

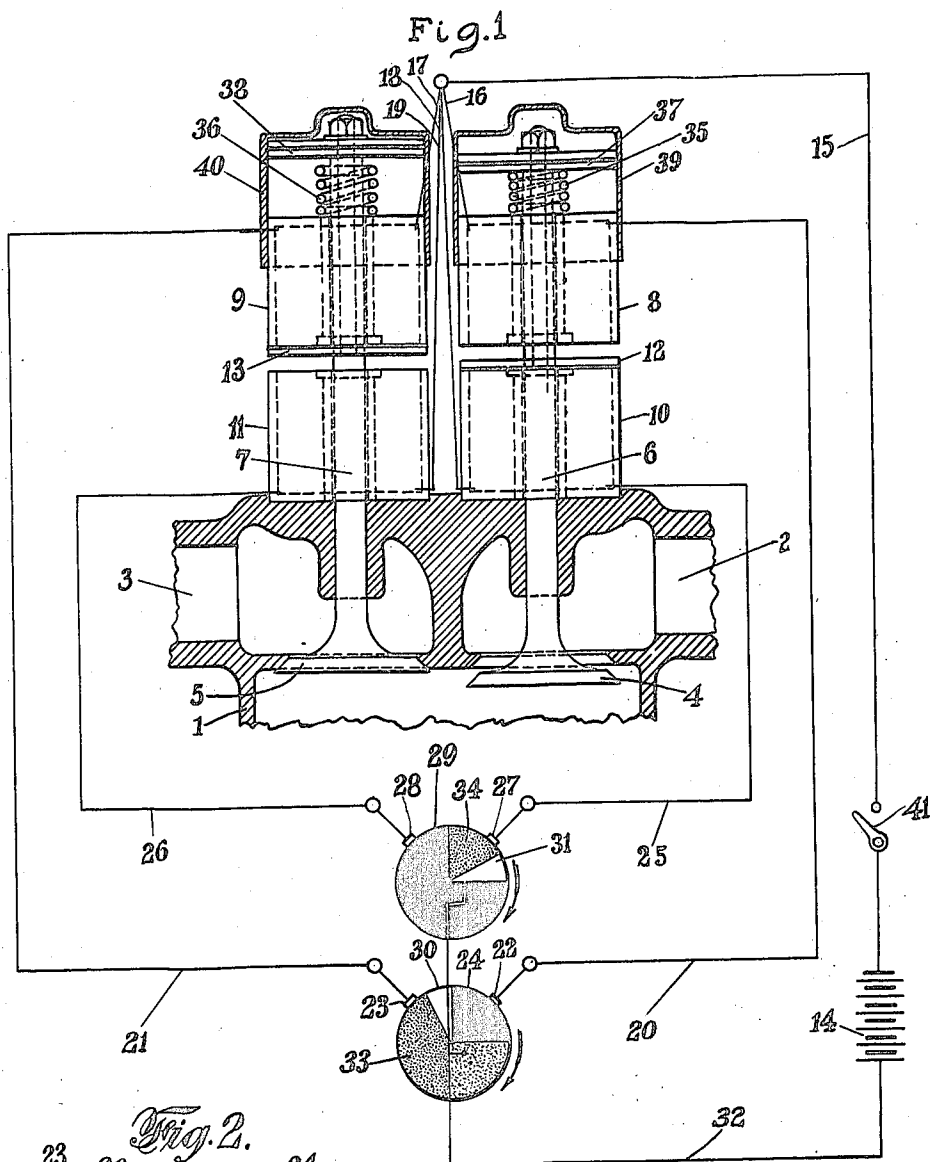
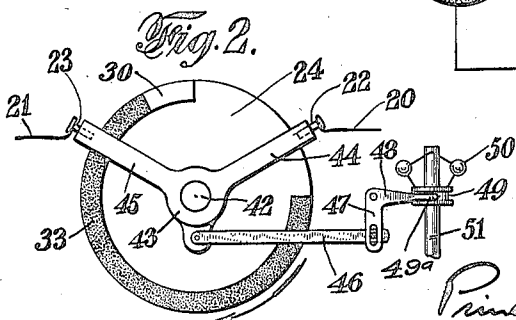
Oct. 23, 1923.

1,471,861

O. L. PERRAULT

VALVE ACTUATING MECHANISM FOR INTERNAL COMBUSTION ENGINES.

Filed Sept. 7. 1921



INVENTOR.
Oscar Louis Perrault.
BY
Pincus, Wright & Small ATTORNEYS.

UNITED STATES PATENT OFFICE.

