July 16, 1940. P. O. SKÖLDBERG 2,207,880

FUEL CONSUMPTION INDICATOR

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Fig. 1

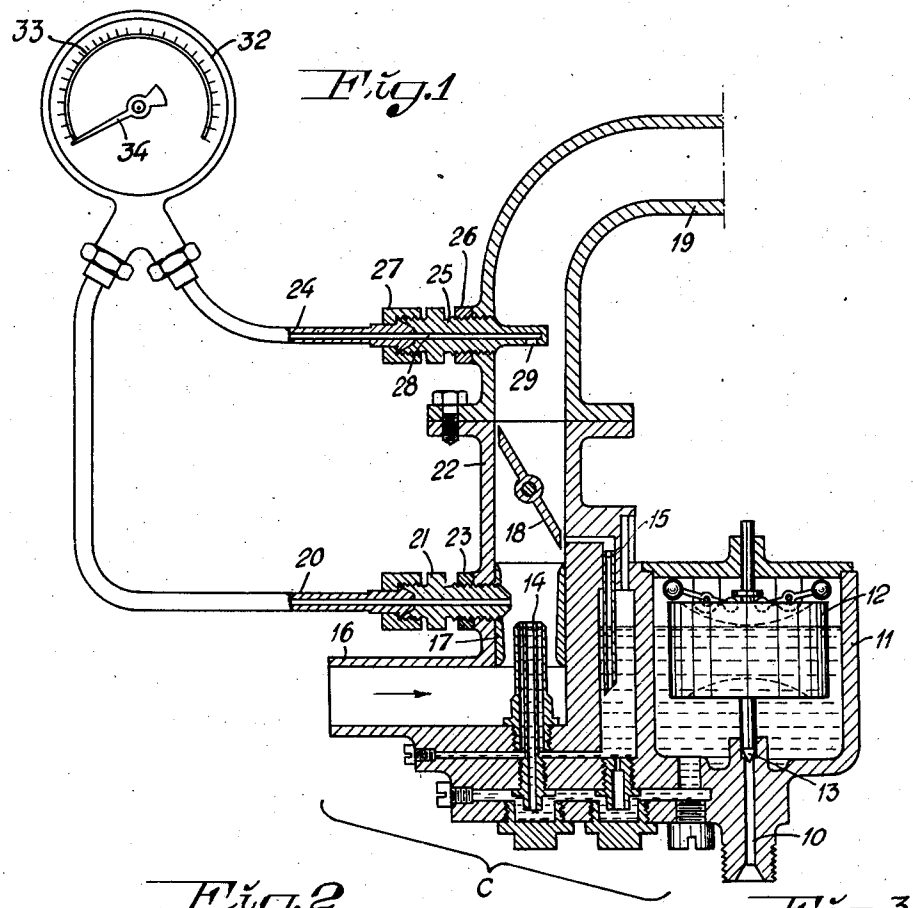


Fig. 2

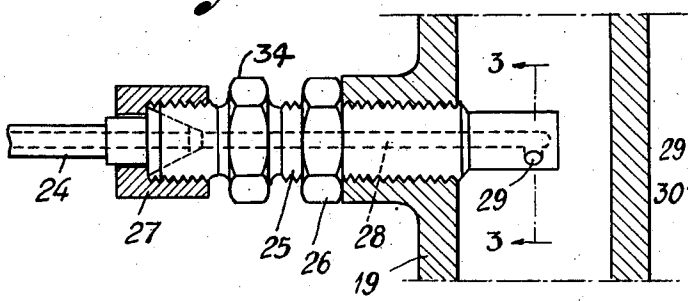
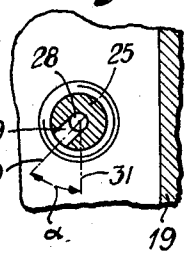


