May 29, 1923. 1,456,847

H. D. GEYER

ENGINE INDICATOR

Filed March 23, 1921 2 Sheets-Sheet 1

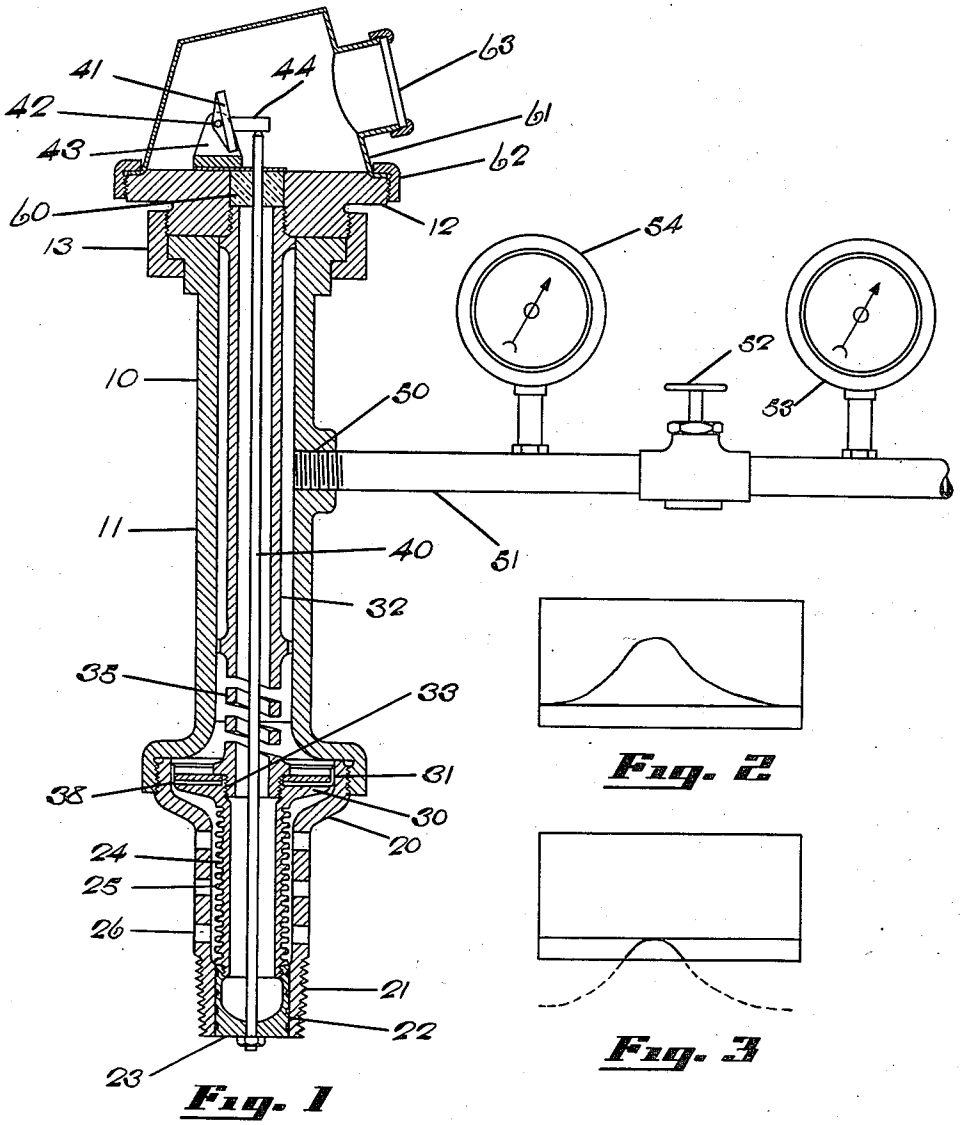


Fig. 1

Fig. 2

Fig. 3

Witnesses
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Filed March 23, 1921 2 Sheets-Sheet 2

