J. I. EMERY.

VALVE FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED FEB. 9, 1914. RENEWED MAR. 16, 1918.

1,283,121.

Patented Oct. 29, 1918.

3 SHEETS—SHEET 1.

Fig. 1,

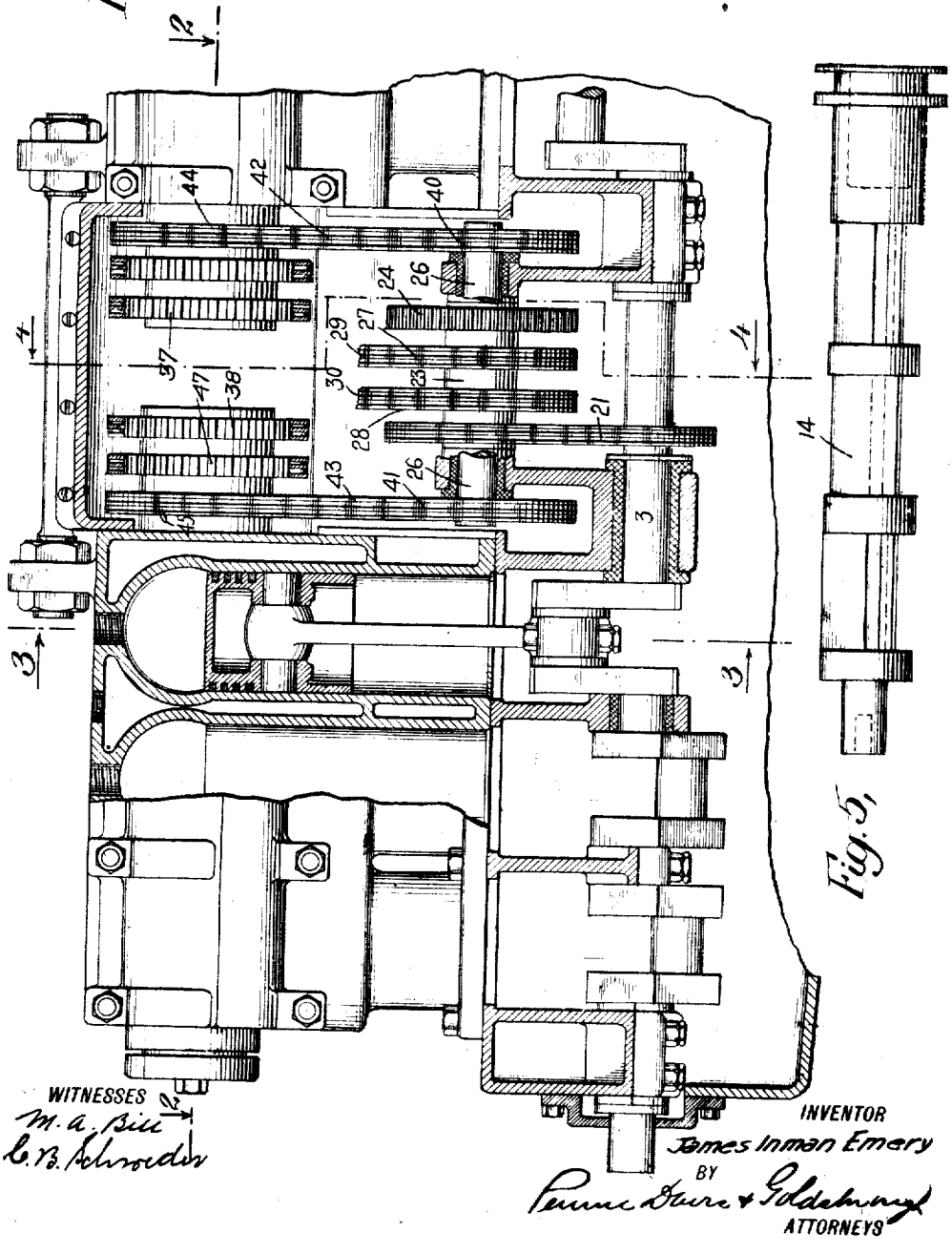


Fig. 5,

WITNESSES

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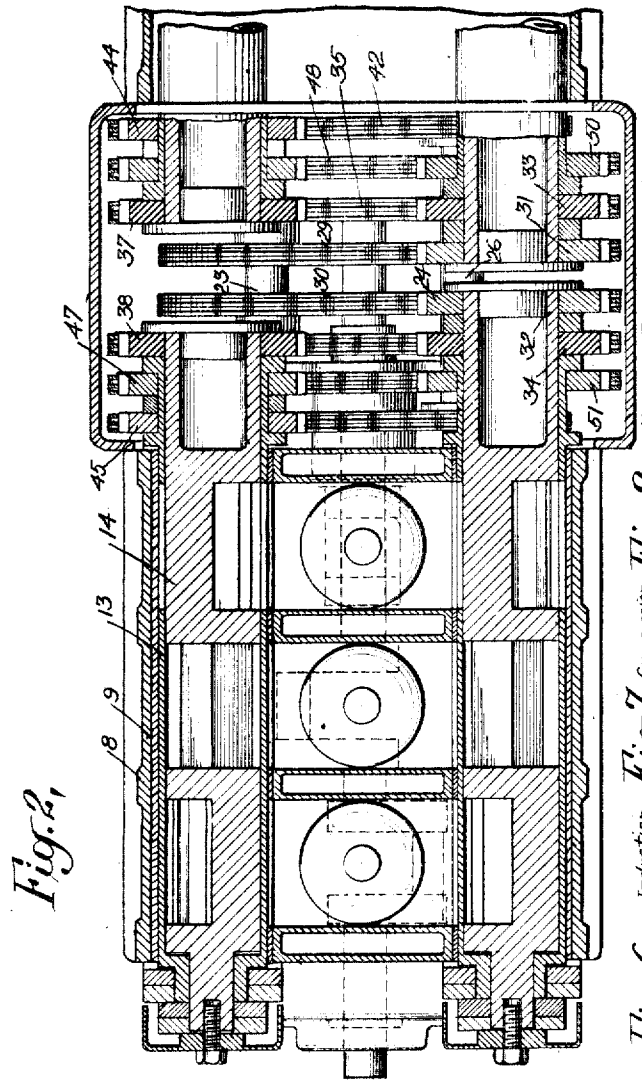


Fig. 2.

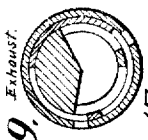


Fig. 9. Exhaust.

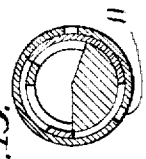


Fig. 13.

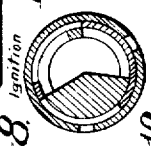


Fig. 8. Ignition

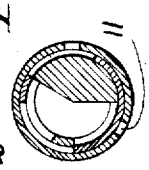


Fig. 12

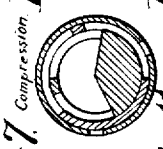


Fig. 7. Compression

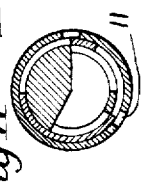


Fig. 11

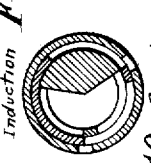


Fig. 6. Induction

Exhaust Valve

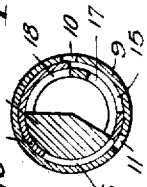


Fig. 10

Intake Valve

WITNESSES

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3 SHEETS—SHEET 3.

Fig. 4.

