

UNITED STATES PATENT OFFICE.

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INDICATOR.

1,389,909.

Specification of Letters Patent.

Patented Sept. 6, 1921.

Application filed September 18, 1919. Serial No. 324,424.

To all whom it may concern:

Be it known that I, RALPH L. SKINNER, a citizen of the United States, and a resident of Sacramento, in the county of Sacramento and State of California, have invented new and useful Improvements in Indicators, of which the following is a specification.

This invention relates to indicators and has particular reference to that class of indicators adapted to be used in connection with internal combustion engines for indicating whether or not the engine is firing properly and for advising an observer as to whether or not the engine is functioning properly in other particulars.

An important object of the invention is to provide in an indicator of the above mentioned character a means whereby both audible and visible operable means may be actuated when a cylinder of an internal combustion engine fails to fire to announce to the observer the failure of proper firing.

A further object of the invention is to provide in an indicator of the above mentioned character a means whereby both audible and visible operable means may be actuated when either an intake or exhaust valve fails to operate properly.

A further object of the invention is to provide in a device of the above mentioned character a means whereby the several co-operating elements of the signaling mechanism may be accurately and effectively operated regardless of whether or not the engine is running at full speed or at an extremely low speed.

A further object of the invention is to provide in a device of the above mentioned character a means whereby the audible signal may be rendered inoperative without affecting in any particular the operation of the visible signal.

A further object of the invention is to provide in a device of the above mentioned character a means whereby the device as a whole may be rendered particularly adapted to use in connection with automobile engines and to further so arrange the signals that the visible signal may be within sight, at all times, of the operator and to arrange the audible signal so that it may at all times be within hearing of the operator.

Other objects and advantages of the invention will be apparent during the course of the following description taken in connection with the accompanying drawings.

In the drawings, forming a part of this specification and wherein like numerals are employed to designate like parts throughout the same,

Figure 1 is an assembled view of the device embodying my invention, certain elements thereof being shown in section,

Fig. 2 is a perspective view of an indicator hand, and,

Fig. 3 is a sectional view showing the indicator hand mounted upon an arbor.

In the drawings, wherein for the purpose of illustration is shown a preferred form of my invention, the numerals 5 and 6 indicate respectively the exhaust and intake manifolds adapted to be connected with any conventional type of internal combustion engine not shown. The device embodying my invention is adapted to be connected to the exhaust and intake manifolds respectively by means of pipes 7 and 8 provided with stop-cocks as shown at 9. The pipe 7 is further provided with a pressure relief valve indicated as a whole by the numeral 10 and comprising a plunger 11 adapted to be lifted under certain conditions under the influence of a spring 12' to permit escape or gaseous pressure through the bleed port 13'.

The pipes 7 and 8 are connected to a casing indicated as a whole by the numeral 12, which casing comprises an intermediate cylindrical section 13 having a divisional wall preferably formed integral therein as shown at 14. The intermediate section 13 is at each end provided with internal screw-threads as shown at 15 adapted to retain in position upon the intermediate section the end closures 16, the closures 16 forming with the divisional wall 14 chambers 17 and 18 within which are arranged vibratory diaphragms indicated respectively by the numerals 19 and 20, the diaphragms 19 and 20 dividing the chambers 17 and 18 respectively into chambers 17^a, 17^b, 18^a and 18^b. The diaphragms 19 and 20 are provided with bleed ports 21 and are further provided with centrally disposed contact points 22 adapted to cooperate with adjustable thumb-screws 23 carried by the closures 16 and suitably insulated therefrom by means of insulating material as shown at 24. Upon the insulating material 24 there is arranged a pair of metallic terminals each being indicated by the numerals 25 and 26. The terminal 25 is connected to a suitable source of electrical

energy as shown at E by means of a conductor 27 having a manually operated switch interposed therein as shown at 28. The source of electrical energy, which may be in the form of a battery, a dynamo or magneto, etc., is connected by means of a conductor 29 to a pair of electro-magnets 30 carried within a casing 31 to which is secured a horn 32. The electro-magnets are arranged to oscillate an armature 33 which in turn is connected to a vibratory diaphragm 34 by means of a link 35, the diaphragm 34 being arranged in proximity to the opening of the horn 32. The armature 33 is provided with a contact point 36 adapted to cooperate with an adjustable contact 37 when the armature 33 is moved under the influence of a suitable spring as shown at 38 to complete the electric circuit through the electro-magnets 30 and a conductor 39 connected at one end to the adjustable contact 37 and at its other end to the closure 16 as shown at 40. The terminal 26 is likewise connected to the electro-magnets 30 by means of a suitable conductor 41 which in turn is connected to conductor 27, the conductor 41 having a suitable manually operated switch interposed therein as shown at 42.