OSCAR LOUIS PERRAULT, OF ALBANY, NEW YORK.

VALVE-ACTUATING MECHANISM FOR INTERNAL-COMBUSTION ENGINES.

Application filed September 7, 1921. Serial No. 499,040.

To all whom it may concern:

Be it known that I, OSCAR L. PERRAULT, a citizen of the United States, a resident of Albany, in the county of Albany and State of New York, have invented a certain new and useful Valve-Actuating Mechanism for Internal-Combustion Engines, of which the following is a specification.

The invention has for an object to provide a valve actuating mechanism of the above character wherein the valve stems are moved by electro-magnetic action, and which will require but a minimum quantity of current, to the end that power for the mechanism may be obtained from sources of electrical energy ordinarily available in connection with internal combustion engines, without imposing too great a load thereon.

Another object is to simplify the valve operating mechanism particularly in regard to the timing devices employed, circuit connections between such timing devices and the electromagnets, and similar features.

Another object is to provide a mechanism wherein if the circuit connections are open or inoperative, the inlet valve will be maintained in closed position and the exhaust valve in open position.

Still another object is to enable the timing of the devices to be adjusted during the operation of the engine to actuate the valves in proper relation to the speed or load conditions under which the engine is operated.

Further objects and advantages of the invention will be in part obvious and in part specifically pointed out in the description hereinafter contained, which, taken in connection with the accompanying drawings, discloses a preferred embodiment thereof; such embodiment, however, is to be considered merely as illustrative of its principle. In the drawings:

Fig. 1 is a side view partly in section showing a valve actuating mechanism constructed in accordance with the invention, the timing devices being represented diagrammatically.

Fig. 2 is a detail view of the timing devices shown detached.

Referring to the drawings, I have shown conventionally a portion of an internal combustion engine cylinder 1 having inlet and exhaust passages 2 and 3 respectively, controlled by poppet valves 4 and 5 which may be of ordinary form, having stems 6 and 7

projecting outwardly through a wall of cylinder 1.

If valves of the above character be urged toward one position by spring pressure and moved to or held in the opposite position by electro-magnetic action, the electromagnets will have to work continuously against a spring pressure which is necessarily substantial in order to insure proper functioning of the valves, and thus the energy consumed by the electromagnets in moving and holding the valves, will be considerable.

According to the present invention, I provide electromagnets 8 and 9 which respectively move the valves 4 and 5 to closed position and hold them in such position at the proper times, and further electromagnets 10 and 11 respectively opposed to the magnets 8 and 9, which serve to move the valves to open position and hold them in such position during the proper periods in the cycle of the engine. In the particular form illustrated, the magnets 8, 9, 10 and 11 are of the iron clad type, each embodying a magnetic core enclosing the corresponding valve stem, and a magnetic shell surrounding its coil. The valves 4 and 5 are provided with armatures 12 and 13 respectively which are attracted by the adjacent coils when energized.

Thus, when inlet valve 4, for example, is to be opened, electromagnet 10 is energized to draw down armature 12 and hold the valve open, electromagnet 8 being deenergized at this time, whereby no substantial resistance is offered to movement of the valve, or in holding it in open position, such as would be encountered in case electromagnet 10 were required to open the valve and hold it open against the pressure of a heavy spring. The energy consumed by electromagnet 10 therefore may be correspondingly reduced, and the same is true in regard to electromagnet 8 which operates to close inlet valve 4 and hold it against its seat during the period when electromagnet 10 is de-energized. Electromagnets 9 and 11 control the exhaust valve 5 in a similar manner.

The electromagnets are energized at the proper periods in the stroke of the engine by means of timing devices comprising contact members movable in timed relation to the speed of the engine and co-operating fixed contact members which are connected in circuit with the electromagnets. As shown, a source of energy 14 is in circuit

with the electromagnets through a conductor 15, which leads to branch conductors 16, 17, 18 and 19 respectively connected to one terminal of each of the electromagnets 8, 9, 10 and 11. The remaining terminals of the valve-closing magnets 8 and 9 are connected respectively by conductors 20 and 21 to fixed contacts 22 and 23 of a timing device which includes the movable contact member 24 rotating in timed relation to the crank shaft. In a similar manner the remaining terminals of the valve-opening magnets 10 and 11 are connected by conductors 25 and 26 to the fixed contacts 27 and 28 of a timing device having a movable contact member 29 similar to the element 24 previously described. The movable contact members 24 and 29 are provided with conducting sectors 30 and 31 respectively which are connected to one pole of source of energy 14 by means of conductor 32.

