

March 31, 1925.

E. L. WRENTMORE
INTERNAL COMBUSTION ENGINE

1,531,430

Filed March 26, 1919

5 Sheets-Sheet 1

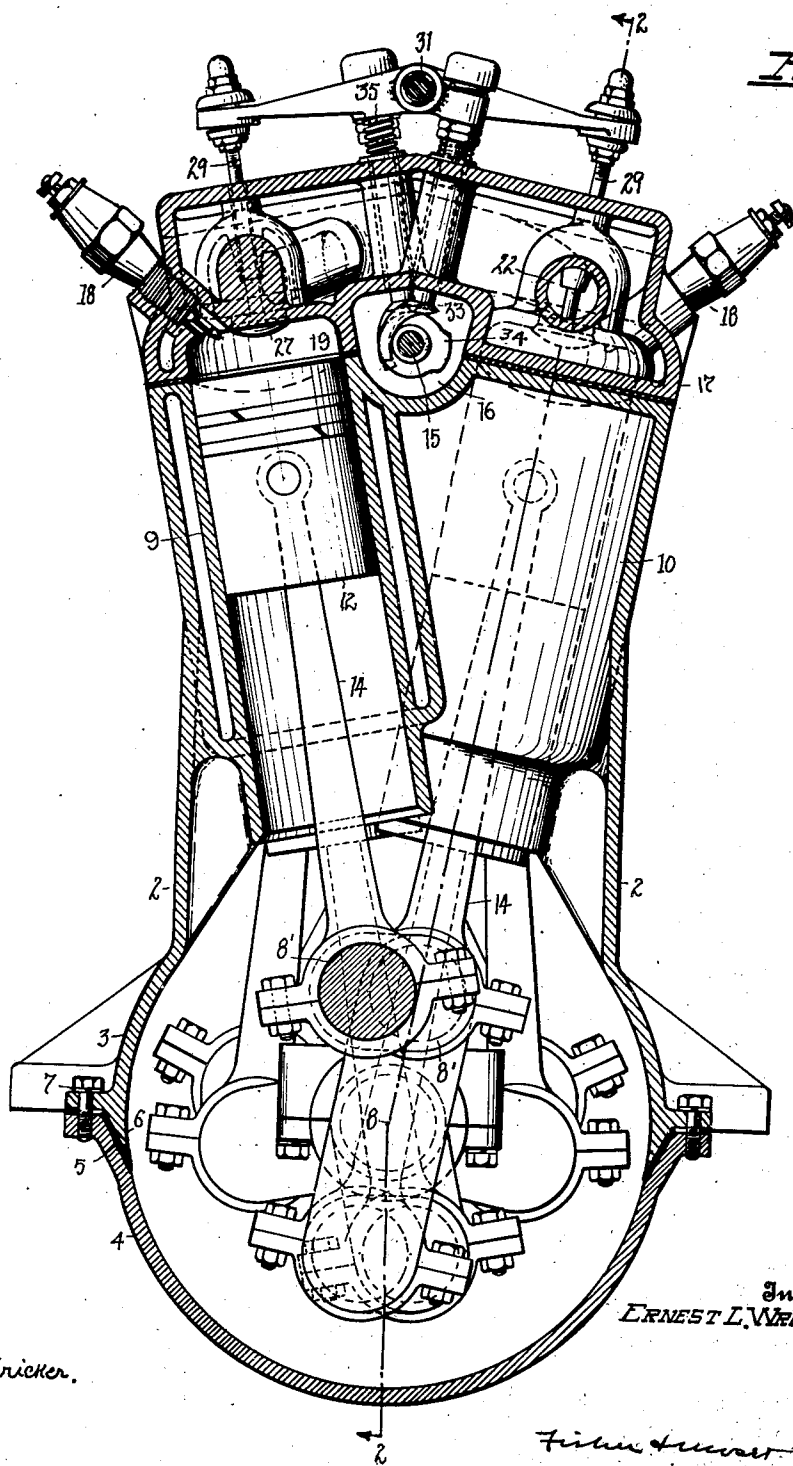


FIG. 1

Witness
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March 31, 1925.

