April 28, 1925. 1,535,688

J. F. SAUER

ENGINE PRESSURE REGISTER

Filed Dec. 19, 1921

Fig. 1

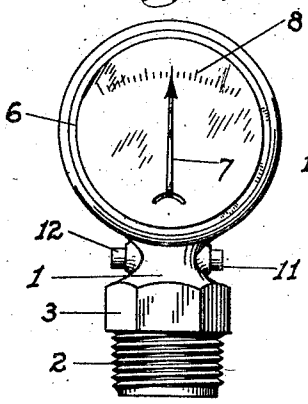


Fig. 2

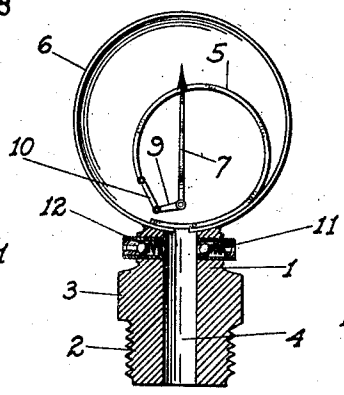


Fig. 3

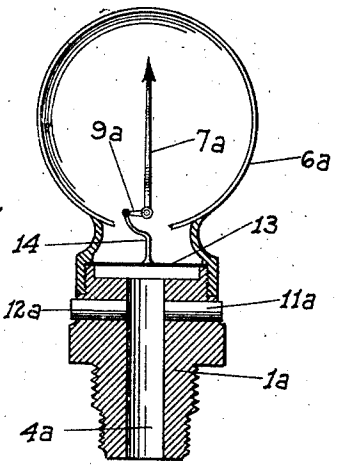


Fig. 4

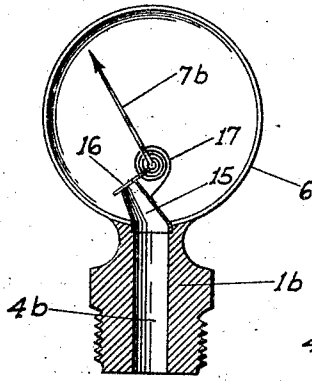


Fig. 5

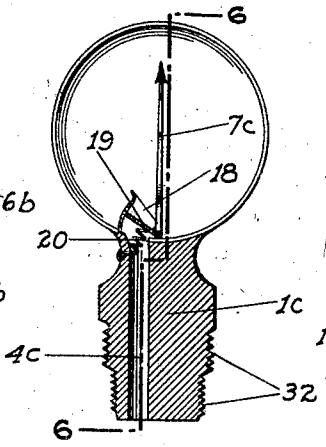


Fig. 6

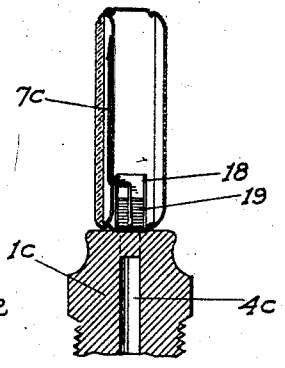


Fig. 7

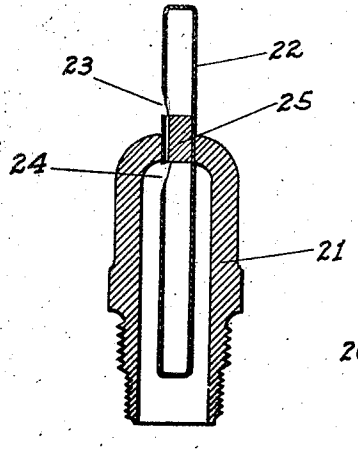


Fig. 8

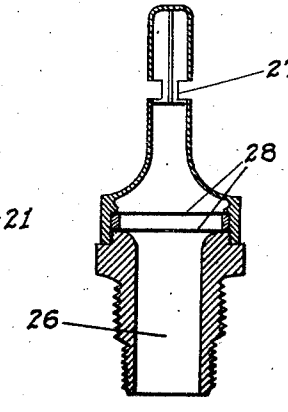
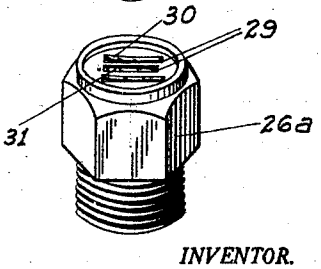


Fig. 9



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UNITED STATES PATENT OFFICE.