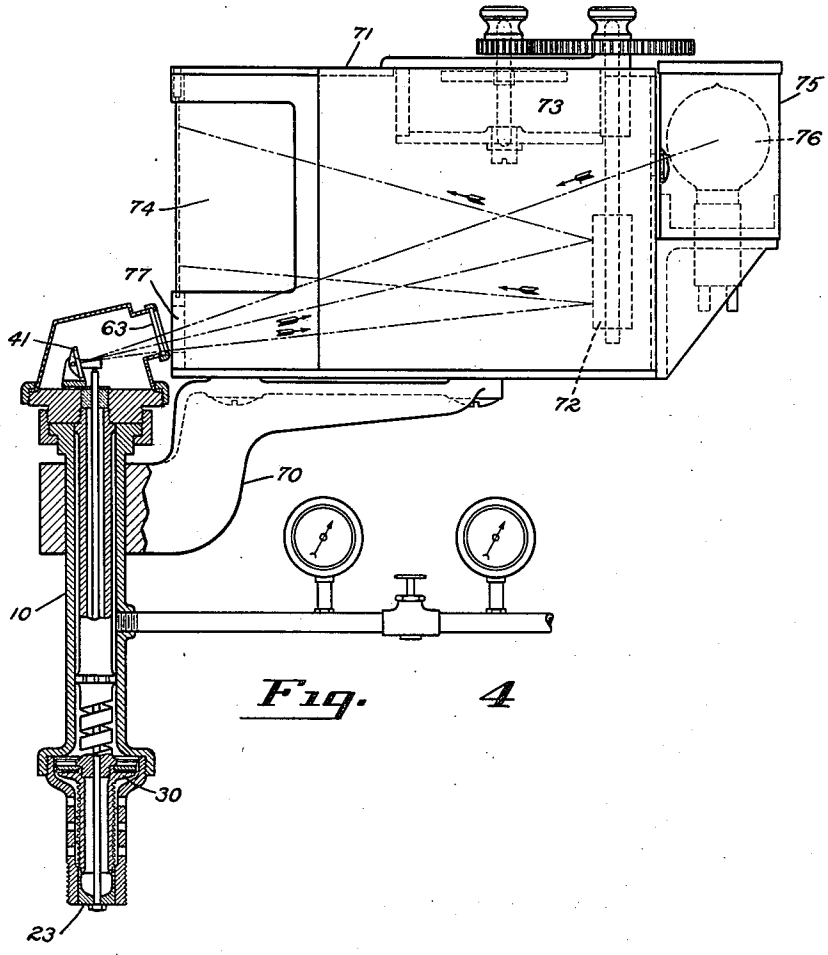


Fig. 4

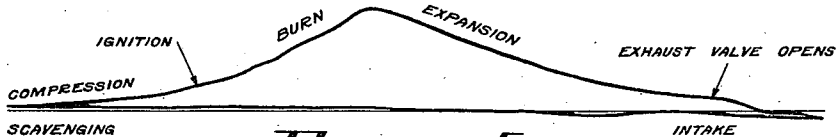


Fig. 5

Witnesses
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Patented May 29, 1923. 1,456,847

UNITED STATES PATENT OFFICE.

HARVEY D. GEYER, OF DAYTON, OHIO, ASSIGNOR TO GENERAL MOTORS RESEARCH CORPORATION, OF DAYTON, OHIO, A CORPORATION OF DELAWARE.

ENGINE INDICATOR.

Application filed March 23, 1921. Serial No. 454,746.

To all whom it may concern:

Be it known that I, HARVEY D. GEYER, a citizen of the United States of America, residing at Dayton, county of Montgomery, and State of Ohio, have invented certain new and useful Improvements in Engine Indicators, of which the following is a full, clear, and exact description.

The present invention relates to optical engine indicators and in its preferred form of embodiment, which has been chosen as convenient for the purposes of description and explanation, relates particularly to pressure elements for such instruments.

In prior application, Serial No. 370,427, filed April 1, 1920, by Thomas Midgley, Jr., on "indicators," there has been described an optical indicator, more particularly for use on internal-combustion engines of the high speed type, and designed to enable obtaining pressure-time as well as pressure-volume indications. The indicator is provided with a pressure element carrying a mirror so arranged as to oscillate in accordance with the variation in pressure in the cylinder. From this mirror a beam of light is reflected to another mirror and thence to a surface upon which movements of the path of the beam may be observed.

In operating the device, forming the subject matter of the said prior application, it is often desirable to know the pressures which exist in the cylinder at any time during a cycle.

