Dec. 13, 1966 W. G. McKENZIE 3,291,054

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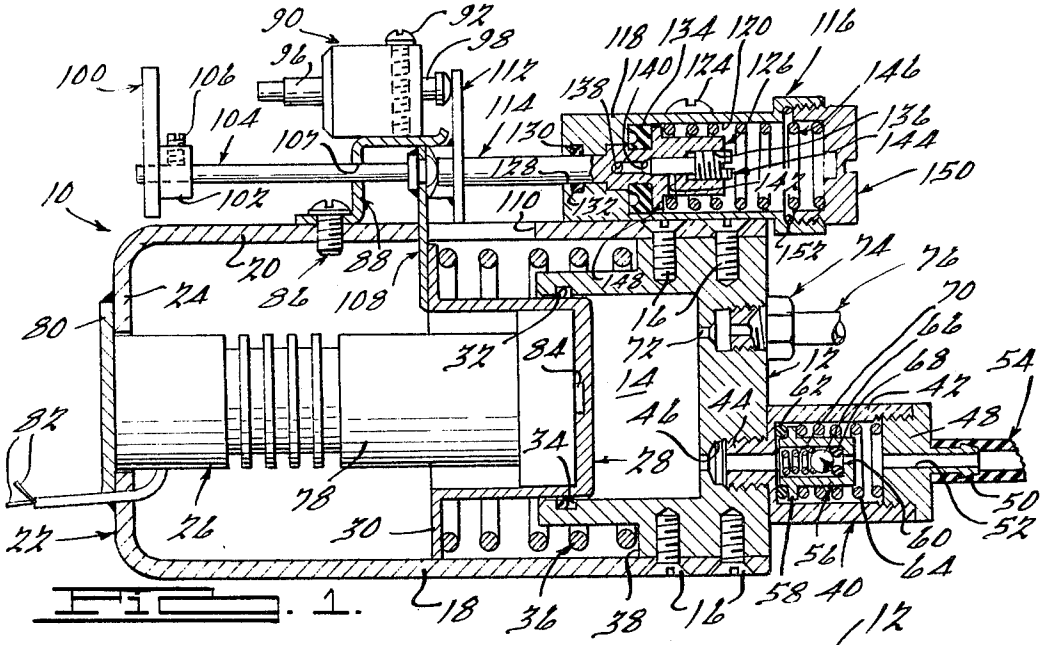


FIG. 1.

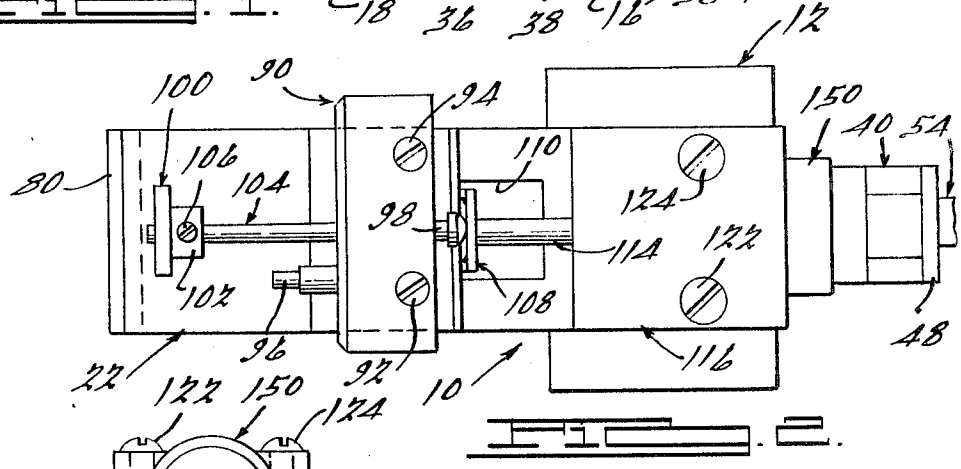


FIG. 2.

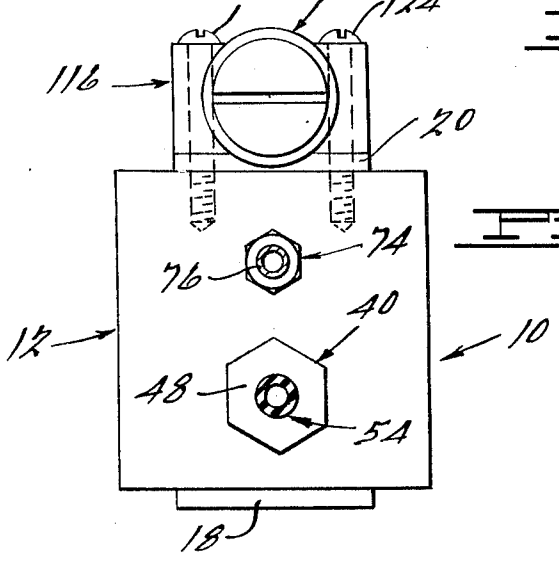


FIG. 3.

