This invention relates to devices for metering and injecting fluids and more specifically to metering and injection devices to be used in conjunction with fluids which require continuous flow. Many fluid compounds tend to thicken, settle or separate out when the fluent body is allowed to rest for any substantial length of time. This is typical, for example, of certain permanent lubricants for motor bearings in which cellulose or other fibrous material is intermixed with a viscous petroleum base. When such lubricants are used in conventional metering and injection equipment, the petroleum tends to liquify and be squeezed out of the fibrous material due to the high pressure exerted upon the fluid. This results in repeated clogging of the equipment and a highly diluted injected lubricant.

Conventional metering equipment employs a continuous flowing line of fluent out of which a predetermined quantity of fluent is removed for injection. It is the object of the present invention to provide a piston and injection device of this type which does not substantially interrupt the flow of the fluent to be metered and which does not separate the liquid portion of a fluent mixture from its solid constituents.

The present invention achieves this object by providing a valve member defining an interior chamber and having an inlet and outlet both communicative with the chamber such that fluent enters through the inlet from a continuously flowing stream and re-enters the stream through the outlet. In a preferred embodiment of the invention which is substantially described in detail, first and second pistons are slidably disposed within the chamber on opposite sides of the flowing fluent. When the pistons are actuated, they move to a position blocking the inlet and outlet and a quantity of fluent is trapped between them.

The pistons and fluent continue their movement away from the inlet and outlet until the condition to prevent further movement in this direction. As the first piston then approaches the second piston, the fluent is forced at increased pressure out of the device through a port in the valve member and a connected nozzle. The inlet and outlet are blocked only for the period during which the first piston is actuated. Since this period is of short duration, the flow of fluent is substantially uninterrupted, thus preventing settlement or solidification of the fluent material. In addition, the port and nozzle allow the fluid to leave the device at an increased pressure without squeezing the liquid portion out of the solid material in the mixture.

Other objects and advantages of the present invention will be more readily apparent from the following detailed description of several preferred embodiments of the present invention. The description makes reference to the drawings in which:

FIGURE 1 is a sectional view of an embodiment of the present invention;
FIGURE 2 is a sectional side view of this embodiment;
FIGURE 3 is a sectional view showing the device partially actuated;
FIGURE 4 is a sectional view showing the completed stroke of the device;
FIGURE 5 is a sectional view taken on the lines 5--5 in FIGURE 1;
FIGURE 6 is a schematic view of the present device and its connecting fluent line;
FIGURE 7 is a sectional side view of a section of the device with a shim mounted to reduce the quantity of fluent metered;
FIGURE 8 is a front view of the shim shown in FIGURE 7;
FIGURE 9 is a sectional side view of a portion of a second embodiment of the present invention.

Referring to the drawings in detail, the present invention is illustrated as embodied to inject metered quantities of lubricating fluid into motor bearings. As shown in FIGURE 1, a piston 10 having a fluid-tight gasket 12 is slidably positioned in a stationary cylinder 14. Ports 16 and 18 in the cylinder are connected by means of a four-way valve 20 to a high-pressure air supply and to the atmosphere. The piston 10 is connected by means of a bolt 21 to the end of a shaft 22 which extends through one end of the cylinder 14. A gasket 24 maintains a fluid-tight connection between the cylinder 14 and the shaft 22.

When the valve 20 is actuated to introduce high pressure air at the port 16 and to vent port 18 to the atmosphere, the piston 12 remains in the rearward position shown in FIGURE 1. Reversing the connections, high pressure air introduced through the port 18 will force the piston forward (to the left in FIGURE 1) and allow high pressure air to vent through the port 16. Hereinafter, the term "forward" refers to a movement or a position to the left, and the term "rearward" refers to a movement or position to the right, in FIGURES 1 to 4, 7 and 9.

The shaft 22 terminates at its other end in an end section 26 of reduced diameter. A collar 28 of increased diameter is permanently mounted on the shaft intermediate of the end section 26 and the main portion of the shaft. The free end of the end section 26 projects into an opening 30 in a block 32. A spring 34 extends between the block and the collar 28 along the length of the end section 26.

