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PRESSURE INDICATOR FOR INTERNAL COMBUSTION ENGINES.
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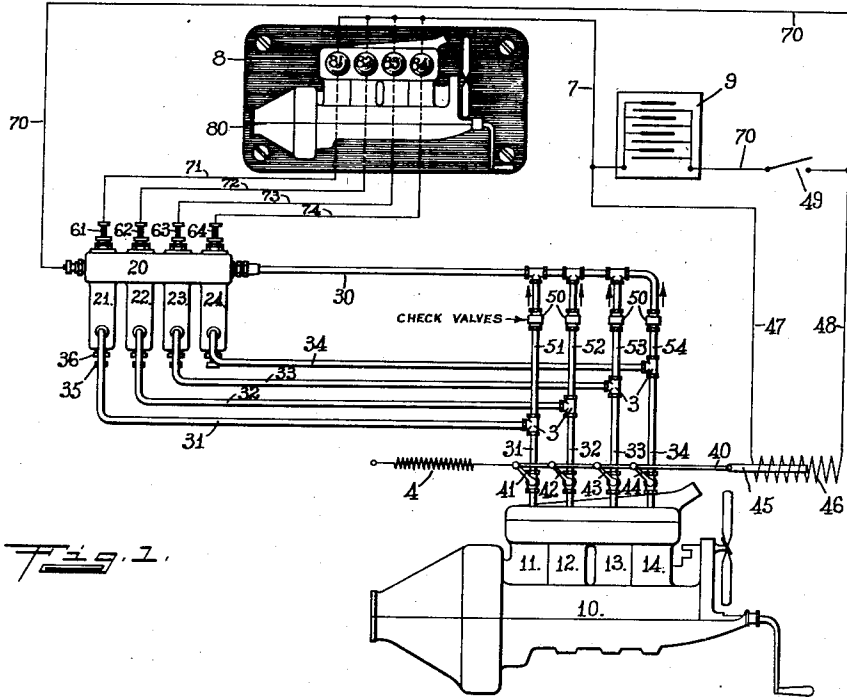


Fig. 1.

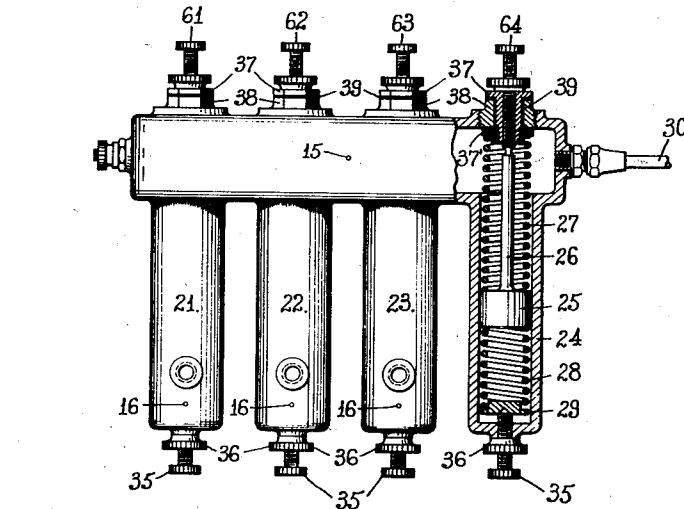


Fig. 2.

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PRESSURE-INDICATOR FOR INTERNAL-COMBUSTION ENGINES.

1,266,627.

Specification of Letters Patent.

Patented May 21, 1918.

Application filed December 17, 1917. Serial No. 207,642.

To all whom it may concern:

Be it known that I, JAMES D. RENNE, a citizen of the United States, and a resident of Omaha, in the county of Douglas and State of Nebraska, have invented certain new and useful Improvements in Pressure-Indicators for Internal-Combustion Engines, of which the following is a specification.