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This invention relates generally to fluid pumping means and, more particularly, to a pumping device for maintaining a predetermined fluid pressure within an associated fluid metering system.

It is a general object of the present invention to provide a fluid pumping device which pumps fluid from an associated fluid reservoir to a fluid metering system and maintains the fluid pressure within the system at a predetermined level, the device also serving to communicate any excess fluid back to the reservoir.

It is another object of the present invention to provide a fluid pumping device of the above character which has very few moving components and therefore has a a long service life.

It is still another object of the present invention to provide a fluid pumping device of the above character that is simple in construction and operation and which is therefore economical to produce.

It is yet another object of the present invention to provide a fluid pumping device of the above character which cycles automatically.

It is still a further object of the present invention to provide a fluid pumping device of the above character which comprises means for controlling the cyclic rate of operation thereof.

In accordance with the principles of the present invention, the foregoing and other related objects and advantages are attained through the provision of a novel pumping device which includes a thermal actuated piston assembly and a timing valve assembly which serves to control the cyclic rate of operation of the piston assembly. The pumping device of the present invention also includes a combination check valve and relief valve mechanism which is preloaded such that when a preselected fluid pressure level is achieved through operation of the device, any excess or surplus fluid will be automatically communicated back to the associated fluid reservoir.

A more complete understanding of the present invention and other objects and features thereof will be obtained from the following detailed description taken in conjunction with the accompanying drawing, wherein:

FIGURE 1 is a longitudinal cross-sectional view of the pumping device embodying the present invention;

FIGURE 2 is a top elevational view of the pumping device illustrated in FIGURE 1; and

FIGURE 3 is an end elevational view of the pumping device illustrated in FIGURE 1.

Referring now to FIGURE 1 of the drawing, a fluid pumping device **10**, in accordance with a preferred embodiment of the present invention, is shown, as comprising a generally square-shaped piston housing **12** which is formed with a central annular bore that defines a pumping chamber **14**. The housing **12** is rigidly secured, as by a plurality of suitable machine screws **16**, between a pair of spaced parallel leg sections **18** and **20** of a generally U-shaped mounting bracket **22**. The bracket **22** comprises an end section **24** which extends between the left ends of the leg sections **18** and **20** and supports a thermal energized drive motor **26** which serves to actuate the pumping device **10**, as will later be described.

Reciprocally mounted within the pumping chamber **14** is a generally cup-shaped piston member **28** which is formed with a radially outwardly extending flange section **30** at its open (left) end. A suitable O-ring sealing

member **32** is compressed between an annular recess **34** formed around the inner periphery of the chamber **14**, and the outer periphery of the piston member **28**, which sealing member **32** serves to prevent fluid leakage between the left end of the chamber **14** and the outer periphery of the piston **28**. A helical return spring **36** extends around the outer periphery of the left end of the housing **12** and abuts at its right end against an annular shoulder **38** defined by a medial portion of the housing **12**. The opposite (left) end of the return spring **36** abuts against the outwardly projecting flange section **30** of the piston member **28**, whereby the spring **36** functions to resiliently urge the piston member **28** toward the right end of the motor **26**.

