with a resilient contact in the form of a conductive compression spring **83**. When the valve member **60** moves up against the force of spring **70** to the extent permitted by the length of the bore in member **52**, the plate **76** engages the three contacts and provides electrical connection therebetween. The terminal **78** is connected to the indicator lamp **44**. The terminal **80** is connected by a lead wire to the positive side of the engines' power supply **42**. The negative side of this battery is connected to ground. The third terminal **82** is connected to ground through the solenoid **8A** of valve **8**. The switch **40** is connected between the positive side of power supply **42** and the solenoid of valve **12**. With this circuit arrangement, closing of the switch **40** by the operator causes the solenoid to be energized by the power supply **42**. The solenoid will continue to be energized so long as the switch is held closed. However, engagement of contact plate **76** with the contacts of terminals **80** and **82** will establish a holding circuit for the lamp **44** is completed when the contact plate **76** engages the contacts of terminals **78** and **80**.

Still referring to FIG. 2 the temporary fresh oil storage unit **30** comprises a tank **90** having an inlet port **92**, an outlet port **94** and vent port **96**. The line **28** is connected to inlet port **92**. The interior of the tank includes a sleeve **98** that functions as a guide for an inlet valve member **100** and a vent valve member **102**. The inlet side of port **92** is bevelled so as to function as a seat for valve member **100** and sleeve **98** is provided with a number of ports **104** which provide communication between the inlet port and the interior of the tank when valve member **100** is off of its seat. The vent valve member **102** is attached to a float member **106** made of a suitable lubricant-resistant material that is buoyant in the lubricant that is supplied to tank **90**. Vent member **102** is tapered to mate with a tapered valve seat formed around vent port **96**. It is to be noted that sleeve **98** is provided with a number of slots **110** which provide fluid communication between lubricant in the tank and the float member **106**. The float **106** is coupled to inlet valve member **100** by a flexible tether **111**.

The outlet port **94** of tank **90** is provided with a tubular extension **112** that forms a guide for an outlet valve member **114**. The bottom end of valve member **114** is tapered to mate with a tapered valve seat surrounding the inner end of outlet port **94**. Member **112** has a number of ports **116** that permit escape of lubricant to discharge port **94** when valve member **114** is lifted off of its seat. Tank **90** also has a second smaller outlet which is fitted with a spring biased valve **117**. The latter is normally biased to the closed position but will open under fluid pressure to connect tank **90** with conduit **32**. Valve members **100** and **114** are pivotally connected to the opposite ends of a lever **118** that is pivotally connected to a post **120** attached to the bottom wall of the tank. The pivot pin connecting lever **118** to valve member **114** is located in a slot in the valve member so as to provide a lost motion connection. A tension spring **121** links valve member **114** and the end of lever **118**. A spring member **112** attached to the vertical port **118** bears on lever **118** so as to urge valve member **100** into closed position with respect to inlet port **92** and valve member **114** into open position with respect to outlet port **94**. In the absence of any lubricant in the tank the vent port **94**. In the absence of any lubricant in the tank the vent portion **96** will be open, valve members **100** and **117** are closed, and valve member **114** is open. When lubricant fluid is introduced into the tank via port **92** the float **106** will move up according to the level of the lubricant so that eventually valve member **102** will close off vent hole **96**. Valve member **100** will remain in closed position until such time as lubricant is delivered to inlet port **92** via line **28**. The incoming lubricant will be under sufficient pressure to lift valve member **100** off of its seat. Because of the connection therebetween provided by lever **118**, upward movement of valve member **100** will cause valve member **114** to close off the outlet port **94**. The latter will be closed by valve member **114** as long as lubricant continues to be delivered to the tank via line **28**. Float member **106** will rise with the level of lubricant in the tank and eventually will cause valve member **102** to close off the vent port. However, the float member is designed so that closing of the vent port does not occur until the tank has received substantially all, e.g. 80–90%, of the fresh lubricant supplied by the fresh oil supply cartridge **16**. Closing of the vent port causes a back-pressure to be created in the tank. This back pressure causes valve **117** to open so that oil will start to flow into conduit **32** at a modest rate. Oil continues to leave tank **90** solely via valve **117** until no more oil is delivered via conduit **28**, whereupon spring **122** will force valve member **100** back onto its seat and reopen the outlet port **94**. The tether **111** causes the vent valve member **102** to open the vent port **96** when valve member **100** moves back onto its seat. When this occurs the lubricant in tank **90** will discharge into conduit **32** at a rapid rate via port **92**.

