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METER FOR INDICATING RATIO OF FLUID FUEL CONSUMPTION TO ENGINE SPEED

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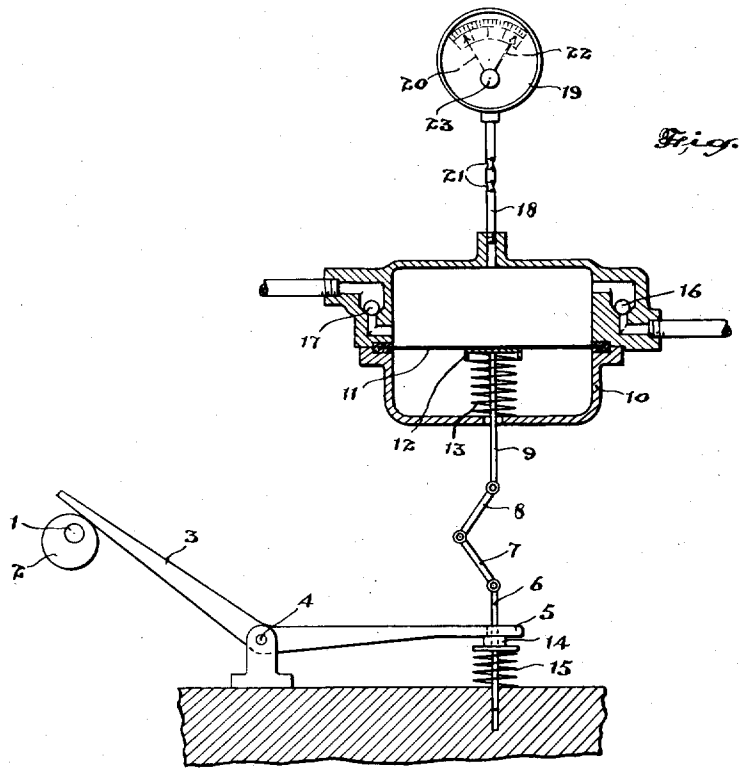


Fig. 1.

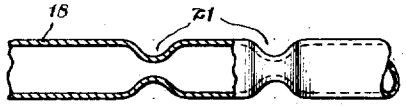


Fig. 2.

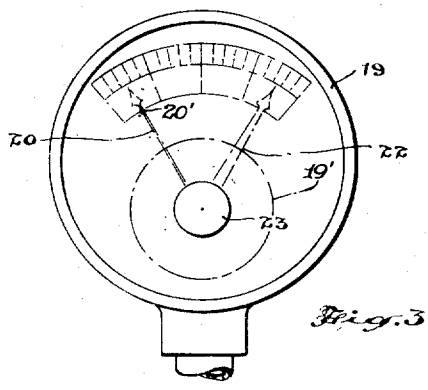


Fig. 3.

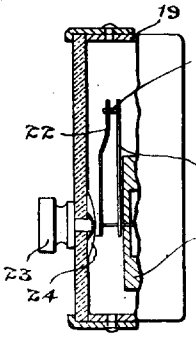


Fig. 4.

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METER FOR INDICATING RATIO OF FLUID FUEL CONSUMPTION TO ENGINE SPEED

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2 Claims. (Cl. 73—51)

The principal objects of the invention are, to enable the person operating an engine of the variable or constant speed type to ascertain the ratio of the rate of flow of fuel to the engine speed, thus enabling him to determine whether or not the engine is operating efficiently.

The principal feature of the invention consists in the novel arrangement of a gauge communicating with the pressure chamber of the engine operated fuel pump, whereby the pressure in the pump body, indicated by the gauge, will give a measure of fuel consumption in relation to engine revolutions, which in the case of vehicles operating on land may be indicated in terms of miles per gallon.

In the accompanying drawing, Figure 1 is a diagrammatic sectional view of a fluid fuel pump for use in supplying fuel to a fluid fuel motor and equipped with our improved gauge arrangement.

Figure 2 is an enlarged detail of a portion of the pipe connection between the fuel pump and the gauge.

Figure 3 is an enlarged elevational view of the gauge.

Figure 4 is a part sectional view showing the indicator fingers of the gauge.