To each of the closures 16 there is connected a tube 42, the tubes 42 being arranged to communicate with the chambers 17 and 18. The tubes 42 are each connected to bypasses 43 communicating with chambers 17 and 18, the bypasses 43 serving as a means to facilitate the equalization of pressure on each side of the diaphragms 19 and 20 as will hereinafter be more fully described. The tubes 42 are each connected to a pressure pipe 44 which is adapted to communicate either of the chambers 17 or 18 with an indicator shown at 45, the pressure pipe 44 having a suitable valve disposed therein as shown at 46 by which communication may be established or severed between the pipe 44 and either of the chambers 17 or 18.

The indicator 45 comprises a casing 46' having a graduated scale 47 indicating pounds pressure and a second indicator scale 48 indicating pressure in the terms of inches. The indicator is further provided with an arcuate shaped hollow resilient tube 49 communicating with the pressure pipe 44 and having its closed end connected to a link 50 which in turn is connected to an arm 51 which arm is provided at its end with a rack 52 adapted to suitably engage a spindle 53 to which is secured an indicator hand 54, the indicator hand being moved in either a clockwise or counterclockwise direction depending upon the degree of pressure within the pressure pipe 44 which will hereinafter be more fully described. To the face of the indicator 45 is secured a boss 54' within which the spindle 53 is journaled as most clearly shown in Fig. 3. Upon the boss 54'

there is suitably journaled a second indicator hand 55 preferably of a contrasting color to that of the indicator hand 54. The indicator hand 55 is so journaled upon the boss 54' as to be capable of being moved under certain conditions independently of the indicator hand 54 and is provided at one side with a lug 56 and at its opposite side with an arm 57 carrying a lug 58, the lugs 56 and 58 being adapted to engage opposite sides of the indicator hand 54 when it is being moved respectively in a clockwise and counterclockwise direction under the influence of the increase or decrease pressure within the pressure pipe 44. It is to be understood that a certain amount of friction exists between the boss 54' and the hand 55, the friction being sufficient to retain the hand 55 in a given assumed position until it is again moved by the hand 54 into contact with either of the lugs 56 or 58.

In use, the operation of the device is as follows: Assuming that the engine is running at a normal speed and that the several cylinders thereof are firing in their proper successive order, by turning the valve 9 carried by the pipe 7 to communicate the exhaust manifold 5 with the chamber 17 and by turning the valve 46 to communicate the chamber 17 with the pressure pipe 44, a pressure is built up within the chamber 17 and within the pipe 44, which pressure is communicated to the indicator 45, causing the hand 54 to move from zero in a clockwise direction carrying with it the hand 55, the hands 54 and 55 assuming a position corresponding, of course, to the pressure within the pressure pipe 44. When pressure is communicated to the chamber from the exhaust manifold 5 the pressure on each side of the diaphragm 9 is equalized through the bypass 43 communicating with the chamber 17 and the bleed port 21, the contact point 22 carried by the diaphragm 19 being retained normally spaced from the end of its corresponding cooperative thumb-screw 23. Should a miss in the successive fire of the cylinders occur the pressure within the chamber 17 at one side of the diaphragm 19 is materially decreased whereupon the excessive pressure upon the opposite side of the diaphragm 19 moves the diaphragm to such a position as to bring the contact 22 carried thereby into engagement with the end of its cooperative thumb-screw 23 thereby completing the circuit through the electro-magnets 30, causing an oscillatory movement of the armature 33, which oscillatory movement is transmitted into a vibratory movement of the diaphragm 34 causing an audible signal to be given indicating to the operator of the automobile that a miss in the successive firing of the internal combustion engine has occurred. Due to the sudden decrease in pressure within the cham-

ber 17, a corresponding sudden decrease of pressure within pressure pipe 44 occurs in which instance the indicator hand 54 is moved in a counterclockwise direction, thereby uncovering the indicator hand 55 which is preferably of a contrasting color to that of the hand 54 giving a visible signal to the operator to the effect that a miss in the excessive firing of the cylinder has occurred.