Turning now to FIGS. 2, 3, and 4, the reserve oil supply unit **16** comprises a housing **126** fitted with a removable cover **128**. The latter is provided with a pair of ears **130** adapted to receive tie-down bolts **132** that are pivotally secured to lugs **134** formed on the exterior of housing **126**. Nuts **136** screwed onto bolts **132** act to secure the cover to the housing. The cover **128** is provided with a central opening in which is secured a bushing **138**. Mounted in and secured by bushing **138** is a rigid sleeve **140** that forms an extension of a pipe line **14A**. In this connection it is to be appreciated that the pipe line **14A** is a flexible conduit. The other pipe lines in the system also may comprise flexible conduit. It is to be noted further that pipe line **14A** forms an extension of pipe line **14** and is connected thereto by a check valve **142** arranged to prevent backflow to solenoid valve **8**. Sleeve **140** extends through the cover for a short distance and its inner end is provided with a number of small openings **144**.

The bottom end of housing **126** is provided with a discharge opening in which is secured another bushing **146** having a tubular extension **148** whose inner end is provided with a number of holes **150** similar to holes **144**. The inlet end of check valve **22** is screwed into the outer end of bushing **146**.

Check valve **22** (and also check valve **142**) may take any one of several conventional forms. Preferably, however, it is of the type that comprises a spherical valve member **152** that is urged against an appropriate valve

seat at its inlet end by means of a compression spring **154**. It is to be understood that the valve member **152** is normally in closed position and opens only under the pressure of lubricant introduced into its inlet port by way of the tubular extension **148**.

The housing **126** contains a removeable reservoir oil cartridge **158**. As shown in FIG. 3, this cartridge comprises a rigid cylindrical case **160** made of metal or plastic which is closed off at its top and bottom ends by wall members **160'** and **162**. The upper wall member **160'** is provided at its center with a frusto-conical depression **164** having one or more ports **166**. Attached to upper wall member **160'** is a cup-shaped member **168** having an end opening in which is secured a resilient collar **170**, preferably made of an oil resistant rubber. The inner end of collar **170** is closed off by a flat valve member **172** which is urged in closed position by a compression spring **174**.

The bottom end of case **160** is provided with a similar frusto-conical depression **176** having ports **178** similar to ports **166**. A second cup-shaped member **180** is attached to the bottom end wall **162**. This cup-shaped member **180** is similar to member **168**, including a second resilient collar **182** which is closed off by a valve member **184** that is influenced by a compression spring **186**.

The case **160** contains a fresh supply of lubricant **188** and a piston **190** which is provided with flare ring seals **192** at its periphery. With a full supply of fresh lubricant the piston **190** engages and is stopped by the frusto-conical section **64** of the upper end wall **160'**. Although not shown, the cartridge of FIG. 3 may include a guide shaft for piston **190** extending between and anchored to the end walls of case **160**. The piston would have a center hole sized so that the piston would be able to slide in the shaft. This center hole in piston **190** would, of course, have a seal to prevent passage of lubricant from one side to the other of the piston.

Installation of cartridge **158** in the manner shown in FIG. 4 is straightforward and requires no special tools. With cover **128** removed, the cartridge is dropped into housing **126** and pressed down over the tubular extension **148** so that the latter will penetrate the collar **182** and force valve member **184** off of its seat. The cartridge is forced down far enough for the openings **150** to be exposed to the interior of cup member **180**, whereby communication is established between the supply of fresh lubricant **188** and the inlet port of check valve **22**. Then cover **128** is applied so that sleeve **140** presses valve member **172** into open position, thereby providing communication between the sleeve **140** and the space **194** between end wall member **160** and piston **190**. It is to be appreciated that the normal pressure of the fresh lubricant **188** due to the influence of gravity is insufficient to open the check valve **22**.