Bolts 36 and 38 extend through the block 32, through a pair of rigid tubes 40 and 42, and then through openings in a second block 44. This second block has a center aperture 45 through which the shaft 23 extends. Nuts 46 and 48 secure the bolts in place. The other ends of the bolts are connected into the ends of short rod sections 50 and 52 which in turn attach to a contact block 54. Slide rods 56 and 58 connect to the opposite side of the block 54 and extend parallel to the shaft 22. The slide rods are slidably disposed in passages 50 and 62 in a stationary valve body 64. Nuts 66 and 68 connect the slide rods to a block 70 mounted at the forward face 71 of the valve body. It can thus be seen that the blocks 32, 44, 45, 47, the bolts 36 and 38, the rod sections 50 and 52, and the slide rods 56 and 58 are all interconnected to form a rigid sub-structure generally indicated at 72 which can slide along the passages 60 and 62 of the valve body 64.

The valve body 64 has an inlet port 74 and an outlet port 76 which connect with a central elongated passage or chamber 78 which extends parallel to, and in alignment with, the shaft 22. The ports 74 and 76 are on opposite sides of the passage 78 but are not in axial alignment; the outlet port 76 is situated at a point closer to the air-actuated end of the present device than is the inlet end 74. A tube 80, positioned along the surface of the central passage 76, has openings 82 and 84 which allow fluid to enter the passage through the inlet port 74 and to leave through the outlet port 76. The opening 84 adjacent the outlet port 76 is substantially smaller than the other opening 82. A third opening or slot 86 in the tube 80 is located adjacent the forward face 71 of the valve body 64.

An elongated piston or shaft 88 extends through an opening 90 in the contact block 54 and its forward end
A quantity of fluid is trapped between the transverse face 95 and the shaft 96 and is translated in the forward direction with these two shafts 88 and 96. Since the two openings 82 and 84 are not closed at once but rather in sequence, the possibility of trapping air in the space 116, in the openings 82 and 84, or in the ports 74 and 76, is substantially avoided. As the transverse face 95 moves across the small outlet opening 84, fluid continues to fill the space 116. This space still remains filled with fluid as the face 95 closes the inlet opening 82.

The forward motion of the shafts 22 and 88 and the sub-structure 72 continues until the block 54 contacts the rearward face of the valve body 64 as shown in FIGURE 3. At this time, the tip 108 of the head 100 is in the proper position for injection of lubricant into the motor bearing 112. The trapped fluid is then in position over part of the opening 86.

Further forward motion of the shaft 22 compresses the spring 34 and moves the forward end of the shaft 22 through the space 93 into abutment with the face of the flange section 92. The shaft 22 then moves the shaft 88 forward along the central passage 78. Since the shaft 96 is prevented from further forward movement, the trapped fluid is compressed between the advancing face 95 and the stationary shaft 96. The fluid is forced at increased pressure through the transverse slot 104 into the axial passage 102, the opening 106, and finally into the motor bearing 112. As the transverse face 95 contacts the rearward end of the shaft 96, the flanged section 92 abuts the block 54 preventing further forward motion of the shaft 88.

When high-pressure air is again introduced into the port 16 and the port 18 allowed to vent to the atmosphere, the piston 10 and the shaft 22 move in the rearward direction. The end section 26 moves away from the flanged section 92 until the collar 28 again contacts the block 44 and pulls the sub-structure 72 rearwardly. As the shaft 96 moves rearwardly, it pulls the shaft 88 ahead of it. When the block 70 abuts the forward face 71 of the valve body 64 thus preventing further rearward motion of the sub-structure 72, the deepest portion of the slot 110 is then situated directly above the opening 82 and the inlet port 74. The pressure of the fluid at this point forces the fluid to pass through the outlet port 74 and exposing the slot opening 84 and allowing fluid to again flow through the valve body 64, and thus the return of the device to its normal position.

The limit switch 94 may be utilized to indicate when the device is in its normal position with the space 116 filled with fluid and therefore ready to be actuated again.

Since the fluid pressure at the opening 82 is the force which moves the shaft 88 to its normal rearward position, the possibility of creating a vacuum in the space 116 is avoided. This insures that the flow of fluid through the valve body 64 will be steady and that every stroke of the device will inject a uniform quantity of fluid.

The size of the metered quantity of fluid may be reduced by mounting a shim 120 of suitable thickness on the rearward face of the block 54 by means of a bolt 122, as shown in FIGURES 7 and 8. The shim is formed with a semi-circular slot 124 adapted to fit the shaft 22. The size of the stroke and therefore of the injected quantity of fluid will be reduced as the shim 120 of increasing thicknesses are employed.