My invention relates to indicating devices for use in connection with multi-cylinder internal combustion engines to show defective and inefficient operation of one or more of the engine-cylinders when the remaining cylinders are operating normally and efficiently. It is the object of my invention to provide a simple and inexpensive mechanism, permanently attachable to internal combustion engines such as those used in motor-vehicles, and capable of instantly indicating, while the engine is running, defective operation of any of the engine-cylinders such that the pressures produced in the defectively-operating cylinder or cylinders are materially less than the pressure produced in the normally-operating cylinders.

In the accompanying drawings Figure 1 is a diagrammatic representation of mechanism embodying my invention, and Fig. 2 is a detail side view and partial longitudinal section of the pressure-actuated indication-controlling device by which my mechanism is specially characterized.

In the illustrated structure there is an internal-combustion engine 10 having four cylinders 11, 12, 13 and 14; and the pressure-actuated indication-controlling device comprises a hollow or chambered casing 20 having four small cylinders 21, 22, 23 and 24 dependent therefrom, there being one of said indicator-cylinders for each cylinder of the engine. The lower portions of the respective indicator-cylinders are connected by suitable pipes or conduits 31, 32, 33 and 34 with the combustion-chambers of the engine-cylinders 11, 12, 13 and 14, said pipes or conduits preferably being formed by pieces of small-sized flexible metal tubing provided with the usual and well-known connecting fittings. Adjacent to the engine each of said tubes or pipes is provided with a shut-off cock, the handles 41, 42, 43 and 44 of said cocks being pivotally connected with an actuating-rod 40, and the latter having connected therewith a spring 4 by which the

cocks are held normally in closed position. Adjacent to the shut-off cocks the several tubes have branch-conduits 51, 52, 53 and 54 connected therewith by means of T-fittings 3, each of said branch-conduits having therein a check-valve 50 openable away from the engine-cylinder, and being connected beyond said valve to a common pipe or tube 30. The latter is connected with the main chamber of the casing 20, so as to transmit thereto the gases or combustion-products from the several engine-cylinders delivered under pressure through the check-valves 50, and said valves preventing any return-flow of said gases toward the engine. In each of the indicator-cylinders there is held slidably a piston 25 having a stem 26 extending upwardly therefrom, the piston being normally at a position intermediate the ends of the cylinder, and having coil springs 27 and 28 disposed respectively above and below the same. The lower end of the spring 28 rests upon a seat 29 which may be adjusted vertically to vary the compression of said spring. For adjusting the position of said spring-seat, a screw 35 is extended through a threaded opening in the lower end of the cylinder, the upper end of said screw engaging the seat, and a locknut 36 being provided on the external portion of the screw, as shown in Fig. 2. The stems 26 of the pistons in the indicator-cylinders are adapted to engage the lower or inner ends of contact-screws 61, 62, 63 and 64 which extend into the casing 20 through bushings 37, the latter passing through screw-plugs 38 arranged in alinement with the pistons. On the inner ends of the bushings there are screwed nuts 37' of insulating material, and the bushings are insulated from the plugs by sleeves and washers 39 of non-conducting material. The contact-screws 61, 62, 63, and 64 are connected by means of wires 71, 72, 73 and 74, respectively, with indicator-lamps 81, 82, 83 and 84, which may be located at any desired position, as, for example, on the dash or instrument-board of a motor-vehicle with which the mechanism is used. The indicator-lamps are preferably mounted on a base 8 having thereon the outline 80 of an engine, the lamps being located on the cylinder-portions of said outline corresponding respectively to the several cylinders of the actual engine 10 with which the lamps are connected through the medium of the described devices. A common wire 7

extends from the lamps to a storage battery 9 or other suitable source of electrical energy, and from the other terminal of said source a wire 70 is extended to the indicator-casing 20, for completing the lamp-circuits. The actuating-rod 40 for the shut-off cocks is connected with the plunger or movable core 45 of a solenoid 46, the latter being included in a circuit formed through wires 47 and 48 to the battery 9. A switch 49 is included in both the solenoid-circuit and lamp-circuits, whereby said circuits may be simultaneously opened or closed. Upon closing of the switch 49 the solenoid is energized and the core 45 is drawn into the same, thereby moving the rod 40 to open the shut-off cocks, which are moved to and held at closed position by the spring 4 when the solenoid is not energized.

