The present invention relates generally to liquid feeding and metering devices and it relates more specifically to an improved device for metering liquids such as lubricating oils, to the intake of an internal combustion engine in accordance with its operating requirements.

The device of the present invention is particularly useful as an upper cylinder lubricator and is of the type shown and described in United States Patents No. 1,883,110 and No. 2,539,924, although it may be advantageously employed in any liquid feeding system of the above type. As disclosed in the above patents, liquid feeding systems of the subject nature include a flexible diaphragm which is subjected to and moved by the negative pressure existing in the intake manifold of an internal combustion engine.

The diaphragm, in turn, automatically adjusts the opening in a valve located in a conduit system connecting the engine intake manifold to a reservoir or source of lubricating oil or other liquid so that as the liquid is drawn into the intake manifold by suction, the rate of flow of the liquid is regulated by the diaphragm controlled valve. As the vacuum in the intake manifold increases the flexing of the diaphragm increases to urge the valve toward its closed position and as the vacuum in the intake manifold decreases the flexing of the diaphragm decreases to increase the valve opening. As a consequence the lubricating oil is metered to the engine in accordance with its needs and requirements. In the later types of upper cylinder lubricators, as typified by that described in the above identified United States Patent No. 2,539,924 the valve opening is also regulated in accordance with the temperature of the metered oil. Inasmuch as the viscosity of the lubricating oil varies greatly with temperature, in the absence of any compensation for such change in viscosity the lubricating oil feed will be excessive at high temperatures or too low at low temperatures or both. While satisfactory lubricating oil feed is effected by the latter type of device and temperature and pressure responsive regulation is achieved, these earlier metering devices possessed numerous drawbacks and disadvantages. They are relatively complex and expensive devices of little flexibility. Moreover they are difficult to service and are subject to frequent malfunctioning. Furthermore, their range of feed regulation is limited.

It is therefore a principal object of the present invention to provide an improved liquid feeding and metering device.

Another object of the present invention is to provide a lubricating liquid metering device for use with an internal combustion engine, which device accurately responds to the requirements and needs of the engine.

Still another object of the present invention is to provide an improved upper cylinder lubricator whose delivery rate is regulated by the pressure conditions in the engine intake manifold.

A further object of the present invention is to provide an improved and simplified upper cylinder lubricator having means compensating for changes in the lubricating oil viscosity attendant to changes in the temperature thereof.

Still a further object of the present invention is to provide an upper cylinder lubricator of the above nature characterized by simplicity, ruggedness, flexibility and low cost.

The above and other objects of the present invention will become apparent from a reading of the following description taken in conjunction with the accompanying drawing wherein:

FIGURE 1 is a front elevational view of a metering device in accordance with the present invention shown connected to a tank of lubricating oil illustrated partially broken away;

FIGURE 2 is a sectional view taken along line 2—2 in FIGURE 1;

FIGURE 3 is a top plan view of the metering device illustrated partially broken away; and

FIGURE 4 is a bottom plan view thereof.

In a sense the present invention contemplates the provision of a device for metering a liquid whose viscosity varies with temperature to the intake of an internal combustion engine in the suction of which varies with the speed of the engine, comprising a housing, a flexible diaphragm disposed in said housing and defining the wall of a vacuum control chamber, means for connecting said chamber to said engine intake, a valve having an outlet communicating with said chamber and an inlet adapted to be connected to a source of liquid and including first and second cooperating valve elements relatively movable between open and closed positions, said first valve element being mounted on and movable with said diaphragm, and a member movable in response to the temperature thereof and second valve element to urge said second valve member toward its open and closed positions with the lowering and raising respectively of the temperature of said temperature responsive member.

According to a preferred form of the present device the housing is divided by the diaphragm into upper and lower chambers the lower chamber being connected to a source of lubricating oil and the upper chamber to the engine intake manifold. The first valve element is defined by a tube extending through the center of the diaphragm and terminating at its upper end in a valve seat. The temperature responsive element is a bimetallic lever hinged between its ends and supported at one end by a depending valve needle registering with the valve seat and engaged at its other end by a screw which permits the adjustment of the valve needle position.

The subject device is characterized by its simplicity, ruggedness and range and ease of adjustment. In normal operation the negative pressure in the engine intake manifold initially reduces the pressure in the housing upper and lower chambers to suck oil into the lower chamber and up the valve tube and into the upper chamber from which it flows to the intake manifold. A difference in pressure is thus effected between opposite sides of the diaphragm to regulate the position between the valve elements and hence the valve opening and the rate of flow of the oil, the valve opening varying inversely with the vacuum in the intake manifold. Furthermore with changes in the oil viscosity which accompanies changes in the temperature thereof, the bimetallic element bends due to its corresponding change in temperature to urge the valve needle toward and away from its closed position with raising and lowering of the temperature whereby to compensate for changes in the oil viscosity and hence maintain the oil metering rate substantially independent of temperature. The metering rate is simply varied by varying the position of the valve needle by means of the adjustment screw. Moreover, by reason of the construction of the housing and the relationship of the chambers and valve tube the oil reservoir may be a separate tank spaced from the metering device at any convenient location.