If the present device is to be used only for the metering of fluids, the shaft 96 does not include an axial passage and the head 100 is not provided. The outlet port 126 is provided in the valve body 64 forward of the inlet port 74 as shown in FIGURE 9. An opening 128 allows fluid trapped between the two shafts 88 and 96 to pass into the second outlet port 126. The device is operated in the same manner as in the above described device except that fluid is here led through the outlet port 126 rather than through the axial passage and head of the injection device. Since the port 126 is of relatively large diameter, the fluid forced through it will
be at substantially the same pressure as the fluid passing through the ports 74 and 76. It is to be understood that the present device is applicable to meter and inject any type of liquid or solid material which flows under pressure and it is not intended to be limited to permanent lubricants of the type described in conjunction with the above embodiments.

Having thus described my invention, I claim:

1. A metering device for fluents, comprising:
   a continuous flowing line of fluent;
   a body member defining an interior chamber and having an inlet and an outlet each communicative with said chamber whereby said fluent is permitted to enter said member through said inlet and to depart through said outlet;
   first and second means movably disposed within said chamber and normally displaced from each other on opposite sides of the line of flow between said inlet and said outlet;
   means for actuating said first and second means in a direction blocking said inlet and outlet, a quantity of said fluent being trapped between said first and second means;
   stop means adapted to limit the motion of said second means in said direction;
   and means permitting the removal of said trapped fluent compressed between said first and second means as said first means approaches second means.

2. The structure defined in claim 1 wherein said means for removing said fluent comprises an opening in said body member communicative with said chamber.

3. A metering and injection device for a continuous flowing line of fluent, comprising:
   a valve member having an interior central passage therethrough and including an inlet and outlet each communicative with said passage whereby said fluent is permitted to enter said passage through said inlet and to depart through said outlet;
   first and second means slidably disposed within said passage and normally displaced from each other on opposite sides of the line of flow between said inlet and said outlet;
   means for sliding said first and second means along said passage closing said inlet and outlet, a quantity of said fluent being trapped between said first and second means;
   stop means adapted to limit the motion of said second means;
   and means adapted to remove said trapped fluid compressed between said first and second means as said first means approaches second means.

4. The structure defined in claim 3 wherein said inlet and outlet are disposed on opposite sides of said passage with their axes in parallel spaced relation, whereby said outlet is closed prior to said inlet upon actuation of said first means.

5. The structure defined in claim 3 wherein said means for removing said fluent comprises a passage in said second means communicative with said central passage in said valve member.

6. The structure defined in claim 5 including a nozzle mounted on said second means and extending exteriorly of said valve member and having a passage therethrough connected to said passage in said second means, whereby said trapped fluid is forced through said second means passage and said nozzle passage exteriorly of said valve member as said first means approaches second means.

7. A metering device for a continuous flowing line of fluent, comprising:
   a valve member including an interior central linear passage therethrough having first forward and second rearward ends, an inlet and outlet port communicative with said passage whereby fluent is permitted to enter said passage through said inlet port and to depart through said outlet port;
   a piston adapted to move reciprocally parallel to the extension of said passage;
   means adapted to actuate said piston;
   a sub-structure connected to the forward end of said piston and slidingly connected to said valve member;
   a stop adapted to limit the forward motion of said sub-structure;
   a first shaft connected to said sub-structure and slidingly positioned in the forward end of said passage, said shaft having a rearward position situated forward of the line of flow between said inlet and said outlet;
   a second shaft slidingly positioned in the rearward end of said passage, and having an initial rearward position situated to the rear of the line of flow between said inlet and said outlet and a forward position blocking said inlet and said outlet;
   whereby, upon forward actuation of said piston a quantity of fluent is trapped between said first and said second shaft, and is translated forward of said line of flow;
   and means for removing said trapped fluid from between said first and second shafts to a point exterior of said valve member.