Fig. 3



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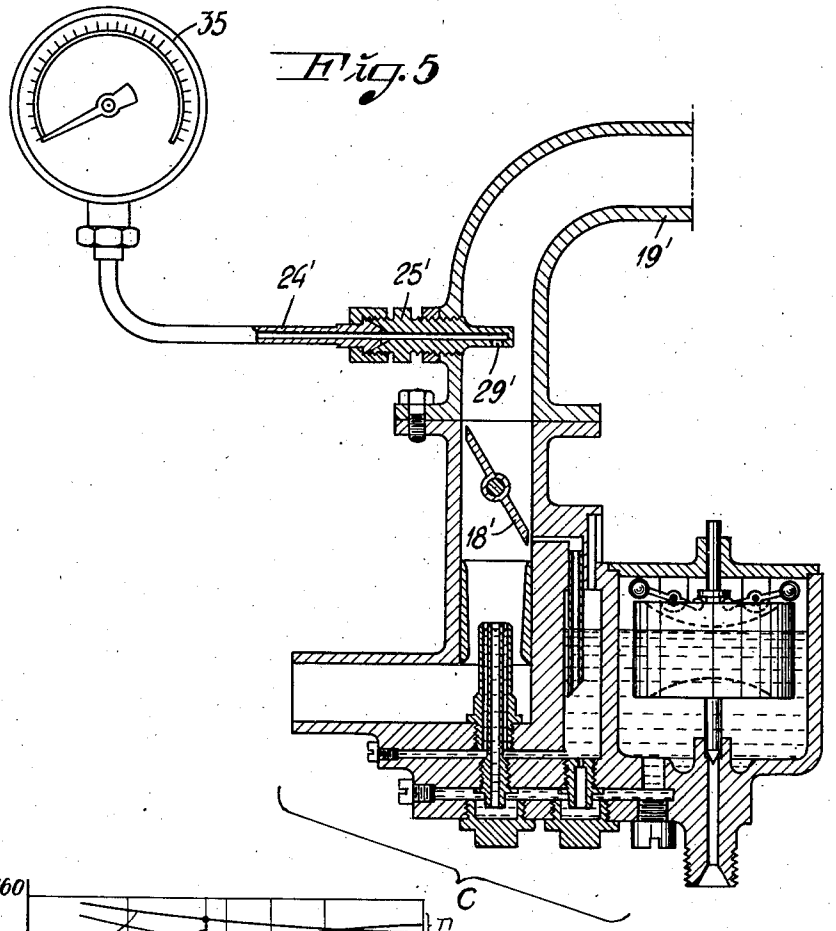


Fig. 5

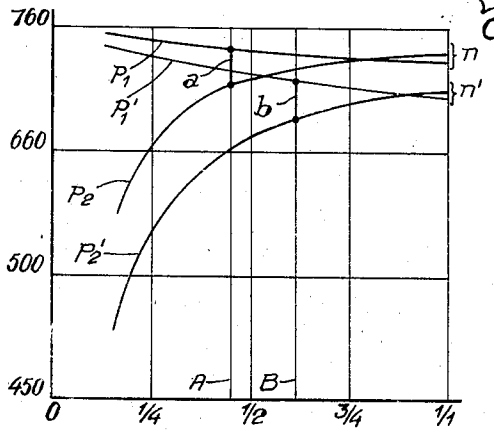


Fig. 4

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UNITED STATES PATENT OFFICE

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FUEL CONSUMPTION INDICATOR

Per Olof Sköldberg, Stockholm, Sweden

Application October 27, 1938, Serial No. 237,323
In Sweden November 9, 1937

1 Claim. (Cl. 73—212)

The present invention relates to apparatus for indicating the consumption of liquid fuel in internal combustion engines of the type in which the fuel is vaporized in a carburetor, and in particular the invention concerns with propelling engines such as used in motor cars, motor boats or aeroplanes.

It is the primary object of the invention to provide an apparatus by means of which the fuel consumption per revolution of the engine or per unit of length of the road passed by a motor vehicle can be easily ascertained at any time the engine is in operation. A further object of the invention is to provide an apparatus for the purpose indicated, which is of simple construction and readily applicable to existing engines and which directly indicates the fuel consumption in, for instance, gallons per mile or miles per gallon.

I attain these objects by mechanism illustrated in the accompanying drawings, in which:

Fig. 1 is a vertical section of the apparatus;

Fig. 2 shows, to a larger scale, a detail of the novel apparatus;

Fig. 3 is a section taken on the line 3—3 of Fig. 2;

Fig. 4 is a diagram illustrating certain pressures in relation to the position of the throttle valve of the carburetor; and

Fig. 5 is another embodiment of the invention.

Referring first to Fig. 1, I have illustrated a carburetor of a well-known type, generally denoted by C and including gasoline inlet 10, float chamber 11, float 12, float valve 13, compound nozzle 14, idling nozzle 15, air intake 16, choke tube 17, and throttle 18. The carburetor itself forms no part of the invention and may be of any desired type. 19 indicates the inlet pipe for the mixture of gasoline vapor and air, said pipe being connected to the intake manifold (not illustrated) of the engine.