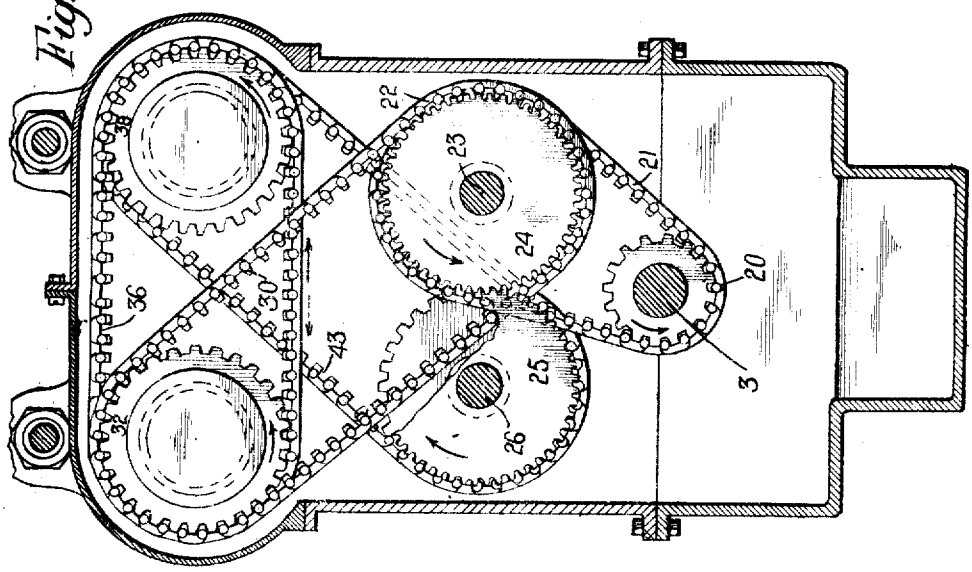
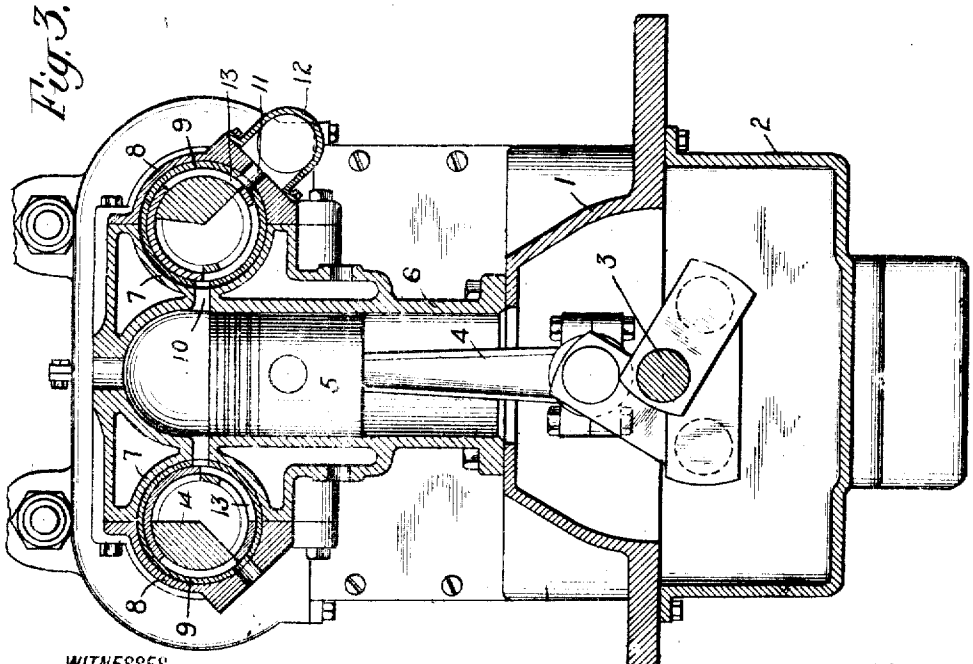


Fig. 3.



UNITED STATES PATENT OFFICE.

JAMES INMAN EMERY, OF LONDON, ENGLAND.

VALVE FOR INTERNAL-COMBUSTION ENGINES.

1,283,121. Specification of Letters Patent. Patented Oct. 29, 1918.

Application filed February 9, 1914, Serial No. 817,444. Renewed March 16, 1918. Serial No. 222,982.

To all whom it may concern:

Be it known that I, JAMES INMAN EMERY, a subject of the King of Great Britain, residing at London, S. E., England, have invented certain new and useful Improvements in Valve Mechanism for Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to valve mechanism for internal combustion engines; and its object is to provide a practicable and efficient valve mechanism of the rotary barrel type, doing away with all puppet-valves and accompanying reciprocating valve parts and cams, and at the same time avoiding any departure from the simple construction of piston and cylinder of accepted type.