8. A metering device for a continuous flowing line of fluent, comprising:
   a valve member including an interior central linear passage therethrough having first forward and second rearward ends, an inlet and outlet port communicative with said passage whereby fluent is permitted to enter said passage through said inlet port and to depart through said outlet port;
   a piston adapted to move reciprocally parallel to the extension of said passage;
   means adapted to actuate said piston;
   a sub-structure connected to the forward end of said piston and slidingly connected to said valve member;
   a stop adapted to limit the forward motion of said sub-structure;
   a first shaft connected to said sub-structure and slidingly positioned in the forward end of said passage, said shaft having a rearward position situated forward of the line of flow between said inlet and said outlet;
   a second shaft slidingly positioned in the rearward end of said passage, and having an initial rearward position situated to the rear of the line of flow between said inlet and said outlet and a forward position blocking said inlet and said outlet;
   whereby, upon forward actuation of said piston a quantity of fluent is trapped between said first and said second shaft, and is translated forward of said line of flow;
   and port means adapted to allow said trapped fluid to be removed from said valve member after said first shaft is limited by said stop and said second shaft approaches said first shaft.

9. A metering and injection device for a continuous flowing line of fluent, comprising:
   a valve member including an interior central linear passage therethrough having first forward and second rearward ends, an inlet and outlet port communicative with said passage whereby fluent is permitted to enter said passage through said inlet port and to depart through said outlet port, a piston adapted to move reciprocally parallel to the extension of said passage;
   means adapted to actuate said piston;
   a sub-structure connected to the forward end of said piston and slidingly connected to said valve member;
   a stop adapted to limit the forward motion of said sub-structure;
a first shaft connected to said sub-structure and slid-
ingly positioned in the forward end of said passage, 5
said shaft having a transverse slot extending inte-
riorly and an interior axial passage extending from
said slot through the forward end of said shaft, said
shaft having a forward position wherein said trans-
verse slot is disposed in communication with said
interior slot of said valve member and a rearward
position situated forward of the line of flow be-
tween said inlet and said outlet;
a second shaft slidingly positioned in the rearward end
of said passage, and having an initial rearward posi-
tion situated to the rear of the line of flow between
said inlet and said outlet and a forward position
blocking said inlet and said outlet;
whereby, upon forward actuation of said piston, a
quantity of fluid is trapped between said first and
second shaft and is translated to a point adjacent to
the interior slot of said valve member, said fluid
then being forced through said slots and said axial
passage after said first shaft is limited by said stop
and said second shaft approaches said first shaft.
10. A metering and injection device for fluents, com-
prising:
a continuous flowing line of fluent;
a valve member including an interior central linear
passage therethrough having first forward and second
rearward ends, an inlet and outlet port communica-
tive with said passage whereby fluent is permitted to
enter said passage through said inlet port and to
depart through said outlet port, and an interior slot
adjacent said first end communicative with said
passage;
a piston adapted to move reciprocally parallel to the
extension of said passage;
fluid pressure means adapted to actuate said piston;
a sub-structure spring-connected to the forward end
of said piston and slidingly connected to said valve
member;
a stop adapted to limit the forward motion of said
sub-structure;
a first shaft connected to said sub-structure and slid-
ingly positioned in the forward end of said passage,
said shaft having a transverse slot extending inte-
riorly and an interior axial passage extending from
said slot through the forward end of said shaft, said
shaft having a forward position wherein said trans-
verse slot is disposed in communication with said
interior slot of said valve member and a rearward
position situated forward of the line of flow be-
tween said inlet and said outlet;
a second shaft slidingly positioned in the rearward end
of said passage, and having an initial rearward posi-
tion situated to the rear of the line of flow between
said inlet and said outlet and a forward position
blocking said inlet and said outlet;
whereby, upon forward actuation of said piston a quan-
tity of fluent is trapped between said first and said
second shaft, and is translated to a point adjacent to
the interior slot of said valve member by the
forward motion of said sub-structure, and then is
forced through said slots and said axial passage
by the forward motion of said second shaft after
the forward motion of said sub-structure is limited
by said stop, and whereby, upon rearward actuation
of said piston said second shaft is returned to
its initial rearward position by said sub-structure.
11. The structure defined in claim 10 including a hol-
low nozzle mounted at the forward end of said first shaft
and communicative with said interior axial passage such
that fluent forced into said axial passage is passed through
said nozzle.

References Cited by the Examiner

UNITED STATES PATENTS

160,589 3/1875 Greiner 222—488 X
1,944,919 1/1934 Bischof 103—154
2,336,998 12/1943 Moe et al. 222—359 X
2,954,146 9/1960 Hullman 222—334 X

FOREIGN PATENTS

493,117 1/1950 Belgium.
561,433 8/1923 France.
841,149 2/1939 France.

RAPHAEL M. LUPO, Examiner.
EVERETT W. KIRBY, Primary Examiner.