Operation of the system of FIGS. 1–4 will now be described. Assume that the engine **2** is running and the operator desires to replace the oil in the engine with the fresh supply contained in the cartridge **158**. The operator closes switch **40** and holds it closed until lamp **44** is illuminated. Closing switch **40** immediately causes the valve solenoid **8A** to be energized whereupon the valve shifts from its normal position connecting lines **4** and **10** to a new position wherein it connects lines **4** and **14**. As soon as this occurs oil commences to flow from the engine via line **14** into the upper end of the cartridge **158**. This incoming oil is under greater pressure than the oil in the cartridge **158** and, therefore, it forces the piston **190** downward. This downward movement of piston **190** forces the fresh lubricant **188** out of the cartridge to the pressure responsive unit **48** comprising valve **26** and relay **36**. The fresh oil entering the pressure responsive unit **48** forces the valve member **60** off of its seat and passes through line **28** to tank **90**. The flowing oil raises valve member high enough to cause plate **76** to engage the contact of terminals **78**, **80** and **82**. At this point lamp **44** will go on and the operator may allow switch **40** to reopen. However, so long as oil continues to be pumped through the lines **24** and **28** the plate **76** will continue to close the circuit between terminal **80** on the one hand and terminals **78** and **82** on the other hand, so that lamp **44** and the solenoid of valve **8** will remain energized. The spring contacts **83** assure that the circuit will be maintained if plate **76** tends to vibrate under fluctuating oil pressure. The fresh oil will continue to flow into the temporary storage tank **90** until the piston **190** engages the frusto-conical portion **176** of case **160**. When this occurs, the valve member **60** will reseat itself and this in turn will cause lamp **44** to go out and the valve solenoid to be de-energized. The latter action causes the valve **8** to return to its original position connecting conduit **4** to conduit **10**. Termination of the flow of fresh oil to tank **90** will cause valve member **100** to close and valve member **114** to open, thereby permitting rapid discharge of oil from tank **90** through line **32** into the engine. Thereafter it will circulate in the normal way through the engine's lubricating system including oil filter **6**. The spent oil remains in the cartridge which at a later time is replaced with a new cartridge containing another supply of fresh oil.

It is believed to be apparent that temporarily storing the fresh oil in tank **90** makes it possible to drain the engine of spent oil before the fresh oil is introduced, so that there is no substantial intermingling of spent oil and fresh oil. In this connection it is to be noted that the exchange of oil takes place within two-three minutes and in the interval between removal of spent oil and delivery of fresh oil, the engine is lubricated by the small amount of oil that is in the filter **6**. In most cases this is sufficient. Otherwise bleeder line **18** is required to make certain that there is maintained in the engine a small supply of lubricant sufficient to prevent injury to pistons, crank shafts, connecting rods etc. during the oil changing operation. It is to be noted that the oil introduced via bleeder line **18** need not be great and is controlled by the diameter of line **18**.

FIGS. 5, 5A and 5B illustrate a further modification of the invention.

The apparatus shown in these figures is intended as a replacement for the reservoir oil supply unit shown in FIGS. 2 and 4. In this case the reservoir oil supply unit comprises a housing **200** that is open at its top end and is provided with a threaded outlet port **202** at its bottom end for connection (by means of a bushing or nipple) to the check valve **22**. The housing **200** is provided with a pair of lugs **204** to which are pivotally secured threaded members **206**. These threaded members **206**, together with nuts **208**, serve to secure to the housing a cover member **210**. The latter is provided with suitable apertures for threaded members **206**. The center of cover member **210** is provided with a hole in which is mounted a bushing **212**. Secured in this bushing **212** is a rigid sleeve **214** that forms an extension of the line **14**. Sleeve **214** is made of metal and its bottom end is cut on an angle so as to form a sharp cutting edge **216**.