The valve-operating mechanism is shown in Fig. 1 in the position it assumes during the first quarter of the cycle of a four-cycle engine. That is to say, circuit is made to the electromagnet 10 which opens and holds open the inlet valve, through conductors 15, 18 and 25, contact members 27 and 31, and conductor 32. Movable contact members 24 and 29 are illustrated as arranged to rotate at one-half the speed of the crank shaft, and thus the inlet valve will be held open during the intake stroke of the piston, and the magnet 10 will be de-energized during the remainder of the cycle when contact 27 is in engagement with the insulating portion of contact member 29. Exhaust valve 5 is held closed during the intake stroke by magnet 9, circuit to which is completed through conductors 15, 17 and 21, contact members 23 and 24, and conductor 32, and the conducting sector 30 of contact member 24 is of such extent that the exhaust valve is held closed until the exhaust stroke of the piston, at which time contact member 23 passes on to the insulating portion of contact member 24, thus breaking circuit to magnet 9, while contact 28 at the same time comes into engagement with the conducting sector 31 of contact member 29, thus energizing magnet 11 to open valve 5 during the exhaust stroke. Contact member 22, which corresponds to magnet 8, is in engagement with the conducting sector 30 of contact member 24 during the remainder of the cycle after the intake stroke of the piston, and thus holds inlet valve 4 closed after the conducting sector 31 of contact member 29 passes out of engagement with contact member 27.

In order to cut down the energy consumed by the electromagnets, the current passing through the same is reduced as soon as each magnet has moved its corresponding valve to the desired position. In the present

instance this is accomplished by providing high resistance portions 33 and 34 respectively, in the conducting sectors 30 and 31 of contact members 24 and 29. When the conducting sector 31, for example, comes into engagement with fixed contact member 27, the resistance of the circuit initially is low, affording a circuit through magnet 10, which will be sufficient to move the same to open position, and shortly after, the high resistance portion 34 of such conducting sector will engage fixed contact member 27, cutting down the energy consumed in the magnet, but leaving sufficient current to hold the inlet valve 4 in open position. Thus, since the valves are not restrained in their movements to any substantial extent by heavy springs which are in opposition to the magnets, and since the current consumed in holding the valves is reduced to a minimum, the energy used up in actuating the valves may be kept within relatively low limits.

Sticking of the valves preferably is prevented by proportioning the parts so that the valves are seated in closed position when armatures 12 and 13 are spaced slightly from magnets 8 and 9, while in open position springs 35 and 36 respectively on the valve stems 6 and 7 bring the valves to rest before armatures 12 and 13 come into physical contact with magnets 10 and 11.

In the present embodiment springs 35 and 36 act between the upper ends of magnets 8 and 9, and discs 37 and 38 mounted on the ends of valve stems 6 and 7. The discs also fit more or less closely within housings 39 and 40 which engage over the ends of magnets 8 and 9 respectively; thus the discs 37 and 38 act to damp the movements of the valve stems by compressing the air within housings 39 and 40, to reduce the metallic click which otherwise would occur when the valves are actuated.

The valve-operating mechanism of course ordinarily will be used in connection with multi-cylinder combustion engines, the several cylinders being provided with electromagnets and timing devices of the character above described, the timing devices being angularly spaced so as to operate the cylinders in proper order.

I prefer to construct the valve-operating mechanism in such manner that in case the electrical circuits to the magnets are broken, the inlet valve will be left in closed position while the exhaust valve will be left open. This is accomplished in the embodiment illustrated by providing a spring 35 of sufficient length to urge the inlet valve 4 to closed position when armature 12 is free from the influence of the electromagnet 8, while spring 36 engages disc 38 only after the exhaust valve has moved down from closed position, and thus when armature 13 is free from the influence of electromagnets

9 and 11, the exhaust valve will drop down by gravity to open position. If both valves were left open, in case the valve-operating mechanism of one cylinder should become inoperative, the other cylinders would not obtain a full throated suction stroke on the carburetor, since communication to the inlet manifold would be afforded through valves 4 and 5, as well as through the carburetor. On the other hand, if both valves were kept closed under such conditions, the inoperative cylinder would act as a brake on the remaining cylinders, thus greatly decreasing the power. The springs 35 and 36, however, may serve the above purpose without being made heavy enough to cause any material increase in the energy necessary to be given up to the operation of the electromagnets.

A switch 41, which may be the main ignition switch or an additional switch operable conjointly therewith, is interposed between the source of energy 14 and the valve operating mechanism to prevent the consumption of current while the engine is not running. Thus, under such conditions inlet valve 4 will be closed and the exhaust valve 5 open.

