C. A. THOMSON.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAY 14, 1919.

1,370,856.

Patented Mar. 8, 1921.

2 SHEETS—SHEET 1.

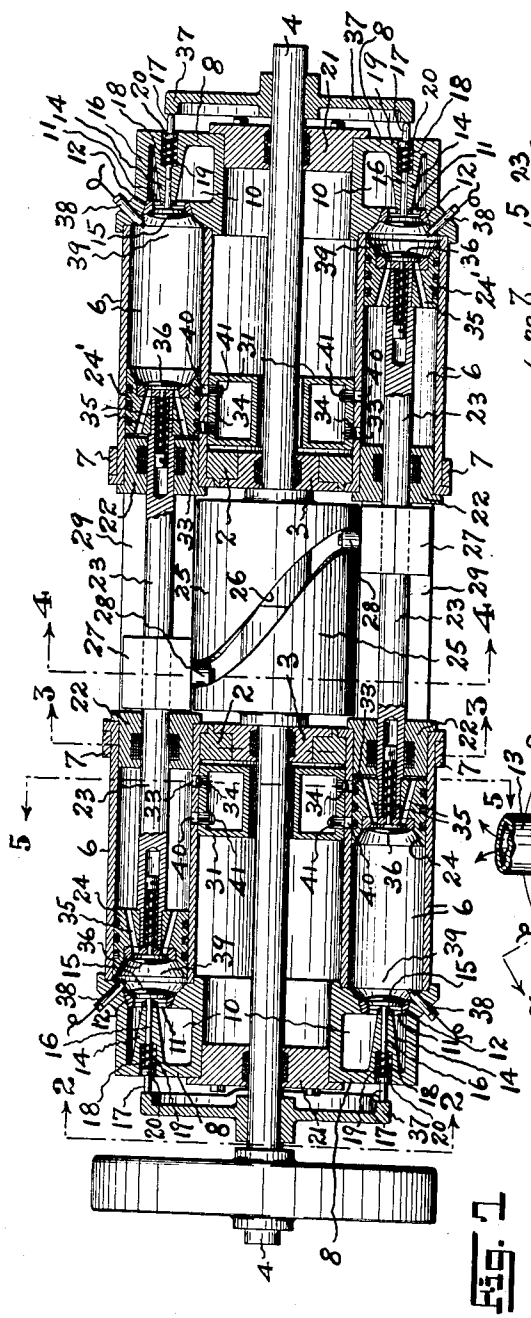

Fig. 1.

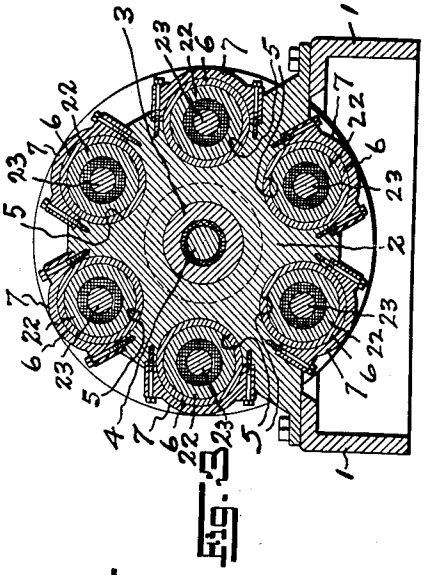

Fig. 3.

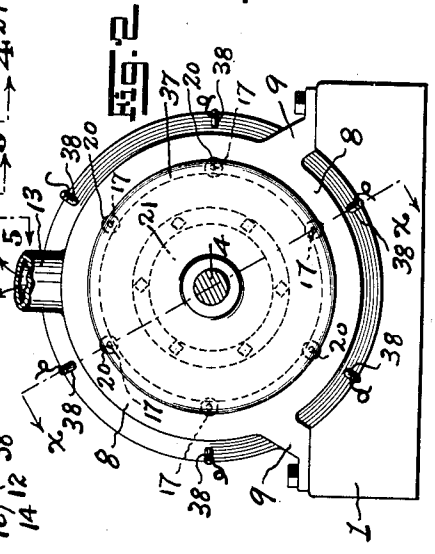

Fig. 2.