Associated with the housing and supported therein is an extendible member **218**. Referring now to FIG. 5A, member **218** is formed with a stiff plate **220** fitted with a rubber gasket **222** at its periphery. At its center plate **220** is provided with a hole in which is secured a resilient sleeve **24** that fits in and makes a fluid tight with the center hole of plate **220**. As shown in FIG. 5A, the upper end of sleeve **224** is sealed off by plastic or metal disc **226** that is rupturable. For example, the disc **226** may be made of aluminum. Attached to the underside of plate **220** is an expandable bellows **230**, having a stiff bottom end wall **232**. The bellows is formed with an open top end and its upper edge is secured to plate **220**. Bellows **230** is made of a flexible material that is resistant to lubricant and is strong enough so as to contain a supply of lubricant when expanded. Thus the bellows **230** could be made out of plastic, oil resistant rubber or a rubber or plastic-impregnated paper. The bellows is normally col-

lapsed as shown in FIGS. 5 and 5A. On its upper side the plate **220** is provided with a pair of bracket members **234** that pivotally support a bail **236**. The latter normally lies flat against plate **220** when member **218** is installed in the manner shown in FIG. 5. It is to be noted that the rupturable disc **226** is provided merely to prevent air from entering the bellows so that it will tend to remain collapsed pending installation in housing **200**.

In practice a supply of fresh oil is poured into housing **200**, filling it to just about the level of the bottom end of member **218** when positioned as shown in FIG. 5. Thereafter member **218** is inserted into the housing so that gasket **222** resets on the peripheral flange **238** formed around the upper end of the housing. Bellows **230** is sized so as to make a snug fit with the interior side surface of housing **200**. Then cover member **210** is placed over the housing and forced down so that the sharp edge **216** of sleeve **124** penetrates and ruptures disc **226**. The cover is secured in place by nuts **208** and threaded members **206**. The mode of operation of the system of FIG. 1 using the arrangement of FIG. 5 is essentially the same as it is using the arrangement of FIGS. 2–4. The fresh lubricant will remain in the housing **200** until the solenoid valve is energized, whereupon spent oil will pass through the line **14** and sleeves **214** and **224** into the bellows **230**. The incoming spent oil will cause expansion of bellows **230** so that its bottom wall **232** will in turn force fresh oil out of the housing **200** through port **202** into line **24**. At the end of the oil exchanging operation the bellows **230** will be completely filled with spent oil. Thereafter member **218** can be removed and spent lubricant discarded simply by detaching the cover **210** and lifting member **218** out of the housing by means of the bail **236**.

FIGS. 6 and 6A show a further modification of the invention wherein the entire reservoir oil supply unit is disposable. This fully disposable unit comprises a rigid cylindrical case **240** having upper and lower end walls **242** and **244**. Rivotally secured at **246** to the upper end of the case is a bail **248**. Secured in a hole in the center of upper end wall **242** is a sleeve **250** made of a resilient material, e.g., rubber. Sleeve **250** is closed off by a rupturable disc **252** made of a suitable material such as aluminum or a plastic. The bottom wall member is provided with a similar sleeve **254** having a similar rupturable disc **256**. Welded to the inner side of the bottom end wall is a cup-shaped member **285** provided with a number of ports **260**. Also disposed within the case **240** is bellows element **262**. This bellows element has a bottom end wall **264**. The upper end of this bellows element has a second end wall **266** that is cemented to the end wall **242** of the case. The center of this end wall **266** has an aperture concentric with sleeve **250**. As made and ready for installation, the disposable reservoir unit is filled with fresh lubricant **268** and the bellows is collapsed as shown in FIG. 6. To accommodate this unit in place of the unit of FIG. 5, sleeve **214** is further provided with a rubber gasket **270A** which is attached a short distance above its sharp end **216**. Thus when the sleeve **214** is made to penetrate disc **252** so as to provide communication between the line **14** and the interior of the bellows **262**, gasket **270A** will make a fluid tight connection with sleeve **250** as shown in FIG. 6A. The bottom end of the case **240** is secured to a sleeve **272** identical to sleeve **214** but secured to the inlet end of check valve **22** shown in FIG. 4. The disc **256** is ruptured by the upper end of sleeve **214**. Another rubber gasket **270B** on sleeve **272** is adapted to make a fluid tight connection with sleeve **254**. Other means (not shown) may be used to support the case **240** so that it is rigid and will not move from side to side.