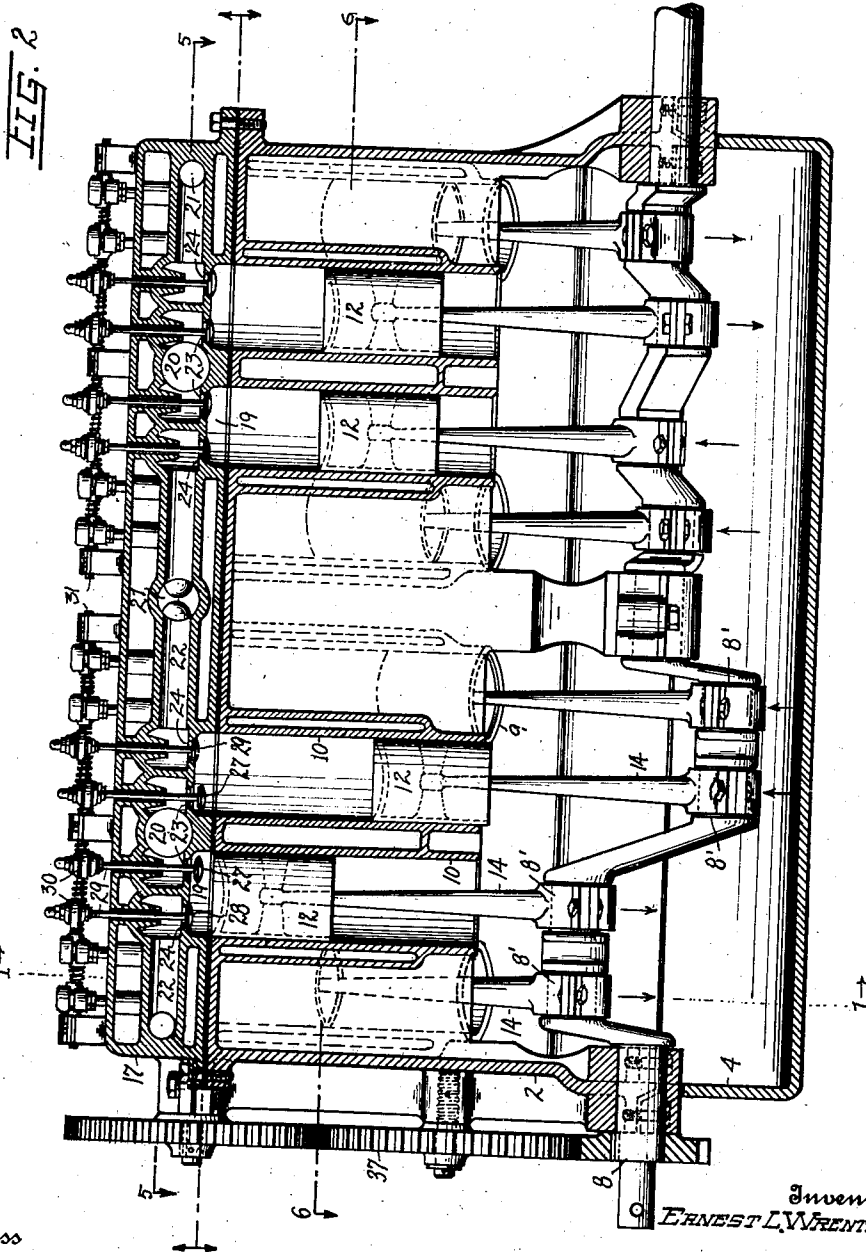
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5 Sheets-Sheet 2



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Filed March 26, 1919 5 Sheets-Sheet 3

