P. H. MUELLER & L. H. SCHULER.

INTERNAL COMBUSTION ENGINE.

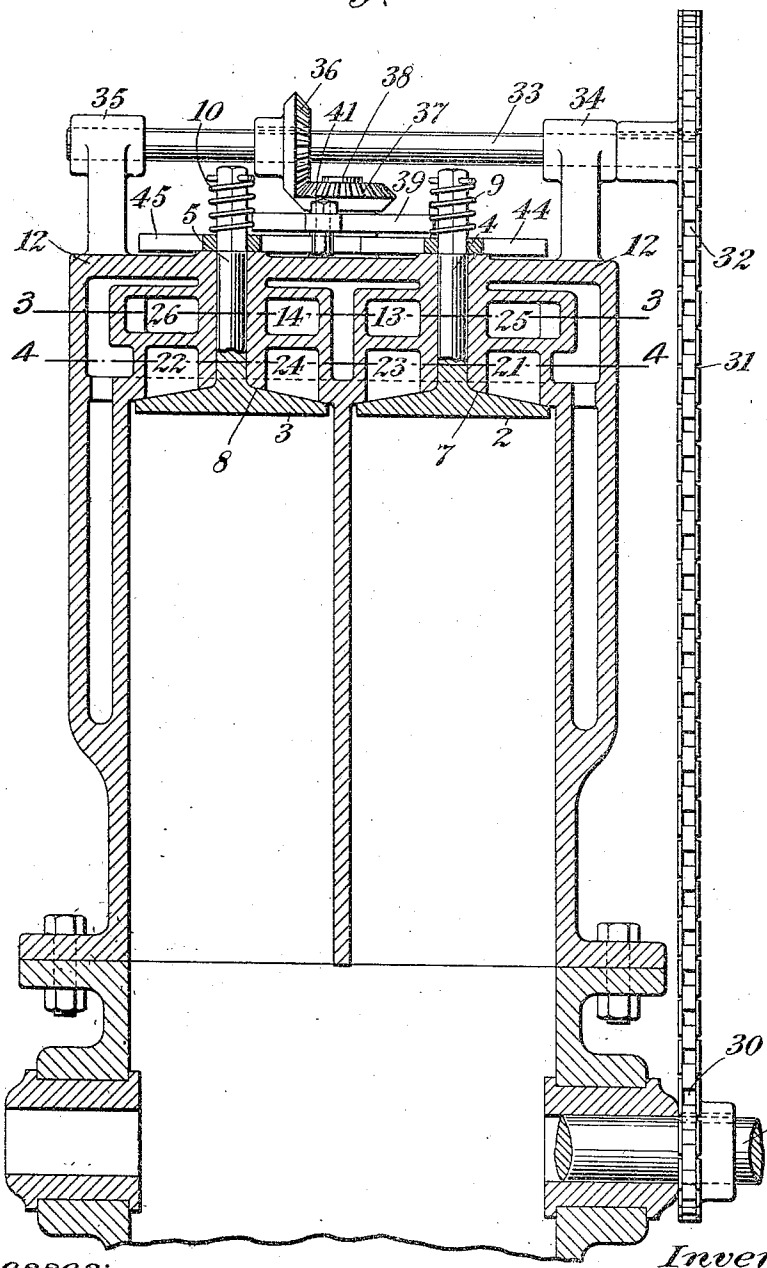
APPLICATION FILED JAN. 9, 1912.

1,189,281.

Patented July 4, 1916.

2 SHEETS—SHEET 1.

Fig. 1



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2 SHEETS—SHEET 2.