A pipe 20 is connected to the choke tube 17 by means of a nipple 21 screwed through the wall of the pipe 22 and secured in proper position by a nut 23. A pipe 24 is connected to the inlet pipe 19 at a place behind the throttle 18, counted in the direction of flow of the combustion gases. A nipple or joint 25, which is secured in its position by the nut 26 and connected to the pipe 24 by the nut 27, has a central passage 28 which communicates with the inlet pipe 19 through a small aperture 29 extending at right angles to the longitudinal direction of the passage 28 and located in or near the centre of the pipe 19 (see Figs. 2 and 3). As will be seen from the drawing, the nipple 25 can easily be adjusted so that the axis 30 of the aperture 29 will form any desired angle α with the direction of flow of the combustion gases through the inlet pipe 19, said direction being substantially parallel to the longitudinal axis 31. Nipple 25 is provided with a hexagonal portion 34 by which the nipple may be turned to vary the direction of axis 30.

The pipes 20 and 24 are connected to a differential gauge 32 including a scale 33 and a pointer 34 and adapted to indicate the difference between the pressure prevailing before the throttle 18 and the pressure behind the throttle. The gauge 32 is conveniently placed on the instrument panel. As will be seen from the following consideration in connection with the diagram shown in Fig. 4, any pressure difference indicated by the gauge 32 corresponds approximately to a certain fuel consumption per revolution of the engine.

In Fig. 4, the abscissae of the coordinate system represent the position of the throttle 18 and the ordinates thereof represent pressure in column of mercury indicated in millimetres. I/I indicates the position in which the throttle is full open, whereas at O the throttle entirely closes the intake to the engine.

The curves p_1 and p_1' indicate the static pressure prevailing before the throttle 18, and the curves p_2 and p_2' indicate the static pressure behind the throttle, both at two different but constant speeds of the engine, n and n', respectively, the speed n' being higher than n. If the engine speed is assumed to be constant, the position of the throttle is a measure of the load on the engine.

At a position of the throttle corresponding to A and with the speed of the engine being n, the difference between the pressures before and behind the throttle is indicated by the line $a=p_1-p_2$. When the engine runs at the speed n', the same pressure difference is obtained at the throttle position B where $b=p_1'-p_2'=a$. If Q and Q', respectively, denote the corresponding quantities of fuel flowing to the engine per unit of time, the fuel consumption per revolution will be

$$\frac{Q}{n}=\frac{Q'}{n'}.$$

It follows therefrom that the pressure difference p_1-p_2 indicated by the differential gauge 32 is a measure of the fuel consumption per revolution and consequently also per unit of length of the road on which a motor car or the like runs, pro-

vided that the ratio of gear of the transmission between the engine shaft and the driving axle is not changed.

The above statement holds true approximately only. However, compensating means can be easily provided such that the values indicated by the gauge will correspond exactly or almost exactly to the real fuel consumption. In the embodiment shown, such compensation is obtained by varying the angle α between the direction of flow of the combustion gases and the longitudinal axis of the aperture 29. The less the angle α, the greater will be the pressure acting on the gauge due to the kinetic energy of the mixture. In this way, the aperture 29 can be adjusted, and the gauge calibrated, such as exactly to indicate the consumption of fuel, for instance in gallons per mile or miles per gallon, which consumption can be directly ascertained on the gauge.

In case of motor cars, the pipe 24 can be connected to the intake tube 19 at the place where the pipe, through which the vacuum windshield wiper is actuated, is connected to the tube 19, whereby the provision of a special aperture in the wall of the tube 19 is avoided.

While the embodiment of the invention described above is constructed in accordance with theoretical considerations, I have found that the same results can be obtained by means of a simple vacuum gauge which is arranged to be actuated by the pressure prevailing behind the throttle 18 only. Such an arrangement is shown in Fig. 5.

C again denotes a carburetor which is of the same type as that illustrated in Fig. 1. 35 is a vacuum gauge which by means of a pipe 24' is connected to the inlet pipe 19' at a place behind the throttle 18'. The connection between the pipes 24' and 19' is effected by a nipple 25' provided with an aperture 29' the position of which can be varied in the same manner and for the same purpose as described in conjunction with the aperture 29 of the embodiment shown in Figs. 1 to 3. In a certain position of the aperture 29', which position must be ascertained experimentally, the gauge can be calibrated so that it directly indicates the fuel consumption.

What I claim is:

An instrument for indicating the fuel consumption of an internal combustion engine having a carburetor and a throttle valve between the carburetor and the inlet pipe of the engine, said instrument including a pressure gauge, a tubular member for connecting said gauge with the inlet pipe, said tubular member having a rotatable adjustable portion extending into the inlet pipe and provided with an aperture adapted to be directed against the direction of flow of the combustion gases, and means for turning the rotatable portion of the tubular member to vary the direction of said aperture relative to the direction of flow of the combustion gases whereby to vary the ratio between the static pressure and the kinetic pressure acting on the gauge, and to insure an accurate indication of the fuel consumption on the gauge irrespective of the type of engine with which the gauge is associated.

PER OLOF SKÖLDBERG.