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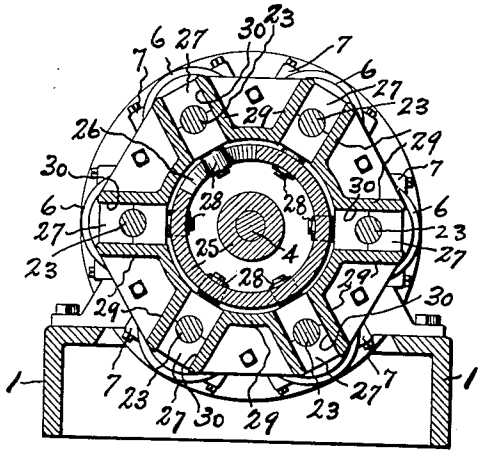

Fig. 4

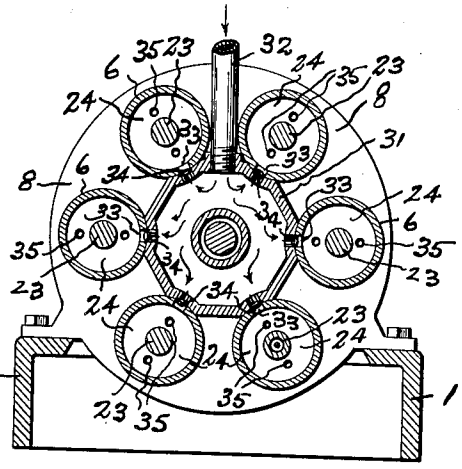

Fig. 5

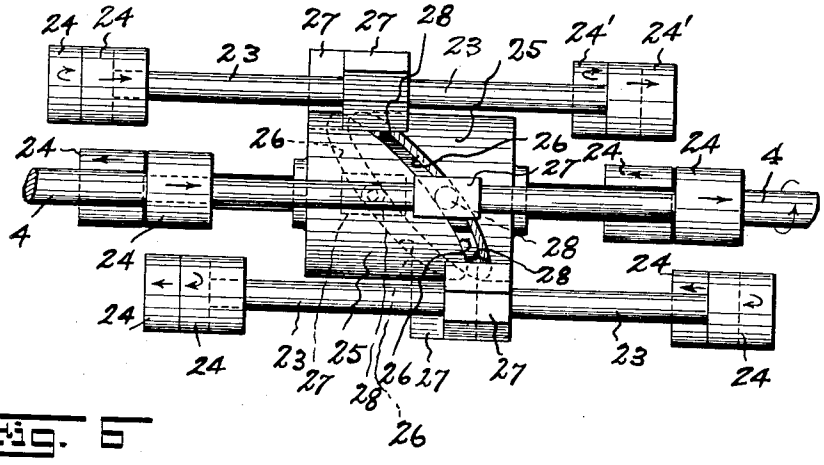

Fig. 6

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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,370,856. Specification of Letters Patent. Patented Mar. 8, 1921.

Application filed May 14, 1919. Serial No. 296,967.

To all whom it may concern:

Be it known that I, CHARLES A. THOMSON, a subject of the King of England, residing at Belleville, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in 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, reference being had to the accompanying drawings, and to characters of reference marked thereon, which form a part of this specification.

The present invention has reference, generally, to a novel construction of internal combustion engine; and the invention relates, more particularly, to a crankless multi-cylinder engine of the horizontally opposed type providing a properly balanced condition of the moving parts of the engine.