Fig. 2

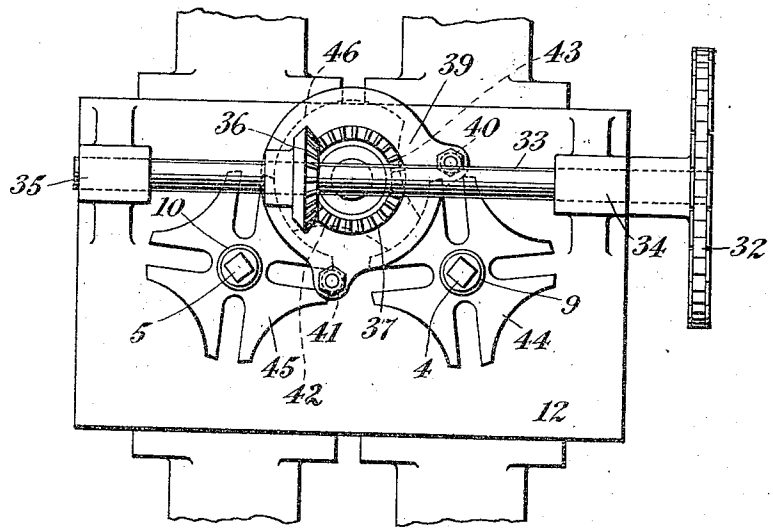


Fig. 3

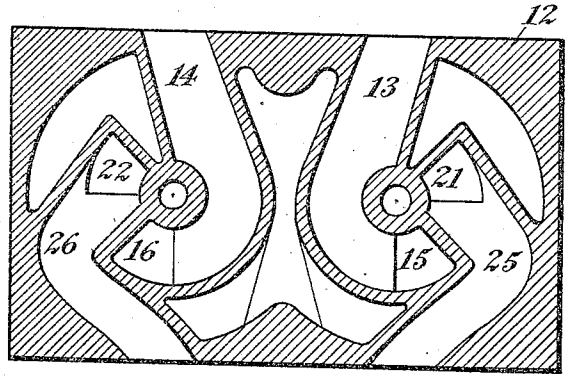


Fig. 5

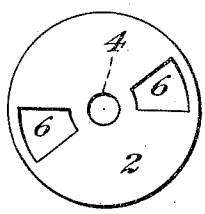
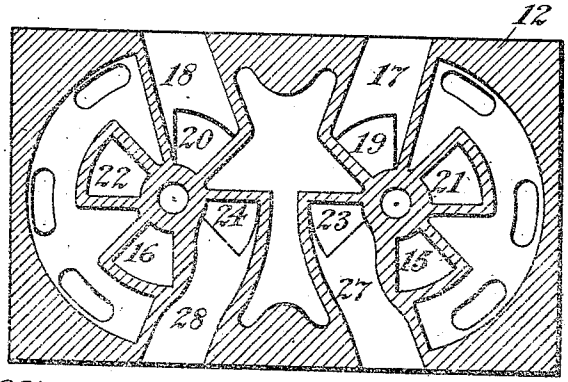


Fig. 4



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UNITED STATES PATENT OFFICE.

PAUL H. MUELLER AND LUDWIG H. SCHULER, OF BROOKLYN, NEW YORK, ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, TO L-M-S. MOTOR CO., OF ESOPUS, NEW YORK, A CORPORATION OF NEW YORK.

INTERNAL-COMBUSTION ENGINE.

1,189,281. Specification of Letters Patent. Patented July 4, 1916.

Application filed January 9, 1912. Serial No. 670,141.

To all whom it may concern:

Be it known that we, PAUL H. MUELLER and LUDWIG H. SCHULER, subjects of Germany, and residents of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to improvements in internal combustion engines, and particularly to the valve mechanism thereof and operating connections therefor; it being in the nature of an improvement upon that disclosed in our prior application, Ser. No. 656,151, filed Oct. 23, 1911, in which we have illustrated a valve mechanism in which a single valve, common to the inlet and outlet ports of a cylinder, controls both the admission of a charge to said cylinder and the exhaust of the waste gases and products of combustion therefrom, said valve being so mounted as to be capable of movement toward and from its seat in the direction of an axis about which it is turned by a suitable rotary element forming a part of the aforesaid operating connections.

In the valve mechanism of our prior application, the valve is so connected with its operating means as to be actuated continuously. The valve being a rotary one and being exposed to the pressure of the charge in the cylinder during compression, and also subject to the pressure developed in the cylinder on the ignition or explosion of a charge, is held strongly against its seat during compression and explosion, the result being that not only is an excessive amount of power required to operate the valves during these portions of the cycle, but there is also an undue amount of wear on the valve-seat.

One of the principal objects of the present invention is to provide means for operating a valve of this general character in such a manner that its operation will be unaffected by pressure in the cylinder during the periods of compression and explosion, while at the same time the wear on the valve-seat just referred to will be avoided. This result is accomplished by providing means for actuating or rotating such a combined admission and exhaust valve as is disclosed in our aforesaid application intermittently instead of continuously, the operating means being such as to actuate the valve during admission and exhaust while preventing movement of the valve during compression and explosion.

Another important feature is the application of such a mechanism to a multi-cylinder internal combustion engine, and the provision of means for operating a plurality of such combined admission and exhaust valves intermittently in similar cycles, but so that the cycles of the different cylinders differ in phase, corresponding operations in different cycles being ordinarily 90° apart.