FIG. 3

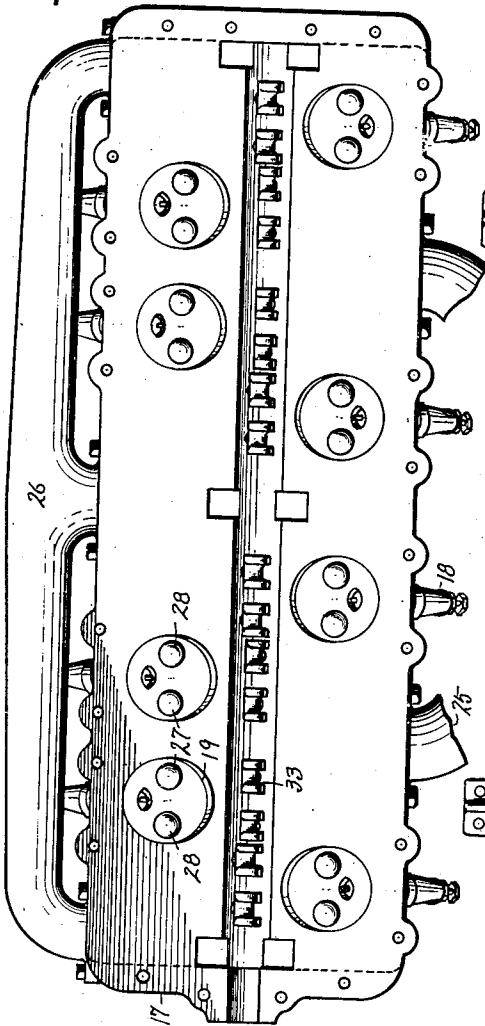
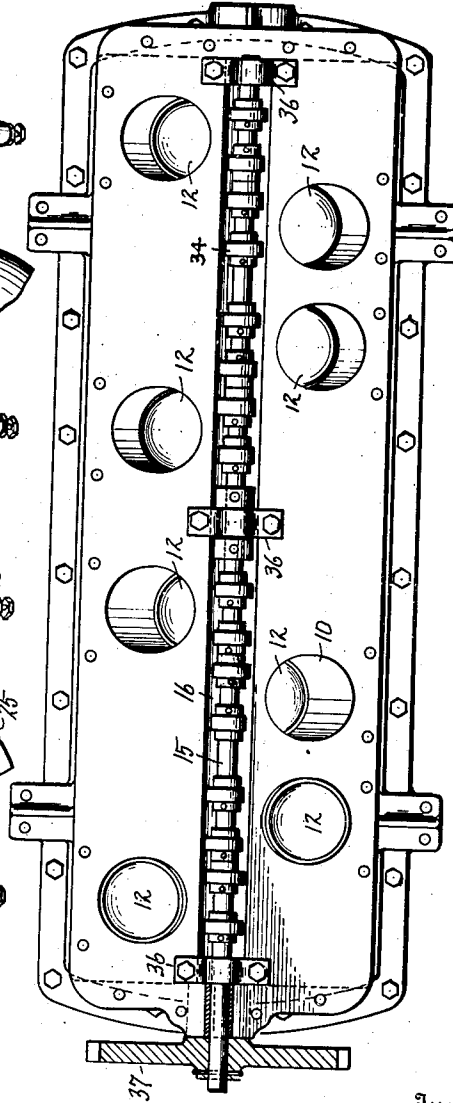


FIG. 4



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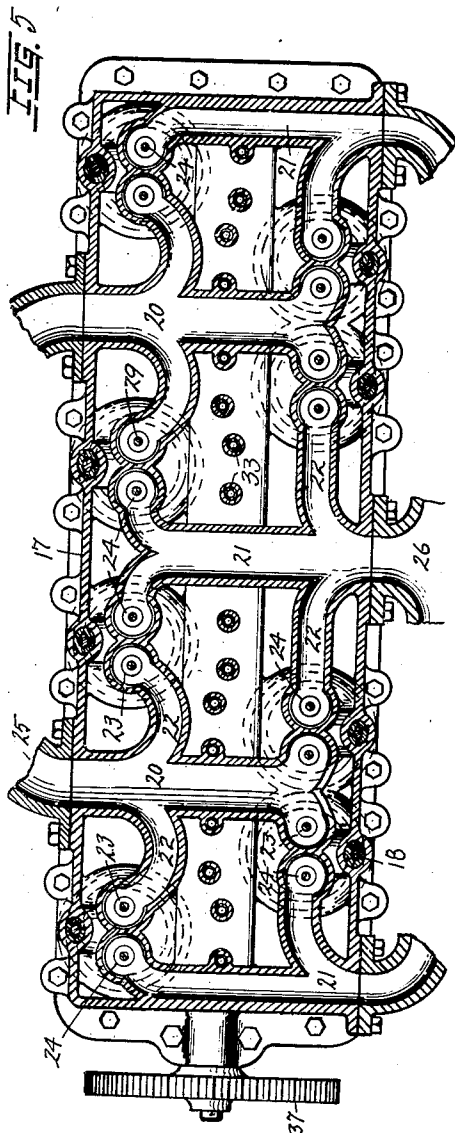
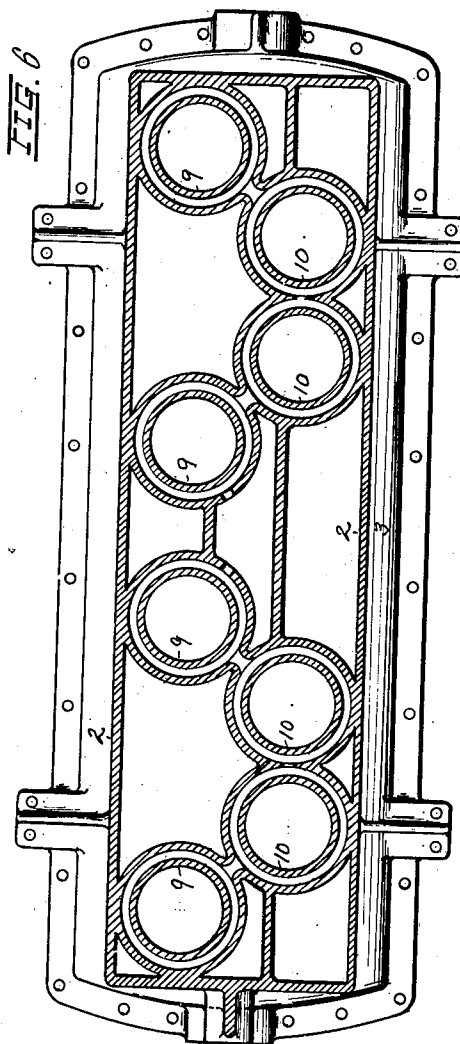
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INTERNAL COMBUSTION ENGINE