Fluid is selectively communicated into the pumping chamber **14** by means of a combination check valve and relief valve assembly, generally designated **40** and comprising a hexagonal-shaped valve housing **42**, as seen in FIGURES 1 and 3. The housing **42** has a mounting section **44** which is threadedly mounted within a fluid inlet passage **46** that is formed in the right end of the piston housing **12**. The valve housing **42** and the mounting section **44** thereof are hollow and are thus communicable with the interior of the fluid inlet passage **46**. A plug or cover member **48**, which is formed with a central outwardly projecting nipple section **50** and a central bore **52**, is threaded within said closes the outer (right) end of the valve housing **42**, the nipple section **50** being inserted within one end of a fluid inlet conduit **54** which serves to communicate fluid to the valve assembly **40** from an associated fluid source or reservoir. Disposed within the interior of the valve housing **42** is a cup-shaped valve member **56** which is formed with a radially outwardly projecting shoulder section **58** at one end and a central discharge orifice **60** at the opposite end. The shoulder section **58** is resiliently urged into engagement with an O-ring sealing member **62** disposed at the left end of the valve housing **42** by a helical valve spring **64** which extends around the outer periphery of the valve member **56** and engages the right side of the shoulder section **58** and the left side of the cover member **48**, as seen in FIGURE 1. A spherical check valve **66** is disposed within the interior of the valve member **56** and is resiliently engaged with an O-ring sealing member **68** disposed at the right end of the member **56** by a coil spring **70** that extends coaxially within the member **56**. It will be seen that when the fluid pressure within the chamber **14** reaches a predetermined level, the valve member **56** will "pop" against the resistance of the spring **64**, whereby the fluid within the chamber **14** will flow through the interior of the valve housing **42** and the conduit **54** to the fluid reservoir, as will later be described.

Fluid is communicated out of the chamber **14** through a fluid outlet passage **72** that is formed in the right end of the housing member **12** directly above the fluid inlet passage **46**. A fluid outlet fitting **74** is threaded within the right end of the passage **72** and communicates the passage **72** with a fluid outlet conduit **76** which is adapted to communicate fluid from the pumping device **10** to an associated fluid metering or a dispensing mechanism (not shown).

As best seen in FIGURE 1, the thermal motor **26** comprises an elongated cylindrical housing **78** which is secured to the end section **24** of the mounting bracket **22** by a retaining plate **80** which is rigidly secured to the left end of the housing **78** and is welded or similarly attached to the left side of the section **24**. The motor **26** is preferably of the wax pellet type and includes a suitable electric heating element (not shown) which is adapted to be energized by connecting a suitable source of electric current with a pair of lead lines **82** which are communicable with the heating element. Upon energization of the heat-

ing element, a wax pellet that is disposed within the housing **78** adjacent the element expands a predetermined amount, thereby forcing a piston rod **84**, which projects from the right end of the housing **78**, toward the right to effect actuation of the pumping device **10**.

Secured to the top of the section **20** of the mounting bracket **22** by a suitable machine screw **86** is a Z-shaped actuating switch support bracket **88** upon which an actuating switch **90** is rigidly attached by means of a pair of screws **92** and **94**. The switch **90**, which is of a conventional toggle type and connected with the aforementioned source of electric current used to energize the thermal motor **26**, comprises a deenergizing section **96** and a reenergizing section **98** that project from the left and right sides thereof, respectively. The motor **26** is adapted to be deenergized upon engagement of the section **96** with a tripping bar **100** which is formed with a sleeve section **102** at its lower end within which the left end of a horizontally extending drive pin **104** is secured by means of a conventional set screw **106**. The opposite (right) end of the drive rod **104** extends through a central opening **107** in the switch supporting bracket **88** and is rigidly secured to a bracket **108** which is connected at its lower end to the flange section **30** of the piston member **28** and extends upwardly through a rectangular opening **110** formed in the section **20** of the mounting bracket **22**, as best seen in FIGURE 2. It will be seen from the foregoing that as the piston member **28** moves to the right upon energization of the motor **26**, the bracket **108** and drive pin **104** will bias the tripping bar **100** into engagement with the deenergizing section **96** of the switch **90**, thereby effecting deenergization of the motor **26**. The reset section **98** of the switch **90** is adapted to be engaged by a tripping bracket **112** which is rigidly secured to the left end of a cylindrical rod or shaft **114** that abuts against the right side of the bracket **108** such that the rod **114** will move to the right along with the drive rod **104** and bracket **108** upon actuation of the motor **26**. Movement of the bracket **112** and rod **114** toward the switch **90** is controlled through a cyclic timing assembly, generally designated **116**, as will hereinafter be described.

The assembly **116** comprises a rectangular-shaped housing **118** that is formed with an annular bore or chamber **120** and which is secured to the top of the section **20** of the bracket **22** by a pair of screws **122** and **124**. Reciprocally mounted within the bore **120** is a timing piston **126** that is rigidly secured to the right end of the rod **114** which extends through an opening **128** formed in the left end of the housing **118**. A suitable O-ring sealing member **130** is provided in an annular recess **132** that is formed around the bore **128**. Disposed around the outer periphery of the piston member **126** is a U-cup annular packing member **134** which is constructed of a resilient and deformable material such as a fluid resistant synthetic rubber or the like. The piston member **126** is formed with an axially extending bore **136** which is communicable at its left end with a bore **138** that extends diametrically through the piston member **126**. The bore **136** is formed with a tapered medial section **140** and is communicable with a bore **142** which extends radially within the piston member **126** immediately to the right of the tapered section **140**. A needle valve member **144** is threadably mounted within the right end of the piston member **126** and is adapted to be selectively adjusted therein such that its left end is engageable with the tapered section **140** of the bore **136** to control the flow of fluid between the bores **138** and **142**.