In order that the valve of each cylinder of a multi-cylinder engine may perform its functions properly and in a definite relation to those of each other valve, the operating means is preferably of such a character as to cause each individual valve to move through a predetermined distance or arc during admission, and through another predetermined distance or arc for exhausting the burned gases, etc., and prevent any movement of said valve during the compression and explosion periods. This result is preferably obtained by providing means for positively stopping or locking the valve so that it cannot move during either of these periods. In addition to this the operating devices for a plurality of valves are preferably so connected that not only does each valve operate intermittently, but the intermittent operation of each valve has a definite predetermined relation to the intermittent operation of each other valve.

Other features of the invention not hereinbefore referred to will be hereinafter described and claimed and are illustrated in the accompanying drawings, in which,

Figure 1 is a substantially central, vertical section of so much of a multi-cylinder internal combustion engine as is necessary for the purpose of illustrating the application of our improvements thereto; Fig. 2 is a plan of the same; Fig. 3 is a horizontal section of the same, section being taken in line 3—3, Fig. 1, and illustrating the inlet and outlet ports as they appear at one level; Fig. 4 is a similar view, section being taken in line 4—4, Fig. 1, illustrating said ports at a different level, and Fig. 5 is a face or underside view of one of the valves.

Similar characters designate like parts in all the figures of the drawings.

As in the case of the invention disclosed

in our aforesaid prior application, our present improvements may be applied to various kinds of internal combustion engines, stationary or movable, and it is to be understood that the particular engine shown in the drawings is merely illustrative of one mechanism in which the invention may be embodied. In order, however, to illustrate the application of certain specific features of the invention to internal combustion engines, we have shown a two-cylinder instead of a single-cylinder engine of the ordinary four-cycle type, with the two cylinders of which are combined suitable means for controlling the admission and exhaust for each cylinder through a single valve in accordance with our invention.

The admission and exhaust ports leading to and from each cylinder may also be located at any suitable points and may cooperate with the valve mechanism in any proper manner so long as the inlet and outlet ports for each cylinder are all controlled by the same valve. In the present case one of the principal features of our improvements is the provision of a plurality of inlet ports and a plurality of outlet ports for each cylinder, these sets of ports being intended to coöperate with correspondingly positioned sets of ports in the respective valves associated therewith. The object of providing a plurality of inlet ports and a plurality of outlet ports for each cylinder are to permit either cylinder to take a heavy charge when it is desirable, as in going up steep grades, etc., and to assure the rapid discharge of the waste gases and other products of combustion. A detailed description of the construction and function of these ports will be given after describing the valves and their operating mechanism. For the purpose of controlling the opening and closing in proper succession of these inlet and outlet ports of the engine, we make use in connection with each cylinder of a combined admission and exhaust valve having one or more ports each adapted to register at the proper times first with one and then with the other of the ports or sets of ports controlling admission and exhaust. The valve may be located at any suitable point in the engine where it will perform its functions properly. In the construction illustrated, our valve is shown as located in the explosion chamber itself, but it is of course clear that it may be placed out of the zone of the explosion, and at any proper point in the passages leading to the explosion chamber. The controlling movement of the valve may also be any suitable for the purpose of uncovering and covering in the proper order the inlet and outlet ports of its cylinder, but preferably this movement will be a rotary one as in our aforesaid application, and the movement will also preferably be derived from power developed in the engine, usually directly from the main crank-shaft. It will not, however, be continuous in the present case as it is in our aforesaid application, but will be an intermittent movement. The specific valve illustrated is a rotary disk-valve, two of which valves are shown, one of which is indicated at 2 and the other at 3. Each has a stem adapted to be operatively connected with means for actuating or turning the valve, these stems being indicated at 4 and 5 respectively. Each of these disk-valves preferably has a plurality of ports through each of which admission or exhaust takes place according to the position of the valve, these ports being indicated in Fig. 5 by 6—6, these ports being so positioned and so shaped as to coöperate with the fixed inlet and outlet ports previously referred to. Each of the valves is intended to be seated constantly against a suitable fixed wall of the engine, as, for example, against the valve-seats, 7 and 8; and substantially the whole back wall of each valve is here illustrated as shaped so as to fit its seat and lie snugly against it. It will be seen that whatever the rotary position of either valve may be said valve is in constant engagement with its seat, the seating of the valve being assisted in the present case, as in our former application, by means of a spring working between suitable stops, which springs are indicated at 9 and 10. Here the stems 4 and 5 of the valves are journaled in bearings in the upper ends or heads, 12, of the cylinders and project outside the walls of the engine into position for connection with suitable means for actuating them.