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5 Sheets-Sheet 4



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INTERNAL COMBUSTION ENGINE

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5 Sheets-Sheet 5

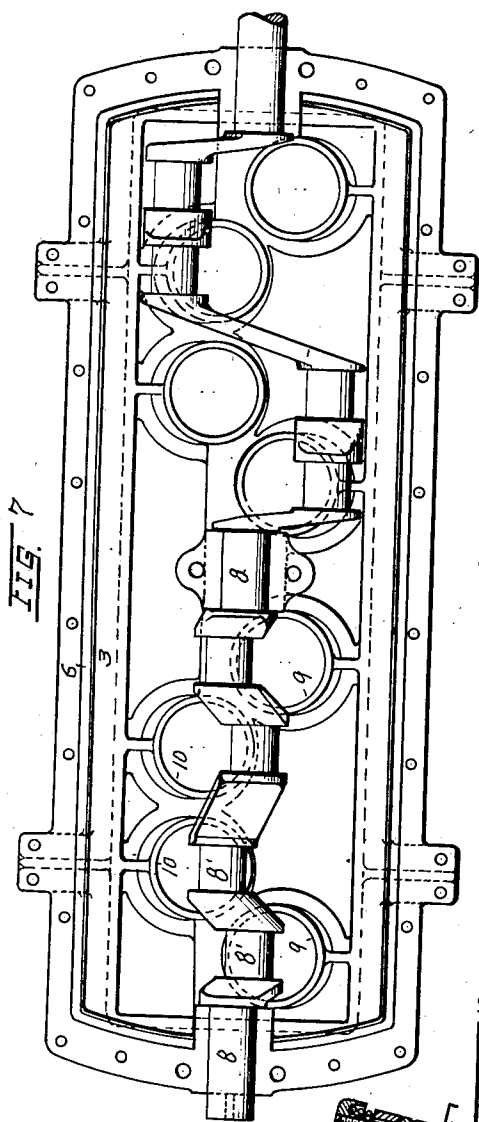
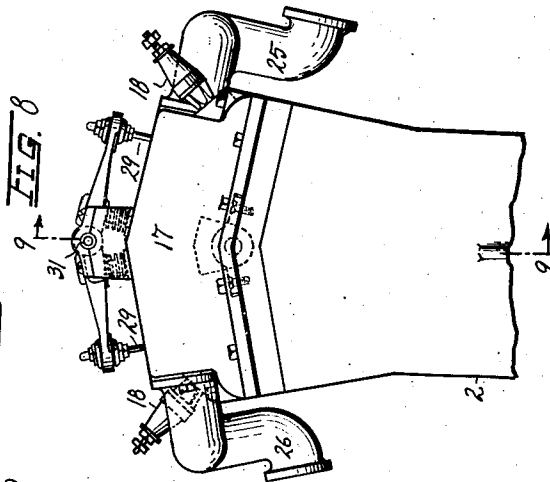
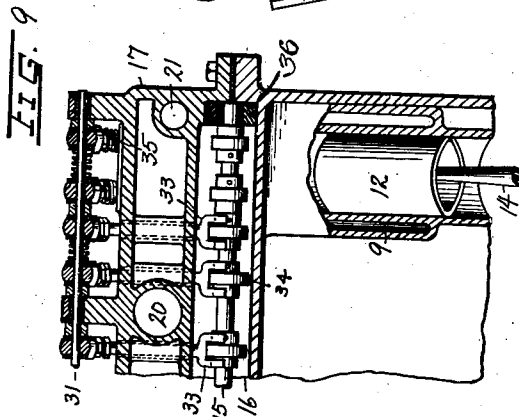
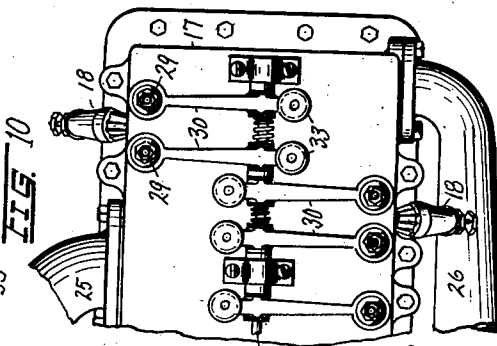
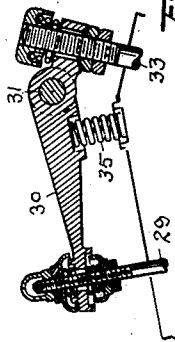