The piston member **126** is resiliently urged toward the left end of the housing **118** by means of a helical timing spring **146** which extends coaxially within the bore **120** and is engageable at its left end with an outwardly projecting shoulder section **148** formed on the piston member **126**, and is engageable at its right end with a cup-shaped plug or closure member **150** which is threaded within and closes the right end of the bore **120**. An O-ring sealing member **152** is interposed between the right end of the housing **118** and the closure member **150**. The housing **118** contains a predetermined quantity of fluid which, upon actuation of a motor **26** and movement of the rod **114** and piston member **126** to the right, flows from the right end of the bore **120**, around the outer periphery of the packing member **134**, to the left end of the bore **120**. When the drive pin **104** moves to the left due to the action of the return spring **36** on the piston **28**, the timing spring **146** will force the piston member **126** and rod **114** toward the left end of the housing **118**, whereby the fluid between the left end of the housing **118** and the piston member **126** is forced through the bores **138**, **136**, and **142** to the right end of the bore **120**. It will be seen that the rate at which the fluid flows between the bores **136** and **142** is controlled by the adjustment of the needle valve **144** within the piston member **126**, and hence the time required for the piston member **126** to traverse from the right end of the housing **118** to the left end thereof and consequently the time interval between deenergization of the motor **26** and engagement of the bracket **112** with the switch **90** effecting reenergization of the motor **26**, is controlled by the relative adjustment of the needle valve **144**.

To facilitate correlating each of the hereinbefore described components of the pumping device **10** of the present invention, the cyclic operation of this device will now be given. Assuming that the lead lines **82** are connected to a suitable source of electric current, and that the fluid inlet and outlet conduits **54** and **76** are connected to an appropriate source of fluid and to an associated fluid metering or dispensing mechanism, respectively, the operational cycle of the pumping device **10** commences upon energization of the thermal motor **26**, as by actuating an external switching mechanism (not shown) to complete the electrical circuit to the motor **26**. Upon energization of the motor **26**, the piston rod **84** will be biased outwardly or away from the right end of the motor housing **78**, thereby urging the piston member **28** toward the right end of the pumping chamber **14**. As the piston member **24** is thus moved, the fluid within the chamber **14** will be forced through the fluid outlet passage **72** and fluid outlet conduit **76**, the reason for this being that the check valve **66** prevents fluid within the chamber **14** from being forced back into the fluid inlet conduit **54**. When the fluid pressure within the associated fluid metering or dispensing device reaches a predetermined level, the valve member **56** will "pop" or move to the right against the resistance of the spring **64**, thereby unseating the shoulder section **58** of the member **56** from the sealing member **62** and permitting the excess or surplus fluid within the pumping chamber **14** to flow back through the valve assembly **40** and the conduit **54** to the fluid reservoir.

The forward movement of the piston member **28** is terminated when the tripping bar **100**, which is secured to the piston member **28** by means of the drive pin **104** and bracket **108**, engages the deenergizing section **96** of the switch **90** to effect deenergization of the motor **26**, at which time the return spring **36** biases the piston member **28**, bracket **108**, pin **104** and bar **100** toward the left. It will be seen that as the piston member **28** moves to the right within the pumping chamber **14** during the discharge portion of the operational cycle, the bracket **108** biases the rod **114** and piston member **126** toward the right end of the timing assembly housing **118**, whereby the fluid within the bore **120** flows around the outer periphery of the packing member **134** to the left end of the housing **118**. After deenergization of the motor **26** and movement of the piston member **28** and bracket **108** away from the rod **114** through action of the return spring **36**, the spring **146** forces the piston member **126** toward the left end of the bore **120**, causing the fluid in the housing **118** to flow through the bores **138**, **136** and **142**, as above described, the speed at which the piston member **126**

and rod 114 are biased toward the left being controlled by the adjustment of the needle valve 144 within the piston member 126. When the piston member 126 and rod 114 have moved a predetermined distance, the bracket 112 which is secured to the left end of the rod 114 engages the reenergizing section 98 of the switch 90, thereby energizing the motor 26 to effect the next successive operational cycle of the pumping device 10, as hereinabove described.