It is among the objects of the present invention, therefore, to provide direct indication of the pressure which exists at any point in the complete cycle of operations in an engine cylinder.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred form of embodiment of the invention is clearly shown.

In the drawings:

Fig. 1 is a sectional view of a preferred form of pressure element.

Fig. 2 is a representation of an indication of a complete pressure-time cycle within an engine cylinder.

Fig. 3 is a representation similar to that shown in Fig. 2 but with the indication displaced as when determining the peak pressure in the cylinder.

Fig. 4 represents the pressure element in combination with the other elements of the indicator, but with certain parts omitted.

Fig. 5 represents a typical indicator card as taken on this form of indicator.

Referring to the drawing and especially to Fig. 1, as in the case of the prior application hereinbefore referred to, the pressure element comprises a casing designated as a whole by the numeral 10 having a body portion 11 adapted for attaching to the cap member 12 of the element by means of a sleeve coupling 13. The bottom of the casing is preferably enlarged and internally threaded to permit securing thereto an extended portion 20, which extended portion is externally threaded at 21 for attaching the element to the wall of an internal-combustion engine cylinder. This extension of the casing has an internal cylindrical portion 22 permitting the operation therein of a suitable piston 23. The piston is attached to a hollow member 24 preferably corrugated to form cooling elements 25 adapted to radiate any heat absorbed by this extended portion, holes 26 being provided in the wall of the casing to permit the access of air thereto.

Carried by the hollow member 24 is an auxiliary piston 30 having suitable means for providing a good fit between the piston and its corresponding cylinder walls 31, preferably by means of a diaphragm or washer 38 of leather, or some suitable metal such as aluminum. An extension 32 of the hollow member 24 is secured thereto by means of its threaded portion 33 and is adapted to coact with member 24 to maintain the auxiliary piston in place.

This extension also may be hollow and has its upper end externally threaded and engaged in the threaded portion of the cap member 12. Adjacent its lower end, extension 32 forms a helical spring 35.

The inner end of the piston 23 is exposed to the pressures existing within the cylinder to which it is attached. The response of this piston to these pressures depends upon the resistance thereto of the spring 35. This spring, therefore, is properly proportioned so as to have sufficient resistance to pressures

to limit the movements of the piston 23 to a desired range.

Attached to the piston 23 and extending centrally through the hollow members 24 and 32 is a connecting rod 40 by means of which operative connection is made between the piston 23 and an oscillatable mirror 41 preferably slightly concave. This mirror is securely mounted on a pivotal shaft 42 carried in suitable standards, 43. These standards are mounted upon the cap 12 as illustrated. Attached to the shaft 42 and extending outwardly from the mirror is an arm 44 the free end of which is in operative relation with the upper end of the rod 40.

The casing 10 is provided with means as indicated at 50 for connecting the pressure element at a point above the auxiliary piston 30 to a source of pressure preferably compressed air and for convenience of illustration and explanation this pressure is represented as entering the casing through a pipe 51 having a pressure regulating valve 52 and a pair of pressure gauges 53 and 54 the former adapted to register the pressure in the line and the latter, the pressure between the regulating valve and the pressure element. By providing as is indicated in the drawing an auxiliary piston 30 of larger area than the piston 23, the line pressure may be correspondingly reduced, thus making the working conditions more desirable. In order to prevent leakages which might cause erroneous pressure readings, packing 60 is provided for the rod 40, which packing may be held in place by the base of the standards 43. As a further precaution, there is provided a cover 61 which is adapted to be rigidly secured to the cap 12 by means of a suitable sleeve coupling 62 and which has a glass covered opening 63 for permitting the passage of the light ray to the mirror 41 as hereinbefore described.

The pressure element just described is to be used in the place of the pressure element described and claimed in the above mentioned prior application, and in conjunction with the rest of the apparatus described therein. Such an installation is shown in Fig. 4.

In this figure, the pressure element 10 carries a bracket 70 which in turn supports a box 71 which contains a rotatable polygonal mirror 72; a motor 73 for driving the latter; and a ground glass screen 74; and also supports a small housing 75 containing an electric bulb 76.

Suitable means (not shown) is provided for operating the motor 73 at a speed having a fixed relation to the speed of the engine and a source of current is provided for the electric bulb.