The invention has for its principal object to provide a novel construction of internal combustion engine of the opposed multi-cylinder type, the reciprocating pistons of which transmit their power producing movements to a rotor member mounted on a main shaft, instead of to a crank-shaft, and the piston movements being so balanced relatively that an equal torque or turning movement is transmitted to diametrically opposite sides of said rotor member. In thus eliminating crank-shaft movements, the reciprocating pistons are enabled to transmit their power movements against the rotor-member in lines parallel to their longitudinal axes, consequently eliminating much friction and consequent loss of power, due to lateral tipping or displacement of the pistons from true axial longitudinal movement, and furthermore, the full maximum pressure of complete combustion is immediately translated into a turning movement of the rotor-member.

Another object of the present invention is to provide a type of engine capable of utilizing to full advantage small cylinder diameters with long piston strokes to the end that high speed operation may be accomplished with less heat development, and a more economical consumption of fuel.

Other objects of the present invention, not at this time more particularly enumerated, will be clearly understood from the following detailed description of the same.

With the various objects of the present invention in view the same consists, primarily, in the crankless multi-cylinder internal combustion engine, hereinafter set forth; and, the invention consists, furthermore, in the several novel arrangements and combinations of devices and parts, as well as in the details of the construction of said parts, all of which will be subsequently more fully described in the following specification, and then defined in the claims appended thereto.

The invention is clearly illustrated in the accompanying drawings, in which:—

Figure 1 is a longitudinal section of an internal combustion engine made according to and embodying the principles of my present invention, said section being taken on line *x*—*x* in Fig. 2.

Fig. 2 is a transverse section taken on line 2—2 in said Fig. 1.

Fig. 3 is a transverse section taken on line 3—3 in said Fig. 1.

Fig. 4 is a transverse section taken on line 4—4 in said Fig. 1.

Fig. 5 is a transverse section taken on line 5—5 in said Fig. 1.

Fig. 6 is a diagrammatic view of the rotor-member and main shaft, showing the relation of the engine pistons thereto.

Similar characters of reference are employed in all of the hereinabove described views to indicate corresponding parts.

Referring now to the said drawings, the reference-character 1 indicates a suitable base or bed upon which the engine is mounted. As illustrated the engine is of a multi-cylinder type, comprising twelve cylinders arranged in opposed groups of six cylinders. It will be understood, however, that the number of cylinders in the opposed groups may be either increased or decreased within practical limits.

Mounted upon said base or bed 1 are a pair of longitudinally spaced frame-members 2, bolted to said base or bed, or otherwise suitably secured thereto. Said frame-members 2 are each provided with centrally disposed bearings 3 in which is journaled a centrally and longitudinally extending main shaft 4. Each frame-member 2 is provided in its periphery with seats 5 for the reception of the inner ends of the cylinders 6,

which are thus disposed to extend outwardly and longitudinally from said respective frame-members in grouped equi-spaced relation about and parallel to said main shaft 4. Detachable clamp yokes 7 are bolted to said frame-members to secure said cylinders 6 in mounted relation to said frame-members.

Secured to the outer ends of each group of said cylinders 6 is an annular head-frame 8 provided with suitably disposed legs 9 for supporting the same upon and securing the same to said base or bed 1. Each head-frame 8 is provided with a chambered interior 10, and is provided in its inner wall with exhaust valve ports 11 having suitably arranged valve-seats 12 respectively alined with the outer end of each cylinder 6 so as to communicate therewith. Said chambered interior 10 of each head-frame 8 provides an exhaust manifold in communication through said valve ports 11 with each cylinder, of the respective groups thereof with which said head-frames are respectively connected, said exhaust manifold possesses a suitable outlet conduit or pipe 13. Connected with said head-frames 8 are valve supporting members 14 alined with each valve port 11. An exhaust valve 15 is seated on each valve seat 12, each exhaust valve 15 having an outwardly extending stem 16 slidably supported in a valve supporting member 14, so that its free end 17 projects outwardly from the outer end wall of said head-frame 8. Said valve supporting members 14 are provided with cylindrical sockets 18 in which are seated a valve-spring 19 which thrust against collars 20 fixed on said valve stem 16 to normally hold said valves 15 against the seats 12 in closing relation to the ports 11, and said free ends 17 of said valve stems in normal outward projection from said head-frames 8.

