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LIQUID INJECTING AND EJECTING APPARATUS
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Fig. 1

Fig. 2

Fig. 3

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This invention relates to apparatus for effecting movement of a fluid, as the injecting of a liquid into a fluid stream under the action of the latter. While capable of many uses and with various fluids, it has been developed in its application to the lubrication of fluid pressure operated motors, especially line oils for rock drills.

One object of the invention is to provide fluid injecting or ejecting apparatus and devices which will function in any position. Another object is to feed or eject the fluid in proportion to the movement of a fluid stream. Another object is to provide devices from which the fluid will not leak by gravity and in general to improve prior devices of the described character in the interest of more satisfactory and efficient service.

In order to illustrate the invention concrete embodiments thereof are disclosed in the accompanying drawings, in which:

Fig. 1 is a plan view of a line oiler;
Fig. 2 is a sectional view of a slightly enlarged scale of the line oiler shown in Fig. 1, the sections being taken on the lines 2—2 and 3—3 respectively of Fig. 1;
Fig. 3 is a sectional view of the line oiler shown in Fig. 4 and 5; and
Fig. 4 is a right end elevational view of the line oiler shown in Figs. 4 and 5; and
Fig. 5 is a right end elevational view of the same device.

The embodiment of the invention shown in Figs. 1 to 5 inclusive comprises a line oiler for pneumatic tools made up of parts 8 and 9 generally circular in form and having flanged portions in abutting relation clamped together as by a series of bolts 10. Part 8 provides a motive fluid conduit 11 having connections 12 by which the oiler may be connected into the motive fluid line at any desired point. Suitable indicia, such as arrow 13, may be applied to the exterior of the conduit to indicate the direction in which the motive fluid should flow. The mating portions of parts 8 and 9 are recessed, as indicated in Figs. 2 and 3, to form a chamber.

A movable member, in the present instance a flexible diaphragm 14, is disposed within the chamber as a partition or separator to divide the same into a reservoir chamber 15 and a pressure chamber 16. Diaphragm 14 may extend as a gasket between the flanged portions of parts 8 and 9 and be secured in place by bolts 10. Resilient means, such as a tapered coiled spring 17, is disposed in reservoir chamber 15 yieldingly to urge diaphragm member 14 to one limit of its movement. A plate 18 is preferably interposed between spring 17 and diaphragm 14 to protect the latter from injury by the spring. Free communication between pressure chamber 16 and motive fluid conduit 11 is established by a passage 19. To assist the motive fluid thus admitted to pressure chamber 16 to overcome spring 17 and move diaphragm 14 to eject liquid, such as lubricant, from reservoir chamber 15, suitable means are provided for reducing the pressure in the reservoir chamber. This may be accomplished by utilizing the principle of the Venturi tube and of a reversed Pitot tube. To this end conduit 11 is restricted at one point, as by a cross member 20 inserted in or integral with part 8. A nozzle 21 extends from cross member 20 into the zone of reduced pressure created by the latter when motive fluid is flowing through conduit 11. A passage 22 extending into cross member 20 serves to connect reservoir chamber 15 with nozzle 21 and the passage is restricted at one point, as at 23, to produce any desired regulation of the flow of lubricant from chamber 15.

To put the device into operation, reservoir chamber 15 is filled with oil by removing filler plug 24, Figs. 1 and 3. The device is connected into the air line so that the motive fluid will flow through conduit 11 in the direction of arrow 13. When the throttle valve of the pneumatic tool to which the air line is connected is then opened, motive fluid will flow through conduit 11 producing a locality or zone of reduced pressure at the end of nozzle 21 as compared with the pressure obtaining at the locality or zone into which passage 19 opens for admitting motive fluid to pressure chamber 16. Thus a reduced pressure, or suction, is created in reservoir chamber 15 while a positive pressure is created in pressure chamber 16 with the result that the force exerted by spring 17 is overcome and diaphragm 14 is moved upwardly reducing the volume of reservoir chamber 15 and forcing lubricant out through the connection 22, 23 leading to nozzle 21. The flow of the lubricant is regulated by the restriction at 23, and the oil which is forced into the motive fluid stream will be carried to the pneumatic tool to lubricate the same. When the throttle valve is closed, the flow of motive fluid will cease and the pressures in chambers 15 and 16 will become equalized. Spring 17 will then force diaphragm 14 to its lowermost position and movement of lubricant is thereby stopped.
cant into conduit 11 will cease. When the throt-
tle valve is again opened motive fluid which has
entered through nozzle 21 into reservoir cham-
ber 15 will be forced back through the nozzle
relatively faster than the oil will move there-
through mainly on account of its lesser friction.
Movement of air into reservoir chamber 15 dur-
ing shut-down periods may be entirely pre-
vented, if desired by closing the modification in the
invention shown in Figs. 4-7 but it has been found in practice
in most cases that motive fluid or air leaves the chamber so rapidly that a check valve is not
absolutely essential.