Should it be desired to test the intake manifold 6 for a continuity of pressure to determine whether or not the engine is operating in a normal manner, the valve 9 is closed, thereby severing communication between the exhaust manifold 5 and the chamber 17 whereupon the valve 9 carried by the pipe 8 is opened to establish communication between the intake manifold 6 and chamber 8 and the valve 46 is then moved to the position shown in Fig. 1. As a result of the suction set up within the manifold 6 during the passage of the gaseous fuel into the cylinders a tendency toward the creation of a partial vacuum within the chamber 18 is brought about. As a result of the partial vacuum thus formed within the chamber 18 the pressure within the chamber and pressure pipe 44 is necessarily reduced below that of atmospheric or normal in which instance the indicator hand 54 is moved from zero in a counterclockwise direction, assuming a position corresponding to the intensity of the partial vacuum within the chamber 18. Should an intake valve fail to operate or become stuck so as to maintain communication at all times between its corresponding cylinder and the manifold 6 the pressure within the chamber 18 will periodically approach or tend to approach that of atmospheric, thereby setting up a fluctuation of the indicator hand 54 on the scale 48 indicating to the operator the abnormal condition of the valve or valve operating mechanism of the engine. As a result of the instantaneous building up of pressure within the chamber 18 on one side of the diaphragm 20, the contact point 22 carried by the diaphragm is moved into engagement with its cooperative thumb-screw 23, thereby completing the circuit through the electromagnets 30, imparting to the operator, as hereinbefore described, by means of an audible signal that an abnormal condition exists which abnormal condition relates to the function of the intake manifold or its cooperative elements.

The valve 10 carried by the pipe 7 is intended to relieve any excessive pressure set up within the chamber 17 and its operation is apparent in that the plunger 11 is lifted against the influence of the spring 12' to permit the escape of excessive pressure through the port 13'.

Should it for any reason be desirable to render the audible signal inoperative while

either a test is being conducted in connection with the exhaust manifold or intake manifold, the electrical circuit may be severed by means of the manually operated switches 28 and 42.

In the above described operation of the device I have elaborated upon the operation of the device under only two conditions, one being in connection with the exhaust manifold when a miss in the successive firing occurs and the other being in connection with the intake manifold when a valve is stuck to maintain at all times communication between its corresponding cylinder and the intake manifold, but by aid of the device embodying my invention and hereinbefore described many other analogous faults or impaired operation of the engine with which the device is adapted to be used may be detected, as for example, the sticking of an exhaust valve, the choking of the muffler or exhaust pipe or clogging of the intake manifold, etc.

I have shown no specific location on the device, when used in connection with an automobile but it is to be understood that the several elements comprising the invention may be located at any proper or convenient position, for example, the indicator 45 may be located on the instrument board part of the automobile and the casing 12 suitably located under the cowl, and it is to be further understood that the form of my invention herewith shown and described is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described my invention, what I claim as new and desire to secure and protect by Letters Patent of the United States is:

1. The combination with the intake and exhaust manifolds of an internal combustion engine, of a signal having a pair of hands adapted to be moved simultaneously in a given direction, means for communicating pressure from said exhaust manifold to said signal whereby said hands are moved simultaneously in a clockwise direction, means for communicating pressure from said intake manifold whereby said hands are moved in an anticlockwise direction, means for severing connection between the exhaust manifold and the signal and simultaneously establishing communication between the intake manifold and signal.

2. The combination with the intake and exhaust manifolds of an internal combustion engine, of a signal having a pair of hands adapted to be moved simultaneously in a given direction, means for communicating pressure from said exhaust manifold to

said signal whereby said hands are moved simultaneously in a clockwise direction, means for communicating pressure from said intake manifold whereby said hands are
5 moved in an anti-clockwise direction, means for severing connection between the exhaust manifold and the signal and simultaneously establishing communication between the intake manifold and signal, and
10 means for relieving excessive pressure from said means for communicating pressure from said exhaust manifold to said signal.

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