FIG. 11.



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Patented Mar. 31, 1925.

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UNITED STATES PATENT OFFICE.

ERNEST L. WRENTMORE, OF WARREN, OHIO, (MRS.) MAUD V. WRENTMORE, ADMINISTRATRIX OF SAID ERNEST L. WRENTMORE, DECEASED.

INTERNAL-COMBUSTION ENGINE.

Application filed March 26, 1919. Serial No. 285,197.

To all whom it may concern:

Be it known that I, ERNEST L. WRENTMORE, citizen of the United States, residing at Warren, in the county of Trumbull and State of Ohio, have invented certain new and useful Improvements in an Internal-Combustion Engine, of which the following is a specification.

My invention relates to improvements in internal combustion engines, and the object of the invention is to provide a multiple cylinder engine in which pairs of cylinders are staggered and slightly inclined relatively to each other and the cranks for each pair of cylinders have the same angular divergence relatively to the crank axis as the cylinders, and in which two pairs of cylinders are grouped in oblique relation to each other and the main crank axis. This aggroupment of cylinders involves other features of novelty and utility which in general consist in the detailed body construction of the engine and in the valves and valve-operating mechanism, all as hereinafter shown and described and more particularly pointed out in the claims.

In the drawings forming part of this application, Fig. 1 is a vertical section transversely of the engine on line 1—1, Fig. 2, showing the first pair of pistons at their extreme outward position and with their respective connecting rod pivots on a straight line with the main crank-axis. Fig. 2 is a vertical section longitudinally through the engine on line 2—2, Fig. 1, showing the relative working positions of the pistons in full lines in the cylinders in section, and in dotted lines in the cylinders located on the far side of the crank shaft axis. Fig. 3 is a bottom view of the removable head for the engine, the head being inverted to show the valves and the inner forked ends of the push rods which are engaged by the cams. Fig. 4 is a top plan view of the main body of the engine as it appears with the head removed and showing the central channel and cam shaft in the channel. Fig. 5 is a horizontal section of the head on line 5—5, Fig. 2, showing the intake and exhaust ducts and their branches for the eight cylinders. Fig. 6 is a horizontal section of the main body of the engine without the working parts on line 6—6, Fig. 2, showing the staggered arrangement of the cylinders, cylinder to cylinder,

and the zig-zag arrangement of the cylinders, pair to pair, and the grouping of the cylinders, four to each group. Fig. 7 is a bottom view of the main body of the engine as it appears inverted without its working parts except the crank shaft, which is shown opposite the cylinder openings to illustrate the shape of the crank shaft and the aggroupment of cylinders whereby one or more of the cylinder ends may be uncovered and the pistons freely withdrawn without interference with the crank shaft. Fig. 8 is an end view of the upper part of the engine, and Fig. 9 is a vertical section on the center line 9—9, Fig. 8, showing the cam shaft and push rod construction. Fig. 10 is a top plan view of one end portion of the engine, and Fig. 11 is a sectional view of one of the rock-arms for actuating the engine valves.