Connected with said head-frames 8 are centrally disposed bearing members 21 for journaling the outer ends of said main shaft 4.

The inner ends of said cylinders 6 are closed by stuffing box caps 22, through which extend the respective piston rods 23. A single piston rod 23 is arranged in reciprocating relation to each pair of longitudinally alined and opposed cylinders 6, one end of said piston rod carrying a piston 24 slidably disposed with one cylinder, and the other end of said piston rod carrying a piston 24′ slidably disposed within the opposite cylinder.

Mounted upon and fixed to said shaft 4 between said respective opposed groups of cylinders 6, is a cylindrical rotor member 25, provided in its cylindrical surface with an oblique continuous cam-groove 26. Secured upon said piston rods 23, midway between their ends, are slide-blocks 27, having rollers 28 mounted thereon, to respectively enter into and ride in said cam-groove 26 of said rotor member 25. Disposed in suitably secured relation between said frame-members 2 are guide-members 29 which combine to provide longitudinal slideways 30 for said respective slide-blocks 27.

Properly associated with each group of cylinders 6 is a fuel manifold member 31, provided with a fuel delivery conduit or pipe 32. Said fuel manifolds are located adjacent to the inner ends of said cylinders 6, and are provided in connection with each cylinder with fuel inlet valve ports 33 communicating respectively with said respective cylinders 6, said valve ports 33 being normally closed by suitable check or poppet valves 34, which, opening under the suction influence of the pistons, admit fuel charges into said cylinders, but which close against returning movement of said fuel charges. The pistons 24 are provided with by-pass ports 35 extending through the same from rear to front, said by-pass ports 35 being normally closed by means of puppet-valves 36.

Secured upon said main shaft 4, adjacent to each head-frame 8 is a cam-wheel 37, which rotates with said main shaft in cooperation with the projecting free ends 17 of the stems 16 of said exhaust valves 15, thereby producing a properly timed opening and closing movement of said exhaust valves relative to the piston movements in the respective cylinders.

The reference-character 38 indicates the usual electric ignition plugs, which are suitably arranged and mounted (preferably in connection with said head-frames 8) to enter the firing chambers 39 of said cylinders 6.

I prefer to operate the internal combustion engine constructed as above described on the principles of the two cycle method of fuel control and combustion, although it will be clearly understood, that if it is desired the same may be modified to operate on the four cycle principle as well.

When operating on the two cycle principle the mechanism functions as follows:—

Outward movements of the pistons in the cylinders 6, suck into the latter behind the pistons, through the fuel inlet valve ports 33, a charge of fuel or gaseous mixture from the manifold members 31. Inward movements or power strokes of the pistons in the cylinders 6 compress the fresh fuel charges behind the pistons. The pressure of the fuel charges thus compressed causes the puppet-valves 36 to open, so that the fresh fuel charges are caused to flow from behind the pistons through the by-pass ports 35, and into the combustion chambers of the cylinders beyond the forward side of the pistons. In order to insure the puppet-valves 36 against opening to admit the fresh charges of fuel before combustion of the

previously introduced charges are completed in the firing chambers 39, I provide in connection with the cylinders 6 and fuel intake manifold members 31, pressure releasing return valve ports 40 leading from the cylinders 6 into the manifold members 31, normally closed by suitable check or puppet-valves 41, which open under pressure from within the cylinders 6. Said return valve ports 40 are located in outwardly spaced relation to said inlet valve ports 33, so that as the fuel charges behind the pistons are compressed by the inward movement of said pistons, the pressure of such compression is relieved through said return valve ports 40, until the pistons pass said latter ports, whereupon the remaining inward travel of the pistons compresses the fuel charges to the extent necessary to open the by-pass port valves 36 to by-pass the charges into the firing chambers 39. In this manner, not only is the properly timed operation of the by-pass port valves 36 assured, but all waste of fuel is eliminated, and a proper volume of fresh fuel for each cycle of piston movement is assured.