A small vent 15 is provided in the casing 20, and a similar vent 16 is provided in the lower portion of each of the indicator-cylinders 21, 22, 23 and 24, as shown in Fig. 2. When the shut-off cocks are closed and the mechanism is not in use for a short time, both the upper and lower ends of the pistons are under equal fluid-pressure, since the vents 15 and 16 enable a gradual escape to atmosphere of any gases under pressure in the several chambers with which the vents connect. The springs 27 and 28 are so proportioned and adjusted that, when the fluid-pressures upon the pistons are equalized, the piston-stems 26 will engage the contact-screws 61, 62, 63 and 64, thus closing the circuits through the respective lamps 81, 82, 83 and 84, if the main switch 49 is in closed position; the spring-pressures being such that the pistons have a slight bias toward the circuit-closing positions thereof.

In the use of the indicating apparatus, after the same is properly connected and adjusted, and while the engine is running, the switch 49 is moved to closed position, and the solenoid-circuit and lamp-circuits are thereby closed. The energization of the solenoid causes opening of the shut-off cocks so that pressure from the combustion-chambers of the engine-cylinders is admitted to the pipes 31, 32, 33 and 34, being thereby conducted to the lower ends of the respective indicator-cylinders, and pressure from the engine-cylinders also passes through the branch-conduits 51, 52 53 and 54, check-valves 50, and pipe 30 to the chamber in casing 20 which connects with the upper ends of all of the indicator-cylinders. If all of the engine-cylinders are operating normally and efficiently, so that substantially equal pressures are produced therein, the fluid-pressures upon the indicator-pistons remain substantially equal, and the lamp-circuits remain closed so that the indicator-lamps are lighted. If, for any reason,

such as improper ignition, valve-leakage, leakage of piston-rings, or obstruction of the inlet or exhaust gas passages, the pressures produced in one or more of the engine-cylinders are substantially less than the pressures produced in the normally-operating cylinders, then less fluid-pressure is exerted upon the lower end of the corresponding indicator-piston or pistons, thereby causing a downward movement of the same, and opening the respective lamp-circuit or circuits, thus extinguishing the corresponding indicator-lamp or lamps. It will be seen that all of the indicator-pistons are exposed at their upper ends to equal fluid-pressure, said pressure being substantially the same as the maximum pressure produced in any of the engine-cylinders, or said maximum pressure less the slight pressure required to open the check-valves, and the friction-losses of the gases in passing through the connecting pipes. It will also be seen that to cause downward movement of any of the indicator-pistons, it is merely necessary that the bias of the respective piston to circuit-closing position be overcome by the difference of fluid-pressures upon the upper and lower ends of the piston. By varying the adjustment of the springs 28, the bias of the pistons toward circuit-closing position may be made such that slight differences of pressure in the several engine-cylinders, such as might occur without the operation thereof being considered as abnormal or inefficient, will not be indicated, or so that an indication will be made of any desired pressure-differential.

It will be understood by those skilled in the art, that the specific structural elements herein shown and described are purely illustrative, and that many changes and modifications thereof may be made without departing from the essential characteristics of my invention, of which the true scope is defined in the appended claims.

What I claim as my invention, and desire to secure by Letters Patent, is:

1. Indicating mechanism for multi-cylinder internal-combustion engines, comprising a movable member for each engine-cylinder exposed at one side to fluid-pressure from the respective cylinder, a common conducting means for directing fluid-pressure from a plurality of the engine-cylinders to the sides of said movable members opposite the side first named, and means for indicating movement of said members resulting from differences of pressure upon said opposite sides thereof.