As shown, the main body of the engine comprises eight cylinders cast en bloc with a depending skirting 2 which is rounded or extended outwardly at its lower end to provide the upper half 3 of a crank casing. The lower half of the crank casing is a separate removable part in the form of a circular oil pan 4 having a beveled seat 5 for a beveled lip 6 at the inner edge of the upper half 3 of the casing, whereby a fluid-tight joint may be obtained with a minimum number of bolts or screws 7, see Fig. 1.

In an eight cylinder engine constructed according to my invention, the main body of the engine is divided transversely into two main groups of cylinders arranged at opposite ends of the body and comprising four cylinders to a group. Each group of four cylinders is subdivided into two pairs of cylinders, and the two cylinders comprising each pair are adjacently located but on opposite sides of a crank-shaft 8 common to all the cylinders. All the cylinders 9 on one side of the crank shaft are inclined reversely to the cylinders 10 on the opposite side and the angle of inclination to the perpendicular center line of the engine is relatively slight. Preferably, the cylinders diverge at an angle of about twenty-two and one-half degrees, and the cranks or wrist pins for each pair of diverging cylinders are also spaced apart the same angular degree, from center to center, as the cylinders, which in the present showing is also twenty-two and one-half degrees. In other words, the paired cylinders 9 and 10,

and their complementary set of cranks or wrist pins to which their pistons 12 are connected by rods 14, diverge or are spaced apart in the same angular degree so that when both pistons are at the extreme end of their strokes the respective connecting rods are each on a straight line with the main crank axis where a straight line drawn through the axis of each cylinder and piston therein will bisect the center of its crank pin and also the main crank axis as seen in Fig. 1. One result of this arrangement of parts is that the pistons for each pair of cylinders move in unison and without variation in stroke throughout the full cycle of revolution of the crank shaft, and the two pistons will move in the same direction and the same distance from their respective cylinder heads and reverse simultaneously because both their connecting rods are thrown out of line with their respective pistons coincidently and in the same degree.

The reciprocal movements of both pistons being identical and never varying a perfect balance between the two pistons of any pair of pistons is maintained throughout each revolution of the crank-shaft, and as a consequence the strain on the double wrist pin is also practically uniform and without a torsional effect as would be imposed by two pistons reversing and moving in opposite directions.

The angle of divergence of the wrist pins and cylinders being relatively small and the stroke of the pistons relatively long the cylinders 9 and 10 comprising each pair are not set directly opposite each other but are offset longitudinally of the crank-shaft and lie in overlapping relations, and the axial centers of the cylinders are just far enough apart longitudinally of the crank shaft to permit a straight connecting rod 14 to be used for each piston with the rods of each pair of such related cylinders in relatively close proximity and disposed between two long crank arms on the crank-shaft.

The small angle of divergence and offset relation of the paired cylinders also narrows the engine materially at its upper end with very little side overhang, which makes the structure compact and stable, and the respective head ends of each pair of cylinders are brought relatively close together, adapting a single cam shaft 15 to be employed and confined within a relatively small cam chamber 16 extending longitudinally midway of the diverging cylinders at their parting line with the removable head 17. Furthermore, the engine cylinders being only slightly inclined to the perpendicular, a more uniform distribution of oil is obtained from the oil splashed from the crank casing than where the angle of divergence of the cylinders is greater and tends to drain the

major part of the oil back into the casing from only one side—the bottom inclined sides of the cylinders. The slight divergence of the wrist pins and paired cylinders and their offset relation also make it possible to remove the pistons from the lower open ends of the cylinders when their connecting rods are disconnected from the cranks but without removing the crank-shaft from its bearings. That is, the crank shaft may be turned in its bearings and the wrist pins and crank arms placed opposite the lower end of any cylinder so that ample clearance is obtained to withdraw the piston after its rod has been disconnected from the crank, and Fig. 7 shows a bottom view of the engine with the crank case open and the crank-shaft in such clearance relation with the first and third cylinders from the right end thereof. The remaining cylinders are also adapted to be uncovered singly or in pairs by turning the crank-shaft and placing the wrist-pins and inclined crank-arms in similar clearing relation, thus permitting any single piston or all of them to be removed without removing the crank-shaft.

By inclining and offsetting a pair of cylinders as described, successive pairs of such cylinders may be used in angular relation to build up a motor consisting of four, or any multiple of four cylinders, and the cylinders are preferably segregated in groups of four with each pair of cylinders arranged obliquely to the crank axis and angularly-related in zig-zag fashion to the next or succeeding pair, substantially as shown in Fig. 6.