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ENGINE PRESSURE REGISTER.

Application filed December 19, 1921. Serial No. 523,597.

To all whom it may concern:

Be it known that I, JOSEPH F. SAUER, a citizen of the United States, residing at Chico, county of Butte, State of California, have invented certain new and useful Improvements in Engine Pressure Registers; and I do declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this application.

This invention relates to improvements in testing devices for internal combustion engines, the principal object of the invention being to provide a device, adapted to be removably connected to the cylinder head of such an engine, whereby the position of the piston therein may be accurately ascertained without it being necessary to remove a hand hole plate or other member and actually see the position of the crank or connecting rod, which governs that of the piston.

Another object is to provide an indicating device, the indicating feature of which may be either audible or visible, or both which will be so sensitive in operation that very slight changes of pressure or vacuum conditions within the cylinder will be registered, and with its use it is possible to tell when the piston is on an up or down stroke, when at dead center, when the exhaust valve opens and closes, and when the intake valve opens and closes. It is therefore possible to check up the correctness of setting of the valves with but very little trouble, whereas with present methods, the defective or inefficient operation of an engine due to wrong valve setting, and faulty ignition timing, cannot be easily traced to this cause, and search is frequently made at other points for the seat of the trouble, to no effect but at considerable loss of time and expense.

With my improved register, poor valve timing and ignition may be found out in but a few seconds, when steps to remedy the defect may then be made with the certainty that the seat of the trouble has been positively located.

A further object of the invention is to produce a simple and inexpensive device and yet one which will be exceedingly effective for the purposes for which it is designed.

These objects I accomplish by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings similar characters of reference indicate corresponding parts in the several views:

Fig. 1 is a face view of one form of my improved register, adapted to visually indicate both positive and vacuum pressures.

Fig. 2 is a sectional elevation of the same.

Fig. 3 is a sectional elevation of a modified form of the register.

Fig. 4 shows still another modification, suitable to indicate positive pressures only.

Fig. 5 is a sectional elevation of a vacuum and positive pressure register of still different construction as to detail.

Fig. 6 is a cross section taken on the line 6—6 of Fig. 5.

Figs. 7 and 8 are sectional elevations of different or modified forms of audible-signal registers.

Fig. 9 is a perspective view of another form of audible-signal registers, these three last shown types indicating or registering both positive and vacuum pressures.

Referring now more particularly at this time to Figs. 1 and 2, the numeral 1 denotes a base member, preferably threaded at its lower end as at 2 and provided thereabove with a polygonal faced or round and knurled portion 3, whereby this member may be screwed into the plug or relief-cock hole in a cylinder, and tightened down.

The base is provided with a longitudinal bore 4 leading into a coiled tube 5, similar in general design with that used on various steam and air pressure gages. This tube is enclosed and concealed within a disc-like casing 6, similar to that of an ammeter or the like, which is rigidly secured to the base 1.

Pivoted at one end in the casing is a needle 7, adapted to project through and indicate a reading on the outside of a dial 8 fixed in the casing.

A short arm 9 is fixed with the needle at its pivoted end and projects toward that side on which the free end of the coil 5 is located, being flexibly connected thereto by a link 10.

By means of this construction, when air pressure passes up the bore 4 and into the tube 5, the latter opens up, moving the arm 9 upwardly also and the needle to the right; and owing to the much greater length of the needle than said arm, the point of the needle

will have a great length of travel with a very small movement of the arm, thus insuring the sensitiveness of the instrument as regards registering very small pressures. When pressure is withdrawn from the tube, creating a tendency to vacuum, the movements are reversed, and the needle moves to the left of a neutral central position.

Since undue pressures would unduly strain and possibly break the delicate mechanism, I provide a suitable type of pressure release valve 11 leading from the bore 4 to the atmosphere, this valve operating when any predetermined pressure is reached, which will ordinarily be in the neighborhood of 1 pound.

While not usually necessary, I may also provide an independent release valve 12, similarly located and set, for negative or vacuum pressures.