To this end I interpose between the usual inlet or exhaust conduit, or manifold, and the usual cylinder or cylinders, a valve casing having ports communicating with the cylinder or cylinders, and with the conduits or manifold, respectively, and containing a rotatable ported valve sleeve or barrel, which in turn contains a rotatable ported core, and I provide means for rotating the sleeve and the core simultaneously and continuously in opposite directions, the arrangement of the ports in the casing, the sleeve and the core being such that in each revolution of the sleeve and core, communication is established for the desired period of time between each cylinder and the conduit or manifold.

In the preferred form of the invention, the arrangement of the ports and intervening closure portions of the sleeve and of the core is such that the closure portions separate, to open the passage from the cylinder to the conduit or manifold, at points which are opposite the centers of the casing ports, so that, because of the simultaneous movement of these closure portions away from one another, to enlarge the port area, the time of opening and closing is correspondingly reduced.

It is also preferable to make the casing ports of small angular extent and relatively long, while the ports in the sleeve and core have an angular extent corresponding to the desired period of opening, so that during substantially the entire period of intake or exhaust, the passage will be fully open.

In the accompanying drawings, which illustrate the preferred form of my invention as applied to a six-cylinder internal combustion engine;

Figure 1, is in part a central vertical section and in part an elevation; Fig. 2 is a sectional plan on the line 2—2 of Fig. 1; Fig. 3 is a vertical cross-section on the line 3—3 of Fig. 1; Fig. 4 is a vertical cross-section on the line 4—4 of Fig. 1; Fig. 5 shows the valve core; Figs. 6, 7, 8, and 9 illustrate diagrammatically the several critical positions of the exhaust valve mechanism; and Figs. 10, 11, 12 and 13 are like diagrams of the inlet valve mechanism.

The engine particularly chosen for purposes of illustration is a six-cylinder engine in which the cylinders are arranged in two blocks of three each, spaced apart and having the valve driving mechanism housed between them. The base-plate 1, with crank-well 2, crank shaft 3, piston rods 4, and pistons 5, are of common construction, and the cylinder castings 6 do not differ from the accepted type otherwise than that they are formed with the semi-cylindrical recesses 7, which, being completed by bolting on of the castings 8, having complementary semi-cylindrical recesses, constitute housings for the reception of the cylindrical valve castings. In the present case the inlet valve mechanism, which is common to three cylinders, is shown at the right of Fig. 3, and the exhaust valve mechanism which is likewise common to three cylinders, is shown at the left. The inlet valve mechanism is identical in construction and mode of operation with the exhaust valve mechanism and differs therefrom only in timing and preferably also in the fact that the area of the port openings of the exhaust valve mechanism is slightly greater than 90° of a circle, allowing of a slight scavenging action. It will, consequently, be sufficient to describe in detail the construction of one of the inlet valve mechanisms.

Each valve casing 9, lies within and is supported by its housing 7—8, and has, for each cylinder, a port 10 communicating with the cylinder and a port 11 communicating with a supply conduit 12, or the exhaust conduit as the case may be. In the present instance the conduit 12 is shown as the usual inlet manifold, but it will be understood that in the case of a single cylinder engine it may

be simply a pipe leading from the carbureter or other source of supply. Within each valve casing 9 is a rotatable valve sleeve 13, and within each sleeve a rotatable valve core 14. Each sleeve and each core, contains three sets of ports for controlling respectively the inlet to and exhaust from the three cylinders, and these sets of ports are so angularly disposed with respect to one another, as to bring about the induction and exhaust in the respective cylinders in proper sequence, as will be understood. Except for this difference in the angular placement of the several sets of ports, they are identical and a description of one will serve for all.

By reference to Figs. 2 and 3 and the diagrammatic Figs. 6 to 13 inclusive, it will be seen that the casing ports 10 and 11 are of relatively slight angular extent, but are prolonged lengthwise of the casing, as indicated in Fig. 2, to produce the required port area. The casing ports are so arranged that the angle formed between two lines drawn from the center of the axis of rotation through the outside edges of the ports of entry and exit is equal to 135° of a circle, the port openings each occupying about 15° of the circumference.