In each group of four cylinders, the pistons in one pair of cylinders balance the pistons in the next or succeeding pair of cylinders, and to that end the wrist or crank pins 8' for one pair of pistons are set one-hundred and eighty degrees apart from the wrist or crank pins for the next pair. Thus in each revolution of the crank shaft one pair of pistons travel together in unison in one direction, while the adjoining pair travel in unison in the opposite direction. In an eight-cylinder engine, where two groups of four cylinders each are used, the second group is arranged in the same way as the first group, but the cranks for the second-group are quartered or set at an angle of ninety degrees in respect to the cranks of the first group, thereby permitting a firing operation at each quarter revolution of the crank shaft; and firing may occur successively, first in one cylinder in one group and then on the opposite side of the crank shaft in a cylinder of the next-group. The spark-plugs 18 for firing purposes are adapted to be screwed at an angle into suitable bosses at each side of the head 17 opposite a compression space 19 for each cylinder, and by projecting these plugs at an

angle to and beyond the sides of the head they may be easily inserted or removed and the connections conveniently made and inspected from the sides of a car.

5 The staggered or zig-zag arrangement of cylinders affords ample room for relatively large ducts 20—21 transversely within the cast cylinder head 17 in the angle between the successive pairs of cylinders, and branch
10 channels 22 connect each duct with separate valve ports which open into the compression spaces 19 of the cylinders. Each cylinder is thus provided with an inlet and exhaust port, 23 and 24, respectively which com-
15 municates with the separate ducts 20 and 21 respectively, and the inlet ducts 20 have their intake ends on one side of the engine for joint connection with a single manifold 25, and the exhaust ducts 21 have outlets on
20 the opposite side of the engine for a similar connection with a manifold 26. This gives an equal distribution of fuel to each cylinder and a common exhaust for all the cylinders, and the branch channels are also
25 curved at their point of union with the transverse ducts to more effectively distribute the fuel and to sweep out the exhaust freely.

The inlet and exhaust valves 27 and 28, respectively, for each cylinder have seats in the bottom of the removable head, and the stem 29 of each valve extends parallel with the inclined axis of the cylinder and projects through the top of the head. The
30 outer end of each valve stem extends through an opening in the outer end of the long arm 30 of a rock member which is sleeved on a shaft 31 extending longitudinally at the center and top of the head. Coiled springs
35 seated in cupped washers bear against the top and bottom of said arm and separate adjusting and lock nuts on the stem regulate the tension of the springs and establish a working connection which is sufficiently flexible to render the operation of the parts
40 noiseless. Each rock member also embodies a perforated short arm on the opposite side of the shaft 31, through which the upper end of a push rod 33 projects, and this rod extends through the head at the same inclination to the perpendicular as the cylinder lying beneath the short arm. The
45 lower end of the push rod is adapted to straddle and engage a cam 34 on cam shaft 15, and a noiseless working connection between the upper end of said push rod and the short arm of the rock member is obtained by means of an adjustable cap nut and a coiled spring bearing upon the upper
50 side of said arm, together with a rounded nut locked in working engagement within the rounded socket in the bottom side of said short arm. A quick closing movement of the valve is obtained by placing a coiled
55 spring 35 underneath the long arm at ap-

proximately the same distance from the shaft as the push rod is positioned from the shaft, and this position of the spring 35 is of further advantage in maintaining a constant and practically noiseless working en-
70 gagement of the forked extremity of the push rod with the cam. The intake and exhaust valves are operated alike but at different intervals necessarily, and the rock arms are arranged in pairs for each cylinder
75 and extend transversely of the head, with the long arms either on one side or the other of the rock-shaft 31, dependent upon the position of the cylinder.

The cam-shaft 15 is held in removable
80 bearings 36 bolted to the top of the engine body and adapted to be covered by the removable head 17, and one end of the cam shaft extends beyond one end of the engine body and is driven by a train of gears 37
85 or equivalent means deriving a rotative movement from the crank shaft, see Fig. 2. The body and head of the engine is also suitably cored to provide water cooling spaces and to reduce the weight, and the rock
90 arms above the head may be covered by a light-weight cover or cap if desired, leaving only the spark-plugs exposed for convenient removal and replacement and connection and disconnection of the electric
95 conductors.