Operation of the system of FIG. 1 using the embodiment of FIG. 6 is essentially the same as that described above. When the solenoid valve is energized, spent oil removed from the engine enters bellows **262** via line **14** and sleeves **214** and **250**. The incoming spent oil causes the bellows to expand, and this expansion forces the fresh oil **268** out of the case **240** via sleeve **272** into line **24**. The bellows will expand to the limit afforded by its own length and/or the length of the case **240**, depending on which is shorter.

In practice it is preferred that the bellows expand the full length of case **240**. When fully expanded and filled with spent oil **276** the bottom end **264** of the bellows will rest on the bottom end wall **244** of the case and on member **258**. In this connection it is to be noted that the latter elevates the center portion of the bottom end of the bellows so that it cannot be injured by the sharp pointed end of the sleeve **272**.

The unit of FIGS. 6 and 6A offers advantages similar to those of the embodiment of FIGS. 3 and 4. It is easy to install and replace and, because its construction is relatively simple, it is disposable. On the other hand it is to be noted that the spent oil in the bellows could be emptied out and the bellows returned to its collapsed form by refilling the case with fresh lubricant. In the event of such reuse, new rupturable plugs **252** and **256** would be installed. Like the member of **218** of FIG. 5 the unit of FIG. 6 offers the advantage that it can be lifted out by means of its bail and taken away without spilling its contents.

It is believed to be apparent that many variations of the invention are possible in the light of the foregoing description. The reservoir oil unit construction is susceptible of many modifications and changes. Similarly other components employed in the system may be rearranged or modified. Thus, for example, it is not necessary for the pressure responsive valve and the valve actuated relay to be constructed as the single unt **48**. Furthermore the electrical circuit could be changed so that the relay would be actuated by a timer rather than oil pressure. Accordingly, it is to be understood that within the scope of the appended claims the invention may be practiced other than described, illustrated, or suggested herein.

I claim:

1. In combination with an engine having a lubricating system including a reservoir chamber containing lubricating oil for said system, apparatus for replacing used lubricating oil in said system with a supply of fresh lubricating oil, said apparatus comprising a container filled with a supply of fresh lubricating oil, conduit means for withdrawing used lubricating oil from said reservoir chamber and delivering it to said container under pressure, a valve in said conduit means normally preventing flow of used lubricating oil to said container, said valve being operable to permit flow of used lubricating oil to said container, displaceable means in said container for forcing fresh lubricating oil out of said container as used lubricating oil is delivered thereto by said conduit means, said displaceable means being constructed so as to prevent intermingling of fresh and used lubricating oil, means connected to said container for receiving fresh lubricating oil therefrom and introducing it into said lubricating system after substantially all of the used oil has been withdrawn from said reservoir chamber, and valve operating means adapted to open said valve so as to permit delivery of used lubricating oil to said container from said reservoir chamber and to automatically close said valve after substantially all of said used lubricating oil has been withdrawn from said reservoir chamber.

2. The combination of claim **1** wherein said valve is a solenoid valve and said valve operating means comprises a control circuit for energizing and deenergizing the solenoid of said valve.

3. The combination of claim **2** wherein said control circuit includes a manually operated switch that is normally open and is connected so as to complete said control circuit when it is closed.

4. The combination of claim **3** further including means for establishing a holding circuit for said solenoid after said switch has reopened provided that fresh oil is being

forced out of said container at the time said switch reopens.

5. The combination of claim 4 further including means for interrupting said holding circuit after flow of fresh oil from said container has terminated.

6. The combination of claim 1 wherein said container is a replaceable cartridge.

7. The combination of claim 1 wherein said displaceable means is a piston.

8. The combination of claim 1 wherein said displaceable means comprises a bellows adapted to be filled with said used oil.

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