Referring now to the drawings which illustrate a preferred embodiment of the present invention the reference numeral 10 generally designates the improved metering device which includes a housing 11 comprising a base...
section 12 and a dome shaped cap section 13. The base section 12 consists of a bottom wall 14 and an upstanding integrally formed cylindrical peripheral wall 16 having a flat top rim or face. A centrally disposed sump defining wall 17 is formed in the base bottom wall 14. The cap section 13 includes a top wall 18 and a depending cylindrical peripheral wall 19 of substantially the thickness of the base wall 16 and having a flat bottom face confronting the top face of the base wall 16. The cap section 13 is preferably formed of a transparent material such as an organic plastic to provide visual access to the interior of the housing 11. Thus, the operation and metering action may be viewed from many angles, this being of distinct advantage in ascertaining quickly whether the device is in operation. An annular gasket 20 is superimposed on the top face of the base wall 16.

The outer border of a disc shaped flexible metal diaphragm 21 rests on the inner border of the gasket 20, the gasket 20 and the diaphragm outer border being tightly sandwiched between the confronting end faces of the base and cap walls 16 and 19. The housing and diaphragm are releasably maintained in assembled condition by a plurality of bolts 22 which register with bores formed in the base wall 16 and with openings formed in the gasket 20 and engage corresponding tapped bores formed in the cap wall 19, the heads of the bolts 22 resting in the countersunk holes. The diaphragm 21 hermetically divides the housing 11 into an upper chamber 23 and a lower chamber 24. A boss 25 is formed on the outer face of the base wall 16 and is provided with a tapped bore fitted with a tube coupling 27 to permit the connection of the device in any suitable manner to the intake manifold of an internal combustion engine. A passageway 28 is formed in the base wall 16, gasket 20 and cap wall 19 and affords communication between the upper chamber 23 and the coupling 27. A second coupling member 29 engages a corresponding tapped opening in the base wall 16 and communicates with the lower chamber 24 by way of a passageway 30 formed in the base wall 16. The lower chamber 24 is connected by way of the passageway 30, the coupling member 29 and a tube 32 to the tube 34. The coupling cap 33 is provided with a screw section 34 and a depending tube 35 which communicates with the tube 32 by way of a passageway 37 formed in the cap 33. An oil reservoir or tank is defined by a metal receptacle 38 provided with a threaded neck section 39 engaged by the screw section 34, the tube 35 being extended almost to the bottom of the tank 38 thereby affording communication between the chamber 24 and the oil in the tank 38.

A tubular first valve element 40 is centrally carried by and projects through the diaphragm 21 and includes a tube 41 depending from the diaphragm 21 into the sump 17 and having an externally threaded upper section 42 projecting through a corresponding central opening in the diaphragm 21 and an integral formed hexagonal flange 43 directly underlying the diaphragm 21. Projecting vertically from the diaphragm 21 is an upstanding tube 44 which is internally threaded at its upper and lower ends and engages the lower tube threaded section 42 to effect the tight assembly of the communicating tubes 41 and 44 to the diaphragm 21. A spout or drip spoon member 46 includes an upper disc shaped platform 47 resting on the top face of the tube 41 and provided with a central opening registering with the bore of the tube 44. The platform 47 is provided with an upstanding peripheral wall 48 which joins the converging side walls of a channel shaped delivery member 49 inclined downwardly from the platform 47 and directed toward the passageway 25 and terminating in a lip 50 of relatively sharp upper conical inclination. A valve seat 51 includes a tubular threaded shank 52 passing through the spout platform openning and engaging the threaded upper section of the tube 44 and an enlarged head 53 bearing on the spout platform 47 to effect the assembly of the tube 44, spout 46 and valve seat 51. The face of the valve seat 51 is shaped to any desired configuration to effect a suitable metering rate adjustability.

Depending from the underside of the cap top wall 18 is a bracket 54 to which is journaled a horizontal shaft rod 56. A lever 57 formed of an elongated strip of bimetallic material which bends about the length thereof in the well known manner in response to changes in temperature, is affixed intermediate the ends thereof to the shaft 56 so as to be rockable about the axis of the shaft 56. The inner end of the lever 57 is disposed above and in vertical alignment with the valve seat 51 and has a medially located longitudinally extending slot formed therein. The outer end of the lever 57 is disposed below and in axial alignment with a tapped bore 58 formed in the cap top wall 18. The bimetal lever 57 is so oriented that increases in the temperature thereof causes its outer ends to bend downwardly and its under face to become concave.