The spring 17 cooperates with the diaphragm 16 to prevent the flow of lubricant from the
reservoir 15 through the nozzle 21 due to gravity
alone, when the motive fluid is not flowing through the conduit. If the device shown in
Fig. 2 were turned upside down, or in any other
position, oil could not flow through the restric-
tion 23 unless it were forced by fluid pressure
resulting from a flow of fluid through the con-
duit 11. As long as the air in this conduit is
stationary, pressures will be substantially equal
at all points in the device, a slight pressure dif-
fERENCE only resulting from gravity. If the
spring 17 were omitted, then oil would leak from
the reservoir through the restriction 23 and into
line 11 due to gravity head. Applicant's spring,
however, is made strong enough to counteract that
gravity head. Hence, when oil starts to flow
it will tend to produce a partial vacuum or a zone
of relatively lower pressure between the oil and
the diaphragm as compared to the pressure in
line 11 as applied at the hole 23. It will be
understood that diaphragm 14, while flexible, will not stretch a great amount. Again, assum-
ing the position of the parts to be as shown in
Fig. 3 and pressures equalized when air stream
in line 11 is stationary, it seems obvious that the
spring pressure if sufficiently great will now
actually suck in air at nozzle hole 23.

Principle employed to prevent flow of
oil due to gravity head alone is generally the
same as that involved in the barometer. If
a bottle partially full of liquid, with a stopper
having a hole of the order of, say two milli-
meters or less is turned upside-down the liquid
will stop flowing when the unit pressure above
the liquid plus gravity head is approximately
equal to the air pressure or unit pressure of
air on the hole. When the hole is of the order
of two millimeters surface tension and super-
flcial viscosity will prevent flow even though
the pressure external to the hole is slightly less
than that above the liquid. If for the glass
bottom of the bottle we substitute a flexible
diaphragm then external pressures would be
equalized and liquid would flow out of the hole.
However by supporting the diaphragm in such
manner that it cannot flex inward we would
then have the same general performance as with
the glass bottom. In order to be able to cause
oil to flow when desired, applicant makes the
spring only strong enough to overcome the grav-
ity head. Hence, while there is an approximate
balance with no air flowing in the conduit, the
flow of air produces sufficient difference in pres-
sures to destroy this balance and oil flows.

In the form of the invention shown in Figs.
4-7 inclusive, the lubricator casing is formed of
tubular parts 8a and 8b in telescoping rela-
tion, part 8a providing the inlet for the motive
fluid and part 8b the outlet. The two parts
cooperate to provide a chamber with an open
tend toward the motive fluid inlet and a movable
partition member, in this instance a piston 14a
sliding in the interior of part 8a, di-
vides the chamber into a reservoir chamber
15a and a pressure chamber 16a, the latter com-
municating directly and unrestrictedly with the
motive fluid inlet. The telescoping portions of
member 8a and 8b are in spaced relation to
provide a passage 11a surrounding members 15a
and 16a, and passages 8a' in member 8a on
either side of a transverse portion corresponding
to cross member 20 in the first form of the
invention establish a restricted connection to
the outlet. Nozzle 21a projects into the zone of
reduced pressure in the outlet and communi-
cates with reservoir chamber 15a through a re-
striction at 23a having a check valve 23a' to
prevent movement of fluid there through into
chamber 15a. A coil spring 17a yielding urges
piston 14a to the right to maintain reservoir
15a at its maximum volume and pressure chamber
16a at its minimum. To reduce the weight of
the device piston 14a may be made quite
short and have an extension 14a' with a three
point joint 14a' engaging the rigid moto-
ive fluid conduit extending from the main eral
surface to prevent angular displacement of piston 14a.
Piston 14a must have a rather close fit with the
interior of part 8a and the space between
the telescoping portions of parts 8a and 9a serves an additional purpose in preventing the
chamber wall with which piston 14a has sliding
contact from being dented or distorted from the
shocks encountered in service. Reservoir cham-
ber 15a is filled through an inlet opening closed
by a plug 24a. Although the structural arrange-
ment is somewhat different from the form
shown in Figs. 1-3, the manner of operation is identical save that on shutting down motive
fluid there is no leakage of the latter back into
reservoir chamber 15a by reason of check valve
23a' but equalization is established by the action
of spring 17a against the fluid pressure in cham-
ber 16a.

From the above it will be apparent that both
forms of the device will function in all positi-
ions from horizontal to upside down and in any
vertical or angular position and that the dif-
ferential pressure, which is made of sufficient
force to counteract the gravity head, will pre-
vent the oil from running or leaking into the
motive fluid line in any position in which the
device is standing without motive fluid thereon
or when the pneumatic tool is not running and all the air pressures are equalized. In addition
both forms of the device will cause oil to flow
into the motive fluid line in amounts approxi-
mately proportional to the amount of air flow.