It will be understood that while we have described as our preferred type of valve one having a plurality of ports, such for example as the diametrically opposite ports, 6—6, this is for the purpose of facilitating admission of a suitable charge and expulsion of the burned gases, etc. So far as intermittent operation of a valve of any cylinder is concerned, a single port, as in our aforesaid application, can as well be used as a plurality of ports. Owing, however, to the additional advantages to be derived from the use of a plurality of ports in each valve and the use of a corresponding plurality or set of ports of each kind—inlet and outlet—in the cylinder head we have illustrated valves having a plurality of ports. The inlet and outlet ports leading to and from each cylinder are shown (see particularly Figs. 1, 3 and 4) as corresponding in numbers and positions with the ports in their respective valves; that is to say, with a valve having two diametrically opposite inlet ports, such as 6—6—which are also at the proper times outlet

ports—will be associated corresponding sets or pairs of inlet and outlet ports in the associated cylinder of the engine. The manner in which these ports are constructed will be clear by referring to these views.

It will be seen that there are two sets of inlet and outlet passages located at different horizontal planes, but suitably connected so that all of the inlet ports and passages for each cylinder communicate with the main inlet to that cylinder while all of the outlet ports and passages of that cylinder communicate with the main outlet from the same cylinder. Referring particularly to Fig. 4, it will be seen that there are two inlets, an upper and a lower one, the upper one of which opens into a passage, 13, which is substantially horizontal and communicates with a substantially vertical passage, 15, of substantially the shape and area of one of the openings, 6, in the valve. The lower inlet port, however, leads into a shorter inlet passage, such as 17, and intersects a substantially vertical passage, 19, which is similar to that shown at 15, but is disposed diametrically opposite to it in order that both of the ports 6—6 may register with the ports 15 and 19 simultaneously. It will be seen that the vertical passage 15 is substantially twice the length of the passage 19 because the inlets of the passages 13 and 17 are located at different levels. The ports and passages through which the burned gases, etc., are permitted to escape are also disposed at different levels. Two diametrically opposite, vertical outlet passages are shown at 21 and 23 respectively, the former of these being substantially twice the length of the latter (for reasons similar to those just given) and leading into a substantially horizontal upper outlet passage, such as 25, while the shorter vertical passage 23 intersects a substantially horizontal outlet passage, 27, disposed at a lower level. Each pair of inlets and outlets just described will, of course, communicate directly with a corresonding main inlet or exhaust pipe in the usual manner. It will be seen from Fig. 4 that not only are the vertical inlet and outlet passages 15—19 and 21—23 disposed so that corresponding ports are opposite each other, but that they are all located about a common center, which is in the axis of a corresponding valve, and are spaced substantially 90° apart, in order that admission and exhaust may take place in proper timing.

The other cylinder shown in these views has corresponding sets of inlet and outlet ports and passages to those just described. The upper, horizontal inlet passage is indicated at 14, the vertical passage which it intersects by 16, the lower horizontal inlet passage by 18, the vertical passage which it intersects by 20, the long, vertical outlet passage by 22, the opposite, short, vertical outlet passage by 24, and the corresponding horizontal outlet passages intersecting the passages 22 and 24 by 26 and 28 respectively.

The manner in which these various inlet ports and passages coöperate with the openings in the respective valves will be hereinafter described.

The means for actuating each of the combined admission and exhaust valves for the purpose of carrying its port or ports through its proper cycle of movement, may be any suitable for the purpose of intermittently actuating or rotating such valve in the manner before specified. The means illustrated comprises power-transmitting chain-gearing, connecting the main crank-shaft 29 of the engine with the stems of the valves. The particular connections used may be varied considerably, but those illustrated constitute a simple means for imparting the necessary intermittent movement to the valves. This transmitting mechanism, as herein illustrated, comprises a small sprocket-wheel, 30, secured to the shaft 29, a sprocket-chain, 31, and a larger sprocket-wheel, 32, around which said chain passes at its upper end and which is secured to an upper horizontal shaft, 33, journaled in bearings, such as 34 and 35, a bevel-gear, 36, secured to said shaft 33, a bevel-gear, 37, meshing with the bevel-gear 36 and mounted to turn on a vertical carrier or stud, such as 38, and suitable connections between the bevel-gear 37 and the stems 4 and 5 of the valves for operating said valves in the proper timing. The connection between said bevel-gear and the valve-stems may be any suitable for the purpose. Preferably, however, it will be of the type shown, that is to say, it will involve a Geneva movement between said bevel-gear and the stem of each valve, the construction illustrated being one in which an actuator and stop-wheel of an ordinary Geneva movement is common to two separate Geneva-wheels. The actuator and stop-wheel as here shown are suitably modified to adapt them for coöperation with two different Geneva-wheels. The combined actuator and stop-wheel illustrated comprises two separate actuating pins and two separate recesses. This combined actuator and stop-wheel is designated generally by 39. The two pins just referred to are indicated at 40 and 41, and the recesses at 42 and 43. The Geneva-wheels which the pins 40 and 41 are intended to drive are indicated at 44 and 45 respectively. Each is secured to the valve-stem which it is intended to drive in such a manner that the stem and the Geneva-wheel will always rotate in unison while the stem may have a movement in the direction of its axis independent of such Geneva-wheel. Each of these two Geneva-wheels is held down against its seat at the upper end of its