The sleeve 13 has two ports 15 and 16, corresponding in length to the casing ports 10 and 11, and having an angular extent corresponding to the time period during which it is desired to maintain communication between the conduit and the cylinder. In the inlet valves this will be preferably 90 angular degrees, but in the exhaust valves it will preferably be somewhat greater than 90 angular degrees to provide for thorough removal of the exhaust gases, as will be understood. The ports 15 and 16 are separated from one another on the one side by a closure portion having an angular extent of approximately 30°, and on the other side by a closure portion having an angular extent of approximately 150°, the extent of these closure portions being somewhat reduced in the exhaust valve, as shown. The core 14 has likewise two ports, 17 and 18, of the same angular extent as the ports 15 and 16, and are separated by closure portions of the same angular extent as the closure portions of the sleeve. With the sleeve and core thus ported, and arranged in proper angular relation to one another, the operation will be as indicated in Figs. 10 to 13, inclusive, showing the intake valve, and in Figs. 6 to 9, inclusive, showing the exhaust valve.

In the position shown in Figs. 6 and 10 induction is about to begin, and with the particular port areas of the exhaust valve mechanism there indicated, the exhaust passage remains open for a short period after the intake passage is opened to effect some scavenging action. It will be observed that in the position shown in Fig. 10 the co-acting closure portions of the sleeve and of the core are about to separate opposite the center lines of the casing ports 10 and 11, with the result that as the sleeve and core continue to rotate in opposite directions the entire area of the ports is uncovered in a very short period of time. In the intake valve the casing port of 15° will be fully open after 7½° of movement of the core and sleeve, and will remain fully open during 75° of movement and will then be fully closed after 7½° of movement. In other words, the operations of opening and closing are each completed during the movement of the crank pin through 15°, making a total of 30°, so that the valves remain in the full open position through 150° of the 180° of movement of the crank pin corresponding to each suction stroke, provided the valves open and close at dead center and the angular extent of each of the ports in the barrel and in the sleeve is 90°.

Stated in terms of actual piston movement, the valves remain fully open more than .925 of the length of the stroke, and the time actually occupied by the operations of opening and closing is less than .075 of the length of the stroke. In other words, as compared with the port opening diagram of a puppet valve, which has approximately the form of a sine curve, or with the port opening diagram of a rotary valve, which has a generally triangular form, the port opening diagram of my engine is nearly rectangular.

From the position of the ports shown in Figs. 7 and 11, it will be seen that after one-quarter of a revolution the intake passage is closed and that the exhaust passage remains closed throughout the compression stroke.

As seen from Figs. 8 and 12, all valves likewise remain closed throughout the ignition stroke, and as seen from Figs. 9 and 13, the exhaust passage is opened slightly before the beginning of the exhaust stroke and remains open throughout that stroke, until slightly after the inlet passage opens, as shown in Figs. 6 and 10.

To effect this operation, the sleeve and the core must be rotated simultaneously and continuously in opposite directions, and at a speed equal to one-half the speed of the crank shaft. This may be effected by any suitable arrangement of gearing, as will be understood. In the particular engine shown, I have used a chain driving mechanism placed between the two blocks of cylinders, and consisting of the following parts:

On the crank shaft 3 is a sprocket 20, which by chain 21 drives the sprocket 22 and the shaft 23 at one-half the speed of the crank shaft. The shaft 23 carries a pinion

24 which meshes with a like pinion 25 on the parallel shaft 26, so that the shafts 23 and 26 are driven in opposite directions. Shaft 23 also carries two sprockets 27 and 28, which, through chains 29 and 30 drive the sprockets 31 and 32, which are respectively carried by the cores of the exhaust valve mechanisms of the two engine blocks, and said cores carry also the sprockets 33 and 34 which, through the chains 35 and 36 drive the sprockets 37 and 38 on the cores of the two intake valve mechanisms. By this arrangement all of the cores are driven in the same direction from shaft 23. The shaft 26 carries two sprockets 40 and 41 which, through the chains 42 and 43 drive the sprockets 44 and 45 on the sleeves of the intake valve mechanism and these sleeves carry sprockets 46 and 47 which, through chains 48 and 49 drive the sprockets 50 and 51 on the sleeves of the exhaust valve mechanisms, so that the sleeves of the four valve mechanisms are all driven in the same direction from the shaft 26, and in an opposite direction to their respective cores.