Upon the completion of the inward movements of the pistons, the new fuel charge is by-passed into the firing chambers 39 in the manner above stated. The ensuing outward movements of the pistons carry forward the fuel charges in the firing chambers 39 and upon the completion of the outward movement of the pistons compress the same. When compression of the fuel charges is complete, the electric ignition devices are timed to operate, and thus ignite the said charges. The combustion of the ignited fuel resulting in expansion of the gases drives inward the pistons to produce their power strokes.

The spent or exhaust gases resulting from combustion are scavenged from the firing chambers 39 by the outward movements of the pistons. The outwardly moving pistons, propelling ahead of them the new fuel charges, also drives outward the spent or exhaust gases, the cam-wheels 37 operating to effect a properly timed opening of the exhaust valves 15 to permit the exit of the spent or exhaust gases from the cylinder into the exhaust manifolds, said exhaust valves, in such operation being timed to close prior to the completion of the outward movements of the pistons, so that they close against the escape of the fresh fuel charges while the remaining outward travel of the pistons produces the proper compression of said fuel charges in the firing chambers 39 preparatory to the ignition thereof. It will be thus apparent that a two-cycle operation of the pistons takes place, so that each inward stroke of the pistons produces a power stroke and a by-passing of fresh fuel charges into the firing chambers, and each outward stroke of the pistons produces a suction drawing into the cylinders fresh fuel, and a scavenging or exhaust of spent gases from the firing chambers followed by the compression of fresh fuel charges therein.

Under the two cycle principle of operation, the explosive or power strokes of the pistons, occur successively in each group of cylinders and a power stroke in a cylinder of one group produces a fuel induction stroke in the opposite cylinder of the other group, since the pistons of said opposite cylinders are interconnected by a common piston rod. Since the cylinders of said respective groups are disposed about the main shaft 4, it follows that power strokes in exact equality are transmitted in opposite directions at respectively diametrically opposite points of said rotor member, so that a perfectly balanced application of force is thus applied to the rotor-member through which the reciprocating movement of the pistons is translated to a continuous torque or rotary movement of the main shaft 4. Owing to the oblique disposition of the cam groove 26 of said rotor-member, it follows that the power strokes of the pistons in the several cylinders of each group follow each other in quick succession, so that before the power stroke in one cylinder is complete, another power stroke is initiated in the next cylinder, at intervals (in a six cylinder grouping) approximating each sixty degrees of turning movement of said rotor member (as illustrated in Fig. 5).

In my type of engine, all the mechanical advantages and thermal efficiency of small cylinder bore and long piston stroke construction are met by its construction; and, furthermore, due to the direct longitudinal thrust of the piston rod connections against the rotor member, which obviates changes of connecting rod angles ordinary to the crankshaft engine, thus eliminating side friction between pistons and cylinder walls, and assuring that the effect or maximum pressure of complete combustion is directly and immediately transmitted to the turning of the rotor-member, so that a maximum proportion of the heat of combustion is converted into power, with almost inconsiderable loss.

I am aware that some changes may be made in the general arrangements and combinations of the various devices and parts of my present invention, as well as in the details of the construction thereof, without departing from the scope of the invention as set forth in the foregoing specification, and as defined in the appended claims. Hence, I do not limit my invention to the exact arrangements and combinations of the devices and parts as described in the said specification, nor do I confine myself to the exact details of the construction of said parts as illustrated in the accompanying drawings.