2. Indicating mechanism for multi-cylinder internal-combustion engines, comprising a movable member for each engine-cylinder, means for directing to one side of each of said movable members substantially the max-

imum fluid-pressure produced in any of the engine-cylinders, and means for directing to the opposite sides of the several members fluid-pressure from the respective engine-cylinders.

3. Indicating mechanism for multi-cylinder internal-combustion engines, comprising an electrical indicator-circuit for each engine-cylinder, a movable controlling-member for each circuit biased to circuit-closing position, means for directing fluid-pressure from the respective engine-cylinders to said controlling-members so as to tend to move the same toward circuit-closing position, and means for directing substantially the maximum fluid-pressure produced in any of the engine-cylinders upon said controlling members so as to tend to move the same away from circuit-closing position.

4. Comparative-pressure indicating means for multi-cylinder internal-combustion engines, comprising a movable indicator-controlling member for each engine-cylinder, conduits for directing upon one side of each of said members fluid-pressure from the respective engine-cylinders, conduits for directing upon the opposite sides of said members fluid-pressure from each of the engine-cylinders, and valves in the latter conduits for preventing return-flow therethrough toward the engine-cylinders.

5. In a mechanism of the class described, a casing having a plurality of cylinders opening to a common chamber, pistons movable in said cylinders, non-return fluid-pressure-conducting means connecting said common chamber with the cylinders of an internal combustion engine, and means for conducting fluid-pressure from each of the several engine-cylinders to the ends of the respective cylinders first-named to oppose the pressures upon the several pistons from the common chamber.

6. The combustion with an internal-combustion engine having a plurality of cylinders, of an indicator-cylinder for each engine-cylinder, said indicator-cylinders communicating at one end with a common chamber, conduits connecting the engine-cylinders

with the respective indicator-cylinders at the ends thereof opposite said common chamber, valved branches from said conduits all communicating with said common chamber, and pistons movably disposed in said indicator-cylinders and exposed at one end to fluid-pressure from said common chamber and at the other end to fluid-pressures from the respective engine-cylinders only.

7. The combination with an internal-combustion engine having a plurality of cylinders, of an indicator-cylinder for each engine-cylinder, said indicator-cylinders communicating at one end with a common chamber, conduits connecting the engine-cylinders with the respective indicator-cylinders at the ends thereof opposite said common chamber, valved branches from said conduits all communicating with said common chamber, pistons movably disposed in said indicator-cylinders and exposed at one end to fluid-pressure from said common chamber and at the other end to fluid-pressure from the respective engine-cylinders only, electrical indicator-circuits controlled by the respective pistons, and electrically controlled shut-off cocks in the conduits.

8. The combination with a multi-cylinder internal-combustion engine, of an indicator-cylinder for each engine-cylinder, said indicator-cylinders communicating at one end with a common chamber, conduits connecting the engine-cylinders with the respective indicator-cylinders at the ends thereof opposite said common chamber, valved branches from said conduits all communicating with said common chamber, pistons movably disposed in said indicator-cylinders and exposed at one end to fluid-pressure from said common chamber and at the other end to fluid-pressure from the respective engine-cylinders only, there being minute vents to the indicator-cylinders and to the common chamber to enable gradual escape of fluid-pressure from both ends of the several pistons, and springs biasing movement of the pistons toward the common chamber.

J. D. RENNE.

It is hereby certified that in Letters Patent No. 1,266,627, granted May 21, 1918, upon the application of James D. Renne, of Omaha, Nebr., for an improvement in "Pressure-Indicators for Internal-Combustion Engines," an error appears in the printed specification requiring correction as follows: Page 3, line 44, claim 6, for the word "combustion" read *combination*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of June, A. D., 1918.

[SEAL.]

F. W. H. CLAY,

Acting Commissioner of Patents.

Cl. 123—198.