It will be observed that the valve mechanism thus described and operated is extremely simple, that the gas passages are extremely short and straight, and that all pockets and waste spaces have been eliminated. Furthermore, the design enables the inlet and exhaust ports to be made of ample area and to take advantage of the full diameter of the cylinder, and this, taken with the fact that the ports are open during so great a part of the stroke, insures an extremely rapid discharge of the exhaust, resulting in a cooler engine and a more even temperature around the valve casings, as well as in an easy flow and good charge of mixture on the induction stroke.

The valve may be easily lubricated on the forced feed principle, the valve lubrication being part of the general lubrication system. For engines up to four cylinders, a single valve mechanism will answer for the intake or the exhaust as the case may be, of all of the cylinders; but for six-cylinder engines, the arrangement shown in the drawing is recommended, because of the excessive length of valves that would otherwise be necessary. As will be understood, the invention is particularly applicable to eight-cylinder engines having two sets of four cylinders set at an angle of 90°.

Although I have shown, and prefer to use a casing 9 surrounding the sleeve 13, and making of the valve mechanism a unit which may be easily placed in and removed from the housing 7—8, yet it will be understood that the casing 9 may be dispensed with and the valve sleeve 13 fitted directly within a housing 7—8 of the proper diameter and suitably machined: and I desire it to be understood that when the expression "valve casing" is used in the following claims, it is intended to cover either one of these arrangements or any equivalent thereof.

In the engine selected for illustration, I have shown the relative dimensions of the port openings and closure portions of the intake valve as different from those of the exhaust valve. It will be understood, moreover, that the relative dimensions of the openings and closure portions may be otherwise modified without affecting the principle of operation so long as they come within certain limitations, that is, the largest closure portion of the valve or the casing must be at least equal to the angular distance between the outside edges of the two casing ports and the smaller closure portion must be equal to the distance between the centers of the casing ports less the angular width of the port opening of the sleeve or casing.

What I claim is:

1. A valve mechanism for an internal combustion engine comprising a valve casing having ports communicating with the two chambers to be periodically connected, a ported sleeve rotatably fitting within the casing, a ported core fitting within the sleeve, means for simultaneously rotating the core and the sleeve in opposite directions, said ports being so positioned as to establish communication directly across the valve casing in a plane substantially perpendicular to its axis once only in each revolution.

2. A valve mechanism for an internal combustion engine comprising a valve casing having ports communicating with the two chambers to be periodically connected, a ported sleeve rotatably fitting within the casing having two port openings in its wall in the same plane substantially perpendicular to its axis, a core rotatably fitting within said sleeve and provided with a port extending therethrough with port openings in the surface of the core in the same transverse plane as the sleeve ports, means for simultaneously rotating said core and said sleeve in opposite directions, the said ports being so arranged that the ports of the core and sleeve come into registration with the ports of the casing and thereby effect a passage therethrough at one only of their two positions of crossing in each revolution.

3. A valve mechanism for an internal combustion engine comprising a valve casing having ports communicating with the two chambers to be rotatably connected, a ported sleeve rotatably fitting within the casing, a ported core fitting within the sleeve, means for simultaneously rotating the core and the sleeve in opposite directions, said ports being so positioned as to establish communication directly across the valve casing in a plane substantially perpendicular to its axis once only in each revolution, the casing ports having a circumferential width equaling only

a minor portion of the width of the core and sleeve ports whereby the passage through the valve is quickly opened and closed and remains fully open for a major portion of the interval.