What I claim is:

1. A plural cylinder engine of the V-type having its cylinders arranged in groups of four, of which the first and fourth cylinders
100 in each group are in one row and the second and third cylinders of said group are in the other row, combined with a crank shaft having its crank pins arranged in groups of two, one associated with a cylinder in one
105 row and one with a cylinder in the other row, said crank pins being circumferentially offset and disposed in diametrical planes which lie at an angle to each other which is the same as the angle between the two rows
110 of cylinders.

2. A plural cylinder engine of the V-type having its cylinders arranged in groups of four, of which the first and fourth cylinders
115 in each group are in one row and the second and third cylinders of said group are in the other row, combined with a crank shaft having its crank pins arranged in pairs which are respectively associated with a pair of cylinders one in each row, the two
120 crank pins of each pair being circumferentially offset with respect to each other and being so placed that when the axis of one crank pin lies in the same plane as the axis of the associated cylinder the axis of the
125 other crank pin of the pair will lie in the same plane as the axis of the cylinder with which it is associated.

3. A plural cylinder engine of the V-type having its cylinders arranged in groups of
130

four, of which the first and fourth cylinders in each group are in one row and the second and third cylinders of said group are in the other row, the cylinders of one row being arranged with their lower ends overlapping the lower ends of the cylinders of the other row, a single head plate for all of the cylinders said head plate containing an inlet passage for each group of four cylinders which inlet passage extends transversely between the first and fourth cylinders of the associated group and has its inlet through that side of the head plate on which the said first and fourth cylinders lie and which is connected with all of the cylinders of the group of four.

4. A plural cylinder engine of the V-type having its cylinders arranged in groups of four of which the first and fourth cylinders in each group are in one row and the second and third cylinders of said group are in the other row, the cylinders of one row being arranged with their lower ends overlapping the lower ends of the cylinders of the other row, a single head plate for all of the cylinders said head plate containing an inlet passage for each group of four cylinders which inlet passage extends transversely between the first and fourth cylinders of the associated group and has its inlet through that side of the head plate on which the said first and fourth cylinders lie and which is connected with all of the cylinders of the group of four, and said head plate having exhaust passages which discharge through the opposite side of the head plate, one of said exhaust passages extending transversely between the two adjacent groups of four cylinders and being connected with two adjacent cylinders of each group.

5. A plural cylinder engine of the V-type having its cylinders arranged in groups of four of which the first and fourth cylinders in each group are in one row and the second and third cylinders of said group are in the other row, the cylinders of one row being arranged with their lower ends overlapping the lower ends of the cylinders of the other row, a single head plate for all of the cylinders said head plate containing an inlet passage for each group of four cylinders which inlet passage extends transversely between the first and fourth cylinders of the associated group and has its inlet through that side of the head plate on which the said first and fourth cylinders lie and which is connected with all of the

cylinders of the group of four, and said head plate having exhaust passages which discharge through the opposite side of the head plate one of said exhaust passages extending transversely between the two adjacent groups of four cylinders and being connected with two adjacent cylinders of each group, and the other exhaust passages being extended transversely between the ends of the head plate and the adjacent end cylinders and being respectively connected with the adjacent end cylinders.

6. In an 8-cylinder internal combustion engine in which the cylinders are arranged in two oppositely inclined rows and are associated in such wise that each cylinder in each row is associated with the adjacent cylinder in the opposite row to form a balanced pair, a single unitary head plate for all of the cylinders spanning the V-space between the two rows, said head plate containing two transversely extended gas inlet passages which open through the same side of the head plate and which are respectively disposed between the two end pairs of cylinders and the two next adjacent pairs of cylinders, each of said gas passages having four branches which respectively communicate with the four cylinders of the two pairs of cylinders between which it is located, and said head plate also containing three transversely extended exhaust gas passages all opening through the opposite side of the head plate, two of said exhaust gas passages being respectively located beyond the two end pairs of cylinders and each having two branches which respectively communicate with the adjacent end pair of cylinders, the third exhaust passage being located between the two middle pairs of cylinders and having four branches which respectively communicate with the four cylinders of the two pairs between which it lies.

7. A plural cylinder engine of the V-type having two rows of cylinders spaced angularly with respect to each other, a crank shaft, pistons in said cylinders and connections from the crank shaft to the pistons for causing the pistons to be operated in pairs, one piston of each pair being in one row of cylinders and the other piston of the pair being in the other row, the two pistons of each pair moving at all times in unison.

Signed at Warren, in the county of Trumbull, and State of Ohio, this 21 day of March, 1919.

ERNEST L. WRENTMORE.