It will be seen from the aforegoing construction that the pumping device 10 of the present invention provides an extremely simple and compact unit which, upon being initially energized, will cycle automatically to maintain a predetermined fluid pressure within an associated fluid metering or dispensing mechanism. It will also be seen that the pumping device 10 includes means for controlling the cyclic rate of the operation thereof and for controlling the flow of excess fluid back to an associated fluid reservoir when a predetermined fluid pressure is attained within the fluid metering mechanism. The device 10 will find particular application when used with a fluid metering device of the type employed in supplying lubricating fluids to a series of bearing surfaces in a production machine or the like. It will be apparent, of course, that the pumping device 10 of the present invention is not limited to such use and may be incorporated in any of a number of fluid systems requiring that a minimum fluid pressure level be maintained therewithin.

While it will be apparent that the preferred embodiment therein illustrated is well calculated to fulfill the objects above stated, it will be appreciated that the pumping device 10 of the present invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. In a fluid pumping device,
a housing defining a pumping chamber,
piston means reciprocable within said chamber,
electrically heated expandable wax thermal motor means for moving said piston means within said chamber,
electrical switch means operated by said piston means for deenergizing said motor means, and
means for reenergizing said motor means.

2. The invention as set forth in claim 1. wherein said means for reenergizing said motor means comprises valve means movable in response to movement of said piston means.

3. The invention as set forth in claim 1 which includes valve means to selectively communicate fluid to said chamber and for relieving the fluid pressure within said chamber when said fluid pressure reaches a predetermined level.

4. In a fluid pumping device,
a housing defining a pumping chamber,
piston means reciprocable within said chamber,
motor means for moving said piston means within said chamber,
means for deenergizing said motor means, and
timing means including fluid valve means for reenergizing said motor means, and a combination check and relief valve means for selectively controlling the flow of fluid to and from said chamber.

5. In a fluid pumping device,
a housing defining a pumping chamber,
fluid inlet and outlet passages formed in said housing and communicating fluid to and from said chamber,
a fluid relief valve in one of said passages,
said relief valve comprising a movable valve member and spring means yieldably seating said member,

a check valve in one of said passages and comprising a valve member and spring means yieldably seating said member,
piston means reciprocable within said chamber,
motor means for moving said piston means within said chamber,
means for deenergizing said motor means, and
timing means including valve means for reenergizing said motor means.

6. The invention as set forth in claim 5 wherein said relief valve and said check valve are arranged in a single valve housing communicable within said fluid inlet passage.

7. The invention as set forth in claim 5 wherein said timing means comprises a timer housing, a plunger reciprocable within said timer housing, yieldable packing means arranged between said plunger and said housing, and valve means adjustably mounted on said plunger, said plunger having an axial bore within which said valve means is disposed, said plunger also having first and second radially extending bores communicating with said axial bore on the opposite sides of said valve means, whereby adjustment of said valve means within said axial bore selectively controls the flow of fluid between said first and second radially extending bores.

8. In a fluid pumping device,
a mounting structure,
a housing secured to said structure and defining an annular pumping chamber.
fluid inlet and outlet passages formed in said housing and communicating fluid to and from said chamber,
a fluid relief valve in said inlet passage,
a fluid check valve in said inlet passage,
a piston member reciprocable within said chamber,
motor means for biasing said piston in one direction within said chamber,
a return spring for biasing said piston in the opposite direction within said chamber,
a switch for controlling energization of said motor means,
means including means movable with said piston for deactuating said switch,
a timer housing on said structure,
a plunger reciprocable within said timer housing,
valve means for controlling the movement of said plunger within said timer housing, and
means connected to said plunger and movable with said piston for actuating said switch.

9. The invention as set forth in claim 8 wherein said motor comprises a heating element and an expandable wax pellet.

10. In a fluid pumping device, a housing defining a pumping chamber, piston means reciprocable within said chamber, motor means for moving said piston means within said chamber, means for deenergizing said motor means, timing means including fluid valve means for reenergizing said motor means, and timing means comprising a timer housing, a plunger reciprocable within said timer housing and valve means for controlling the movement of said plunger within said timer housing.

References Cited by the Examiner

UNITED STATES PATENTS

2,925,786	2/1960	Hill	230—230 X
2,976,675	3/1961	Bonner	60—25
3,012,513	12/1961	Knox	103—52

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