I claim:

1. In an internal combustion engine, the combination with a main shaft of longitudinally opposed groups of cylinders disposed about said shaft parallel thereto, pistons in said cylinders, common piston rods interconnecting the pistons of opposed cylinders, stuffing-box means closing the inner ends of said cylinders through which said piston rods extend, a fuel delivery means associated with each group of cylinders, said fuel delivery means having fuel inlet ports communicating respectively with the inner ends of said cylinders to deliver fuel behind said pistons, check-valves normally closing said fuel inlet ports but adapted to open under suction of said pistons, said pistons having by-pass ports adapted to pass fuel charges from behind said pistons into the firing chambers of said cylinders in front of said pistons, piston check-valves normally closing said by-pass ports, an exhaust discharge means associated with each group of cylinders, said exhaust discharge means having exhaust ports communicating respectively with the firing chambers of said cylinders, exhaust valves having exteriorly projecting stems normally closing said exhaust ports, rotary cams fixed on said main shaft to coöperate with said exhaust valve stems to produce a timed opening of said exhaust valves, a cylindrical rotor member fixed on said main shaft intermediate said groups of cylinders, said rotor member having an oblique cam-groove in its cylindrical surface, and means on said piston-rods for engaging said cam-grove.

2. In an internal combustion engine, the combination with a main shaft of longitudinally opposed groups of cylinders disposed about said shaft parallel thereto, pistons in said cylinders, common piston rods interconnecting the pistons of opposed cylinders, stuffing-box means closing the inner ends of said cylinders through which said piston rods extend, a fuel delivery means associated with each group of cylinders, said fuel delivery means having fuel inlet ports communicating respectively with the inner ends of said cylinders to deliver fuel behind said pistons, delivery check-valves normally closing said fuel inlet ports but adapted to open under suction of said pistons, said cylinders being further provided with compression release ports outwardly spaced relative to said fuel inlet ports and adapted to be closed by the passing of the pistons relative thereto, said pistons having by-pass ports adapted to pass fuel charges from behind said pistons into the firing chambers of said cylinders in front of said pistons, piston check-valves normally closing said by-pass ports, an exhaust discharge means associated with each group of cylinders, said exhaust discharge means having valve controlled ports communicating respectively with said cylinders, a cylindrical rotor-member fixed on said shaft intermediate said groups of cylinders, said rotor member having an oblique cam-groove in its cylindrical surface, and means on said piston rods for engaging said cam-groove.

3. In an internal combustion engine, the combination with a main shaft of longitudinally opposed groups of cylinders disposed about said shaft parallel thereto, pistons in said cylinders, common piston rods interconnecting the pistons of opposed cylinders, stuffing-box means closing the inner ends of said cylinders through which said piston rods extend, a fuel delivery means associated with each group of cylinders, said fuel delivery means having fuel inlet ports communicating respectively with the inner ends of said cylinders to deliver fuel behind said pistons, delivery check-valves normally closing said fuel inlet ports but adapted to open under suction of said pistons, said cylinders being further provided with compression release ports outwardly spaced relative to said fuel inlet ports and adapted to be closed by the passing of the pistons relative thereto, said pistons having by-pass ports adapted to pass fuel charges from behind said pistons into the firing chambers of said cylinders in front of said pistons, piston check-valves normally closing said by-pass ports, an exhaust discharge means associated with each group of cylinders, said exhaust discharge means having exhaust ports communicating respectively with said firing chambers of said cylinders, exhaust valves having exteriorly projecting stems normally closing said exhaust ports, rotary cams fixed on said main shaft to coöperate with said exhaust valve stems to produce a timed opening of said exhaust valves, a cylindrical rotor member fixed on said main shaft intermediate said groups of cylinders, said rotor member having an oblique cam-groove in its cylindrical surface, and means on said piston-rods for engaging said cam-groove.

In testimony that I claim the invention set forth above I have hereunto set my hand this 13th day of May, 1919.

CHARLES A. THOMSON.

Witnesses:

GEORGE D. RICHARDS,

BARBARA SUTTERLIN.