In the type shown in Fig. 3, the outward appearance of the instrument is practically identical with the form already described, the base 1^a, casing 6^a, bore 4^a, needle 7^a, and release valves 11^a and 12^a, are retained; but the tube 5 is replaced by a diaphragm 13 of any suitable material, which is stretched across the base between the bore 4^a and the interior of the casing, and above the release valves, being firmly held in position by any suitable means.

Fixed to the center of the diaphragm is an arm 14, flexibly connected to the short arm 9^a projecting from the pivoted end of the needle, so that with comparatively slight fluctuations of the diaphragm, great movement will be imparted to the needle at the outer end thereof.

In the form of instrument shown in Fig. 4, which is suitable for positive pressures only, the base 1^b, bore 4^b, casing 6^b and needle 7^b, are retained in substantially the same form as those just described. The bore 4^b however terminates in a nozzle 15 projecting into the casing and preferably set to one side of the pivotal connection of the needle and at an angle to the latter.

Normally closing the entrance to this nozzle is a cap or plate 16, projecting from and fixed to the needle at its pivoted end, being normally held in that position by any suitable spring means as indicated for instance at 17. In this type, no release valves are necessary, since as soon as a blast of air bears against the plate and raises the same, a certain portion of the air can at once escape past the plate and into the casing, and thence into the atmosphere.

Owing to the arrangement of the needle connections, a very slight raising of the plate will impart a great movement to the outer end of the needle, and the instrument is so sensitive that it will register as long as an ounce of pressure is bearing against the plate.

The type shown in Figs. 5 and 6 is in many respects very similar to that shown in Fig. 4, but the bore 4^c of the base 1^c discharges into a flat-sided enclosure 18, between the sides of which is fitted a plate 19 fixed to the needle 7^c at its pivoted end.

The back wall of the member 18 is curved concentric with the axis of the needle, and just clears the outer edge of the plate, which is normally held substantially midway of the ends of the enclosure by double-acting spring means 20 of any suitable character. With this construction, a pressure in the bore 4^c forces the plate upwardly, and if this pressure reaches and exceeds a certain amount, the plate will be moved beyond the enclosure, and the excess pressure will then blow past said plate and escape to the atmosphere. When a tendency to vacuum occurs the movements are reversed, and plate 19 moves from its normal position toward the bore 4.

The type shown in Fig. 7 is constructed to give audible instead of visible signals for pressure or vacuum conditions in the engine.

This instrument comprises a shell member 21 adapted to be screwed into a cylinder head in the same manner as the bases 1 etc. Fitted in this shell and spaced from the walls thereof is a tube 22, provided with a specially formed incision 23 above the shell and with a similar incision 24 opening into the shell, the tube itself having an air-tight fit with the top of the shell. A block 25 is placed in the tube between the two incisions, and is arranged to leave a restricted passage therebetween.

This tube is closed at both ends, and the distance from one incision to the adjacent end is different from the other incision to its adjacent end, thereby forming sound-boxes of different sizes. In operation, a pressure or current of air flowing from the engine or inner end of the shell to the atmosphere will pass through the passage 24 to and out of the passage 23, causing a whistling sound as it emerges from the latter, the volume and pitch of the sound thus produced depending on the size of the sound box.

Under the opposite conditions, when an air current is passing from the atmosphere into the shell, that is, when a tendency to vacuum exists in the engine, the sound is created at the lower incision 24, which sound will be different in volume or pitch from that previously produced owing to the different sizes of the respective sound boxes. The operator can thus instantly tell whether a piston is on a pressure or up stroke, or on a suction or down stroke, or at dead center, when no sound will be obtained from either whistle.

In Fig. 8, the combination of two different kind of whistles is shown.

In this type, a hollow base-sleeve 26 is used, capped by a whistle member 27 of any suitable design.

Between the members 26 and 27 and held in place thereby is another form of whistle in order to give a different tone from the other, and which in this case is shown as a pair of spaced and centrally orificed discs 28. In operation, the air rushing out from the sleeve will cause the whistle 27 to sound.

When the movement of the air is reversed, the whistle structure 28 will instead be actuated, notifying the operator of conditions in the engine as in the preceding type.

Still another form of audible signal member is shown in Fig. 9. In this case the shell or sleeve 26^a is capped by a slotted plate 29.