A second valve element 59 is supported at the inner end of the lever 57 and includes a depending bottom valve needle section 60 registering and coaxial with the valve seat 53 and movable with the inner end of the lever 57 toward and away from the valve seat 53 to correspondingly close and open the valve opening. Projecting upwardly from the valve needle 60 is a cylindrical shank 61 having a peripheral groove 63 formed in the face thereof below its upper end and engaging the longitudinal slot formed in the lever 57 to permit self alignment of the valve element 59 relative to the valve seat 53 while restraining axial movement of the valve element 59 relative to the lever 57.

A helical compression spring 64 nestles in a centrally located well formed in the cap top wall 18 and encircles the upper section of the valve element shank 61 and bears upon the upper face of the inner end of the lever 57 to resiliently urge the lever 57 in a counterclockwise direction as viewed in FIGURE 2. The swinging of the inner end of the lever 57 downwardly by the spring 64 is limited by an adjustment screw 65 engaging the tapped bore 58 and bearing on the upper face of the outer end of the lever 57.

The mode of operation of the above described metering device is as earlier set forth. With increases in the intake manifold vacuum the diaphragm 21 flexes upwardly to carry the valve element 59 toward the valve element 59 and reduce the valve opening and hence the flow rate therefrom. With reductions in the manifold vacuum the valve opening is increased. In addition, changes in oil viscosities as effected by changes in temperature which would vary the oil flow rate are compensated for by the bending of the inner end of the lever 57 with increases in temperature to bring the valve element 59 toward the valve element 40 and hence restrict the valve opening, and with a drop in temperature increasing the valve opening in an opposite manner. The rate of flow may be adjusted by turning the screw 58 to rock the lever 57 and move the valve element 59 to thereby open or restrict the valve opening as desired. The rate of flow of the oil may be observed through the transparent cap 13. In a satisfactory embodiment, the cap 13 was fabricated of Plexiglas with its dome-shaped wall about 3/8" in thickness.

While there has been described and illustrated a preferred embodiment of the present invention it is apparent that numerous alterations, omissions and additions may be made without departing from the spirit thereof.

What is claimed is:

1. A liquid metering device of the character described comprising a housing including a cup-shaped base member having an upstanding peripheral wall and a cap member including a top wall and a depending peripheral wall registering with said base peripheral wall, a disc-shaped flexible diaphragm having a border sandwiched between
the ends of said base and cap peripheral walls and hermetically dividing said housing into upper and lower chambers, said housing having passageways formed therein communicating with said upper and lower chambers to define an outlet and inlet respectively, a tubular first valve member extending through the center of said diaphragm and movable therewith and provided at its upper end with a valve seat, a temperature responsive bimetal lever hinged between its ends about a horizontal axis and supported by said cap top wall, a valve needle depending from one end of said lever in registry with said valve seat, a screw element engaging a tapped bore formed in said cap top wall and engaging the upper face of the other end of said lever, and a spring urging said valve needle toward said valve seat.

2. The device of claim 1 wherein said housing base has a centrally located sump defining well formed therein, the lower end of said first valve element projecting into said well.

3. A device for metering a liquid whose viscosity varies with temperature to the intake of an internal combustion engine the suction of which varies with the speed of the engine, comprising a housing, a flexible diaphragm disposed in said housing and dividing said housing into hermetically separated upper and lower chambers, means adapted to connect said upper chamber to said engine intake, means adapted to connect said lower chamber to a source of said liquid, a tubular first valve element mounted on and extending through said diaphragm and movable therewith and affording communication between said upper and lower chambers, said first valve element having a discharge opening disposed in said upper chamber, a bimetallic arm located in said upper chamber and a second valve element registering with said discharge opening and connected to said bimetallic arm and movable therewith relative to said discharge opening between open and closed positions with the lowering and raising respectively of the temperature of said bimetallic arm, said tubular valve element terminating at its upper end in a valve seat and said second valve element being defined by a valve needle coaxial with and confronting said valve seat, said bimetallic arm being hinged at a point between its ends about a horizontal axis, said second valve element depending from one end of said arm and including a detent element engaging the upper face of the other end of said bimetallic arm and being vertically adjustable relative thereto, and spring means resiliently urging said one end of said bimetallic arm downwardly.

4. The device of claim 3 wherein said detent is defined by a screw engaging a tapped opening formed in the wall of said housing and accessible from outside said housing.

References Cited in the file of this patent

UNITED STATES PATENTS

1,219,516 Whittelsey Mar. 20, 1917
2,085,974 Harris July 6, 1937
2,539,924 Pierce Jan. 30, 1951