In ordinary operation of this indicator, a ray of light from bulb 76 is permitted to pass through a small opening in housing 75, through the rear wall of box 71 and through an opening 77 in the front wall thereof. The ray then passes through lens 63 to the mirror 41 and is reflected back into the box 71 through opening 77 to the mirror 72 where it is again reflected to the ground glass 74. The path of the light is indicated by the lines and arrows in Fig. 4.

It will thus be seen that varying pressures upon piston 23 will cause oscillation of mirror 41 and consequent travel of the ray of light reflected therefrom up and down the mirror 72. Mirror 72 in rotating will therefore reflect the ray of glass 74 and cause it to follow a wavy path such as is indicated in Figs. 2, 3, and 5.

Further, it will be seen that by adjusting the initial or rest position of piston 23 lower, mirror 41 will be tilted downward and the ray reflected therefrom will not, after its reflection from mirror 72, strike the ground glass 74 at as high a point as it would otherwise. If such adjustment is made by air pressure upon piston 30 and the air pressure is measured, it is obvious that the pressure at any point in the cycles may be determined by depressing the indication of that point upon the ground glass until it coincides in position with a point or line representing atmospheric pressure. In other words, sufficient pressure is put upon the piston 30 to exactly balance pressure exerted upon piston 23.

The operation of the device is as follows: First the pressure element is operated as a simple indicating element with atmospheric pressure above the auxiliary piston 30, and if necessary the device adjusted so as to have the indication positioned upon the ground glass with reference to a fixed line as indicated in Fig. 2.

When this has been done, pressure is applied above auxiliary piston 30, for example by admitting compressed air, until the indication is displaced to a position wherein the point representing a definite instant in the cycle of operations is directly upon the fixed line above referred to. The pressure in the cylinder at this point is the pressure indicated by gauge 54 multiplied by the ratio of the area of piston 30 to the area of piston 23, this being the pressure required to exactly balance the pressure within the cylinder.

In Fig. 3, there is represented the displacement of the indication utilized in determinating the peak or highest pressure developed in the cylinder.

It is of course obvious that gauge 54 may be calibrated to give directly the product of the pressure and the above mentioned ratio.

While the form of mechanism herein shown and described constitutes a preferred form of embodiment of the present inven-

tion, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What I claim is as follows:

1. In a pressure element for optical engine indicators, means responsive directly to pressures within an engine cylinder; means adapted to exert a variable opposing pressure against the pressure responsive means; and means for indicating the opposing pressure.

2. In a pressure element for optical engine indicators, means directly responsive to and adapted to be actuated by the pressures within an engine cylinder; means operable to exert pressure opposite to and against the pressure responsive means; regulating means for varying the opposing pressures: and means for indicating these opposing pressures.

3. In a pressure element for optical engine indicators, a piston for the pressure element adapted to be acted upon directly by the pressures within an engine cylinder; an auxiliary piston oppositely disposed and operating against the pressure element piston; means for applying a constant pressure to the auxiliary piston; regulating means for varying this pressure; and a gauge for indicating the amount of pressure applied to the auxiliary piston.

4. In a pressure element for optical engine indicators, a piston for the pressure element adapted to be acted upon directly by the pressures within an engine cylinder; an auxiliary piston of greater area than the area of the pressure element piston; a connecting member for the two pistons; means adapted to apply a constant pressure to the auxiliary piston and to oppose the pressure within the engine cylinder; means for regulating the opposing pressure; and a gauge for indicating the pressure applied to the auxiliary piston.

5. In a pressure element for optical engine indicators, a piston for the pressure element adapted to be acted upon directly by the pressures within an engine cylinder; means adapted to balance the pressure exerted within the engine cylinder upon the pressure element piston at any point in the complete cycle of operations of the engine cylinder; and means for indicating this balanced pressure.

6. In a pressure element for optical engine indicators, a piston for the pressure element adapted to be acted upon directly by the pressures within an engine cylinder; means operable to exert a balancing pressure against the pressure exerted within the engine cylinder upon the pressure element piston; an auxiliary piston, oppositely disposed to and operating against the pressure element piston, for receiving the balancing pressure; regulating means adapted to vary this balancing pressure; and a gauge for indicating the balancing pressure.

In testimony whereof I hereto affix my signature.

HARVEY D. GEYER.

Witnesses:
L. H. EMRICK,
A. K. LEE.