Certain of these slots are covered with superimposed reeds 30, fixed at one end, while others are covered by similar reeds 31, positioned thereunder, so that air pressure passing through the plate will cause vibration of either one set or the other of the reeds, with a consequent distinctive sound.

In this case, difference in tone or volume of sound between the sets is had either by making the reeds in a set of different vibratory qualities than the other, or by making the number of reeds in a set larger than in the other, as shown.

The whistle form of register, like the visually indicating form, may be made to operate only with a positive pressure, but this type is not as good as the other, for various obvious reasons.

It will be obvious, that while I have here shown three distinct forms of whistle structure, for the purpose of illustration, many more forms are capable of being incorporated in the device, the only requirement being that in any one instrument, the tone or volume of one whistle shall be different from the other.

Any or all of these instruments may have their bases or corresponding members double-threaded, as shown for instance at 32 in Fig. 5, the thread of one portion being different from the other, so as to accommodate one instrument to two different sizes of spark-plug taps, such as are frequently encountered.

In operation, the register is attached to any desired cylinder, usually in place of the spark plug. The engine shaft is then turned by hand until the piston reaches for example the beginning of the compressing stroke. The crank shaft is then turned, little by little, enough pressure being created at every move to cause the instrument to register, either audibly or visibly. By waiting about a second between each move, the instrument has a chance to resume its normal neutral position, ready for the next move. The instrument will thus register every move of the crank shaft on this stroke until dead center is reached, when no movement or registration will be evident.

The instrument can only accomplish the above results and register so delicately (referring particularly to the needle types) by allowing for the release of pressure when still quite low.

Now with the piston at dead center at this point, checking up of the spark timing is therefore a simple and easy matter, as will be evident, and if correct for one cylinder, the remainder will of course be correct also.

By similar turning of the crank shaft during other strokes, overlap or mis-setting of the intake and exhaust valves relative to each other, or with regard to the relation of their operation to the position of the piston, can be readily detected, since opening and closing of these valves cause different and instantly registered pressure or vacuum conditions in the cylinder, the occurrence of which at the proper or improper time can thus be easily told by the mechanic, who knows, or should know, the exact degree in the arc of movement of the crank shaft at which this valve opening or closing should take place, and can thus tell when they do not so occur, either by noting by eye, the position of the outer end of the crank shaft, or with the aid of a degree-graduated dial temporarily mounted in connection with the crank.

In general, the only requirements for the device operating with air pressure and vacuum are means for indicating the movement, and a pressure release.

From the foregoing description it will be readily seen that I have produced such a device as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of the device, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention as defined by the appended claims.

Having thus described my invention, what I claim as new and useful and desire to secure by Letters Patent is:

1. An engine pressure register comprising a bored base member adapted to be fitted into an engine cylinder-head, and signal means incorporated with said base and connecting with the bore thereof for causing independent and distinct audible signals with a rush of air through said base in opposite directions.

2. An engine pressure register comprising a bored base member adapted to be fitted into an engine cylinder-head and double whistle means incorporated with the base member, only one of said whistles sounding

at a time, depending on the direction of flow of a rush of air through the base.

3. An engine pressure register comprising a bored base member adapted to be fitted into an engine cylinder-head, a tube closed at both ends projecting into the base and spaced from the inner walls thereof while sealed therewith at the top, incisions in said tube opening to the atmosphere and to the interior of the base respectively, and a restricted passage formed in the tube between the two incisions, the distance from one incision to the adjacent end of the tube being different from the other incision to its adjacent end of the tube.

4. An engine pressure register comprising a hollow plug adapted to be fitted into an engine cylinder-head, a tube member sealed on both ends projecting both into and from the plug at a point removed from the lower end thereof, and separate and differently sounding whistle means provided in said tube for indicating, with different sounds, whether a pressure in the plug is positive or negative.

5. The whistle adapted for use in the spark-plug-seat of an internal combustion engine's cylinder for locating the position of the engine's piston at the end of the compression stroke, said whistle including a relatively large end section which is tubular and externally threaded to fit in the spark-plug-seat, also including a relatively small end section provided with a sound-opening and an air passage, the latter being in open communication with the sound-opening and with the larger end section said air passage being of minute sizes, substantially as explained, for the purposes specified.

In testimony whereof I affix my signature.

JOSEPH F. SAUER