In the operation of internal combustion engines it is now common practice to feed the liquid fuel to the carburetor by means of a pump actuated by the engine movement.

In the form of pump device illustrated in Figure 1, 1 represents the engine cam shaft which carries a cam 2 which is in constant engagement with a rocker member 3 pivotally mounted at 4 and having a forked or slotted end 5.

A rod 6 is slidably mounted in suitable supports and passes through the forked or slotted end 5 of the member 3 and is connected by a pair of toggle link members 7 and 8 to the stem 9 of the pump 10.

A diaphragm 11 is arranged to extend across the pump casing and the spindle 9 is surmounted by a cap 12 which is secured to the diaphragm 11 and said spindle in its reciprocations operates the diaphragm against the coiled compression spring 13 surrounding the spindle 9.

A stop member 14 is fixedly mounted on the rod 6 below the forked end 5 of the member 3, so that as the cam 2 rotates and swings the rocker member 3 on its pivot the slotted end 5 engages the stop 14 to pull downwardly.

The spindle 6 is operated against the pressure of the compression spring 15 in its downward movement which causes the rod 6 to follow the movement of the rocker arm.

As the cam 2 operates the rocker arm, swinging the end 5 thereof downwardly to engage the stop 14, it pulls downwardly on the spindle 9 and consequently upon the diaphragm to which the cap 12 is secured.

The upward movement of the rocker arm does not displace the spindle 9 as the toggle links 7 and 8 break joint automatically upon the cessation of a downward pull thereagainst.

The pump 10 is provided with an inlet valve 16 and an outlet valve 17.

The downward movement of the spindle 9 draws liquid into the pump chamber and the return movement of the diaphragm effected by the spring 13 expels liquid through the outlet valve 17.

It will be understood that a pulsating or reciprocating motion of the diaphragm 11 is created which is of a frequency directly proportional to the engine speed and the alternating pulsation creates an alternating vacuum and pressure in the pump body causing the fuel to flow.

It will also be understood that the travel of the spindle 9 is variable in accordance with the movement of the diaphragm 11 and its mean position with respect to the remainder of the pump is dependent on the mean pressure in the pump body.

As the pressure increases the spindle is forced downward. The toggle link 7, 8 is collapsed to an increasing degree and the rod 6 has to straighten the toggle before it can act to operate upon the spindle 9 and diaphragm 11 which thus regulates the stroke of the diaphragm.

As the pressure within the pump decreases the movement of the toggle members is lessened and consequently a greater amount of the travel of the spindle 9 is effective in imparting a greater amplitude of displacement to the diaphragm.

This type of pump is well known in the art and the invention consists in connecting to the pump casing at a point above the diaphragm a tube 18 which connects with the "Bourdon" tube of a pressure gauge 19, the indicator finger 20 of which indicates a measure of fuel consumption in direct relation to engine revolutions and where the engine is arranged on a vehicle operated on land such revolutions are directly proportional to speed, consequently where there is fixed fuel flow the greater the speed of revolution the greater number of pulses per second, which results in the lowering of the mean position of the diaphragm consequent upon a greater pressure.

The higher the flow of fuel with the speed remaining constant the greater will be the displace-

ment per pulse, resulting in the higher position of the diaphragm and a lower pressure.

Let p=spring gradient in pounds per unit area of diaphragm per unit length of stroke.

L=total deflection to free unloading of spring. This is not total length of stroke, since diaphragm is constrained by cam and spring can thus be considered as pre-loaded for full stroke of pump.

l=actual length of stroke for any given delivery per stroke.

P=pressure corresponding to l above.

To every stroke the vehicle travels a definite distance and therefore the volume pumped per stroke is a measure of the gallons per mile (multiplied by a constant). Likewise, since the piston area of the pump is constant, the length of stroke is also a measure of the gallons per mile, or gallons per mile=Kl where K is a constant.