4. A valve mechanism for an internal combustion engine comprising a valve casing having ports communicating with the two chambers to be periodically connected, a ported sleeve rotatably fitting within the casing having two port openings in its wall in the same plane substantially perpendicular to its axis, a core rotatably fitting within said sleeve and provided with a port extending therethrough with openings in the surface of the core in the same transverse plane as the sleeve ports, means for simultaneously rotating said core and said sleeve in opposite directions, the said ports being so arranged that the ports of the core and sleeve come into registration with the ports of the casing and thereby effect a passage therethrough at one only of their two positions of crossing in each revolution, the port openings of the core and sleeve having a circumferential width equal to the angular movement of each during the period which it is desired to maintain the communication between the chambers.

5. A valve mechanism for an internal combustion engine comprising a valve casing having ports communicating with the two chambers to be rotatably connected, a ported sleeve rotatably fitting within the casing, a ported core fitting within the sleeve, means for simultaneously rotating the core and sleeve in opposite directions, said ports being so positioned as to establish communication directly across the valve casing in a plane substantially perpendicular to its axis once only in each revolution, the port openings of the core and sleeve having a circumferential width equal to the angular movement of each during the period which it is desired to maintain communication between the chambers, the casing ports having a circumferential width equaling only a minor portion of the width of the core and sleeve ports whereby the passage through the valve is quickly opened and closed and remains fully open for a major portion of the interval.

6. A valve mechanism for an internal combustion engine comprising a valve casing, a sleeve rotatably supported in said casing, ports in said casing communicating with the chambers to be connected, said ports being in the same plane transverse to the axis of rotation of said sleeve with their centers separated by an angular distance less than 180°, a core rotatably supported in said sleeve, and means for rotating said sleeve and core simultaneously in opposite directions, said sleeve and core having transverse ports adapted to establish a passage across said casing once in each complete rotation of said ports.

7. A valve mechanism for an internal combustion engine comprising a valve casing, a sleeve rotatably supported in said casing, ports in said casing communicating with the chambers to be connected, said ports being in the same plane transverse to the axis of rotation of said sleeve with their centers separated by an angular distance less than 180°, a core rotatably supported in said sleeve and means for rotating said sleeve and core simultaneously in opposite directions, said sleeve and core having transverse ports, the centers of the port openings in the opposite walls of said sleeve and core being separated by an angular distance equal to the angular separation of the casing ports.

8. A valve mechanism for an internal combustion engine comprising a valve casing, a sleeve rotatably supported in said casing, ports in said casing communicating with the chambers to be connected, said ports being in the same plane transverse to the axis of rotation of said sleeve with their centers separated by an angular distance less than 180°, a core rotatably supported in said sleeve and means for rotating said sleeve and core simultaneously in opposite directions, said sleeve and core having transverse ports, and the rotation of said core and sleeve being so timed that the leading edges of the port openings of the core on each side simultaneously pass the leading edges of the port openings of the sleeve at points coincident with the middle lines of the two casing ports respectively.

9. A valve mechanism for an internal combustion engine comprising a valve casing, a sleeve rotatably supported in said casing, ports in said casing communicating with the chambers to be connected, said ports being in the same plane substantially perpendicular to the axis of rotation of said sleeve, a core rotatably supported in said sleeve and means for rotating said sleeve and core simultaneously in opposite directions, said sleeve and core having transverse ports, said core and sleeve ports being of circumferential width equal to one half the angular movement of the engine shaft during the period which it is desired to maintain the chambers in communication.

10. A valve mechanism for an internal combustion engine comprising a valve casing, a sleeve rotatably supported in said casing, ports in said casing communicating with the chambers to be connected, said ports being in the same plane substantially perpendicular to the axis of rotation of said sleeve, a core rotatably supported in said sleeve and means for rotating said sleeve and core simultaneously in opposite directions, said sleeve and core having transverse ports, said core and sleeve ports being of

circumferential width equal to one half the angular movement of the engine shaft during the period which it is desired to maintain the chambers in communication, and said casing ports having a circumferential width equaling only a minor portion of the width of the core and sleeve ports whereby the passage through the valve is quickly opened and closed and remains fully open for a major portion of the interval.

In testimony whereof I affix my signature, in presence of two witnesses.

JAMES INMAN EMERY.

Witnesses:

L. BATES,

M. V. BILL.