While the invention has been herein shown
and disclosed in what are now considered to be
preferred forms, it is to be understood that the
invention is not limited to the specific details
thereof, but covers all changes, modifications,
and adaptations within the scope of the ap-
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along said conduit adapted to have different pressures when motive fluid is flowing through said conduit, the lubricant passage being restricted, thereby requiring the application of pressure to said diaphragm for effecting egress of fluid from said reservoir into the conduit, and resilient means in said lubricant chamber and engaging the diaphragm for yieldingly urging the latter in a position of maximum size for said lubricant chamber, whereby to prevent gravity flow of lubricant through said restricted passage when motive fluid is not flowing through the conduit.

2. A liquid ejecting device having a conduit for motive fluid, means including a member extending across said conduit for providing localities of differing pressure when motive fluid is flowing therethrough, a chamber, a movable member in said chamber dividing the same into a reservoir chamber and a pressure chamber, connections from said chambers to said conduit at said localities of differing pressures to effect movement of said movable member in one direction, one of said connections comprising a restricted outlet for the liquid, and means for effecting reverse movement of said member when motive fluid is not flowing in said conduit, whereby to prevent flow of liquid through said outlet due to gravity.

3. A liquid ejecting device having a conduit for motive fluid, means including a restriction in said conduit for providing localities of differing pressure when motive fluid is flowing therethrough, a chamber, a movable member in said chamber dividing the same into a reservoir chamber and a pressure chamber, connections from said chambers to said conduit at said localities of differing pressures to effect movement of said movable member in one direction one of said connections comprising a restricted outlet for the liquid, and a spring engaging said member for effecting reverse movement of the same when motive fluid is not flowing in said conduit, whereby to prevent leakage of liquid through said outlet due to gravity.

4. In a liquid ejecting device, a casing providing a chamber, a movable separator member in said chamber dividing the same into a chamber for liquid and a chamber for pressure fluid, means urging said member in a direction to increase the volume of said liquid chamber and proportionately to decrease said pressure chamber, said casing providing a motive fluid passageway, a cross member in said passageway forming a restriction, a nozzle protruding from said member into a zone of reduced pressure when motive fluid is flowing through said passageway, a restricted connection from said nozzle to said liquid chamber, and a connection from said passageway to said pressure chamber for supplying motive fluid at substantially full pressure to the latter.

5. A liquid ejecting device comprising open ended tubular members in telescoping engagement providing a chamber open at one end, the inner of said members having a portion in spaced relation to the outer of said members to provide a passage exteriorly of said chamber from the open end thereof to the opposite end of said device, a piston slidably mounted in said chamber and having a guide extension projecting through said open end, a coil spring engaging the opposite or inner side of said piston, a nozzle extending into a zone of reduced pressure in said passage at a point remote from said open end, a restricted connection from said nozzle to the closed end of said chamber, and a check valve in said connection.

6. A liquid ejecting device comprising open ended tubular members in telescoping engagement providing a chamber open at one end, the inner of said members having a portion in spaced relation to the outer of said members to provide a passage exteriorly of said chamber from the open end thereof to the opposite end of said device, a piston slidably mounted in said chamber and having a guide extension projecting through said open end, a coil spring engaging the opposite or inner side of said piston, a nozzle extending into a zone of reduced pressure in said passage at a point remote from said open end, and a restricted connection from said nozzle to the closed end of said chamber.

7. A line oiler comprising two telescoping tubular members, spaced to provide an annular passage therebetween, the inner member having an end wall closed except for a nozzle extending therethrough, the outer member having an end wall apertured to receive an inlet conduit for motive fluid, an outlet conduit surrounding the nozzle, said conduits communicating with each other through said annular passage, a piston slideable in said inner member and providing a lubricant chamber between the piston and the end wall of the inner member, said piston and inlet conduit being coaxial, and a guide secured to said piston and extending into said inlet conduit.

8. An air line oiler comprising two telescoping tubular members spaced to provide a passage therebetween, the inner member having an end wall defining one end of a lubricant chamber, the other end being defined by a piston movable in said chamber, a restricted nozzle extending from the lubricant chamber through the first-named wall and projecting into a continuation of said passage, an inlet conduit for motive fluid leading to said passage and to the piston for forcing the latter in the direction to contract the lubricant chamber as long as motive fluid is flowing through said conduit and passageway, and a spring in said lubricant chamber acting against the piston to enlarge the chamber, whereby to prevent gravity flow of lubricant through the nozzle after the motive fluid has stopped flowing.

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