The pressure P effective in governing the length of the stroke and consequently the delivery per stroke is that pressure in the pump chamber equal and opposite to the force set up by the compression of the spring. This force set up by the spring for any given stroke l is equal to the spring gradient p times the difference between the free spring length L and the stroke l, or:

$$P=p\ (L-l)$$

Therefore

$$l=\frac{pL-P}{p}=L-\frac{P}{p}$$

and

$$\text{gallons per mile}=K\left(L-\frac{P}{p}\right)$$

or gallons per mile=K_1-K_2P where K_1 and K_2 are constants, and

$$\text{miles per gallon}=\frac{l}{K_1-K_2P}$$

Therefore a gage reading P may be suitably calibrated to give an indication of gallons per mile or miles per gallon.

The gauge 19 may be of any of the well known types, but it is preferably provided with a high damping which may be produced by mounting an inertia member 19' to swing with the pointer 20 so that the pulses from the fuel pump will not resonate with the moving parts of the gauge.

It may be found desirable to effect the same result in the gauge by providing one or more constrictions 21 in the tube 18 between the gauge and the pump, as is illustrated in Figure 2.

This invention permits the checking up of performance of the engine over long periods of time and the gauge is preferably provided with an indicator finger 22 which may be manually reset—but is moved to retain an indication of the highest previous efficiency obtained.

Figures 3 and 4 illustrate a gauge capable of showing these features. The pointer 22 is attached to a knurled nut 23 and is adapted to be turned by hand and held in position by a shaft through the gauge glass and a suitable friction device 24 of the well known bowed spring type which draws the nut 23 axially to frictional contact with the surface of the gauge glass. This indicator finger 22 is spaced from the gauge pointer 20, and if desired, the pointer 20 may be provided with an operating extension 20' which will engage the pointer 22 to move same to a maximum indicating position in a manner which is well known in the metering art.

As the gauge is susceptible to the influence of the combined pressure in the pump and the pulsations thereof, the direct effect of the mean condition is indicated by the operation of the gauge finger 20.

A meter for indicating ratio of fluid consumption to engine speed is not only applicable to vehicles operating on land and giving accurate miles per gallon readings, but it may be applied to both water, air and other forms of transport or with other applications of engines where the readings of fluid flow in proportion to engine speed will be quite dependable under normal conditions of operation. In all instances the gauge, which operates on a straight line relationship will enable the operator of the machine to obtain instantaneous check-up on the performance of the machine which will thus indicate the presence of adverse conditions of operations which may not have been otherwise made apparent. The device will thus maintain a constant check on performance and act as a safety factor.

The preferred form of measuring the ratio of engine speed and fluid flow has been herein shown but it must be understood that other means may be employed to indicate this ratio so long as the said means function in a manner proportional to the pressure in the pump casing. For instance the mean position of diaphragm operating stem 9 is proportional to the ratio to be derived and can be indicated in various ways.

What we claim as our invention is:—

1. As a means for indicating the ratio of fuel consumed to distance travelled in fuel engine-propelled vehicles the combination with a pump supplying fuel to said vehicle propulsion engine, said pump having a casing having a pump element operating therein in one direction by said engine at a rate fixed in relation to the engine speed to create a fuel flow to the engine, valve means controlling the inlet and outlet of fluid to and from said casing, means permitting lost motion between the engine and the pump element operated thereby, spring means opposing the engine operated movement for returning the pump element during periods of cessation of the former movement, the said spring means acting to control the pressure in accordance with the engine fuel requirement, of means influentially connected with the pump chamber defined by the operated pump element, the valves, and the pump casing and indicating through the mean pressure therein the ratio between the fuel requirements and distance travelled by the vehicle.

2. As a means for indicating the ratio of fuel consumed to distance travelled in fuel engine-propelled vehicles, the combination with a pump supplying fuel to said vehicle propulsion engine, said pump having a diaphragm periodically operated in one direction by the vehicle propulsion engine, a lost-motion device permitting lost motion between the engine and the diaphragm, and spring means for returning said diaphragm in the reverse direction on a pumping stroke, of a pressure gauge connected with the pressure producing side of the pump diaphragm and responsive to the mean pressure of the fuel therein for the purpose of indicating the ratio of fuel consumed to the distance travelled by the vehicle, and pressure damping means disposed between the said pressure producing side of the pump diaphragm and the gauge to dampen out the pulsations in the pressure created by the movements of said diaphragm.

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