cylinder by the corresponding spring 9 or 10, before described, as will be clear by referring to Fig. 1.

The recesses 42 and 43 and the peripheral stop-face, 46, of the stop-wheel are so proportioned and associated in such a manner with the two Geneva-wheels and with the actuating pins 40 and 41 that each Geneva-wheel—and hence each valve—is operated intermittently, that is to say, during admission and exhaust, and locked against movement intermittently, that is to say, during compression and explosion. The relation of these parts is also such that the cycle of each valve is the same but the movements differ in phase by 90°, the operations in the second cylinder occurring 90° later than those in the first cylinder, the cycle being approximately in each case 90° for admission, 90° for compression, 90° for the explosion period, and 90° for exhaust, although the opening of the exhaust is advanced somewhat, as will be clear from the position of the pin 41 relative to that of the pin 40 in Fig. 2. Thus, for example, in the engine shown the two ports 6—6 in the valve 2 will first open and then close the two inlet ports 15 and 19 during the first quarter turn of the valve, during which movement the ports in the valve 3 will first open and then close the exhaust ports or passages 22 and 24. The valve 2 stands still during the next period, that is, during what would be the next quarter turn of the valve 2 if it were continuously operated. During this second period, however, the ports of the valve 3 first open and then close the inlet ports 16 and 20. During the third period or quarter the valve 2 still remains stationary as it did during the second period, these two periods corresponding to the periods of compression and explosion of the charge in the first cylinder. During said third period the valve 3 also stands still as this quarter corresponds to the period of compression in the second cylinder. During the fourth quarter, however, the valve 2 first opens and then closes its exhaust ports or passages 21 and 23 to permit the escape of the burned gases, etc., from the first cylinder. During this period the valve 3 stands still as this quarter corresponds to the period of explosion of the charge and development of power in the second cylinder. This completes the first cycle of operations for the two cylinders. The succeeding cycles are of course the same as the first.

From the foregoing description of the construction and operation of our improved valve mechanism it will be seen that during the turning movement thereof there is no pressure whatever upon either valve due to pressure exerted by an unexploded or exploded charge in either cylinder of the engine and that the only resistance to be overcome at such times in operating either valve is the normal frictional resistance, etc.

In connection with the parts herein described, we may, of course, use any usual or suitable means for controlling the power developed at each ignition or explosion of a charge, as, for example, by varying the mixture introduced into either cylinder in any well-known manner and also varying the volume of the charge so introduced, as by throttling either inlet pipe or otherwise. These modes of controlling the operation of the engine in accordance with the requirements under varying loads, etc., are well understood and for this reason have not been specially illustrated or described. It will be clear also that an engine having any desired number of cylinders all operating in similar cycles so long as they differ properly in phase from one another, may be used and that a multi-cylinder engine having only two cylinders is illustrated for convenience and simplicity.

What we claim is:

1. In a valve gear for internal combustion engines, the combination of a rotary valve, a Geneva gear for intermittently driving the valve, the driver disk of said gear having a series of pins and the follower disk a corresponding series of slots, an operative connection between the engine crank-shaft and driver disk, and an operative connection between the follower disk and the valve spindle, the pins of the driver disk being spaced unequally to occasion, in relation to the lap between the valve ports, an advance opening of the exhaust.

2. In a multi-cylinder internal combustion engine, the combination with a plurality of cylinders each having inlet and outlet ports, of a plurality of valves one for each cylinder and each constituting a combined admission and exhaust valve having a port adapted to register with the inlet and outlet ports of its cylinder at different times, and means for intermittently actuating said valves in similar cycles differing in phase said means including a pair of valve-actuating Geneva-wheels one for each valve and an actuator and stop-wheel common to said Geneva-wheels.

Signed at New York in the county of Kings and State of New York this 5th day of January A. D. 1912.

PAUL H. MUELLER.
LUDWIG H. SCHULER.

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