I prefer to construct the valve-operating mechanism in such manner that as the speed of the engine increases the time of opening of the valves will be proportionately advanced. As shown in Fig. 2, the movable contact members are carried by the shaft 42, and the fixed contact members, 22, 23, etc., are mounted upon a support 43 journaled on shaft 42, and having arms 44 and 45 supporting the fixed contacts.

The position of the fixed contacts is then adjusted according to the speed of the engine, for example, by a link 46 extending between the support 43 and one arm 47 of a bell crank lever, the other arm 48 of which is forked and provided with pins 49^a which engage the grooved collar 49 of a speed governor 50 shown diagrammatically as mounted on a shaft 51 driven by the engine. Thus, when collar 49 is moved upwardly or downwardly due to change in speed of shaft 51, the support 43 will be correspondingly rocked to vary the points in the stroke of the engine at which the valves will be operated.

While a specific embodiment of the invention has been described, it will be obvious that many changes may be made therein without departing from the spirit of the invention, as defined in the following claims:

I claim:

1. The combination with an internal combustion engine cylinder and a valve therefor of a valve actuating mechanism, comprising opposed electromagnets respectively adapted to move the valve both to open and closed positions and hold the same

in such positions, means for alternately energizing said electromagnets, and means for reducing the current through each electromagnet during the period when it is holding the valve in position.

2. The combination with an internal combustion engine cylinder and a valve therefor of a valve actuating mechanism, comprising opposed electromagnets respectively adapted to move the valve to open and closed positions and hold the same in such positions, and means for alternately energizing the said electromagnets comprising a contact movable in timed relation to the engine speed, a co-operating fixed contact member, one of said contact members having a high resistance portion engageable with the remaining contact member during the period when an electromagnet is holding the valve in position.

3. The combination with an internal combustion engine cylinder and exhaust and inlet valves therefor, of a valve actuating mechanism adapted to move the valves to open and closed positions and hold the same in such positions, and means whereby the exhaust valve will be left in open position and the inlet valve in closed position in case said valve operating mechanism becomes inoperative.

4. The combination with an internal combustion engine cylinder and exhaust and inlet valves therefor of a valve actuating mechanism, comprising sets of opposed electromagnets respectively adapted to move the inlet and exhaust valves to open and closed positions and hold the same in such positions, and means whereby the inlet valve will be left in closed position and the exhaust valve in open position in case circuit is broken to said electromagnets.

5. The combination with an internal combustion engine cylinder and exhaust and inlet valves therefor of a valve actuating mechanism, comprising sets of opposed electromagnets respectively adapted to move the inlet and exhaust valves to open and closed positions and hold the same in such positions, a spring urging the inlet valve towards closed position, the exhaust valve being free to move to open position when the corresponding electromagnets are both de-energized.

6. The combination with an internal combustion engine cylinder and exhaust and inlet valves therefor of a valve actuating mechanism, comprising sets of opposed electromagnets respectively adapted to move the inlet and exhaust valves to open and closed positions and hold the same in such positions, circuit connections leading from a source of energy to one terminal of each of said electromagnets, the remaining terminals of the valve-opening magnets being connected in parallel to a timing device

adapted to make circuit to said electromagnets alternately, and the remaining terminals of the valve-closing magnets being similarly connected to said timing device.

- 5 7. The combination with an internal combustion engine cylinder and exhaust and inlet valves therefor of a valve actuating mechanism, comprising sets of opposed electromagnets respectively adapted to move
10 the inlet and exhaust valves to open and closed positions and hold the same in such positions, circuit connections leading from a source of energy to one terminal of each of said electromagnets, the remaining terminals
15 of the valve-opening magnets being connected in parallel to a timing device adapted to make circuit to said electromagnets alternately, and the remaining terminals of the valve-closing magnets being similarly
20 connected to a timing device, each of said timing devices embodying a contact member movable in timed relation to the engine speed and a co-operating fixed contact mem-

ber, one of said contact members having a high resistance portion engageable with the remaining contact member during the period when an electromagnet is holding the valve in position. 25

8. The combination with an internal combustion engine cylinder and a valve
30 therefor, of an electromagnet adapted to periodically actuate said valve, a timing device in circuit with said electromagnet comprising a contact member movable in timed relation to the engine speed and a
35 co-operating fixed contact member, and means responsive to the speed of the engine for varying the relative positions of said fixed and movable contact members to vary the time of actuation of said valve according
40 to changes in speed of the engine.

In testimony that I claim the foregoing, I have hereunto set my hand this 25th day of August, 1921.

OSCAR LOUIS PERRAULT.