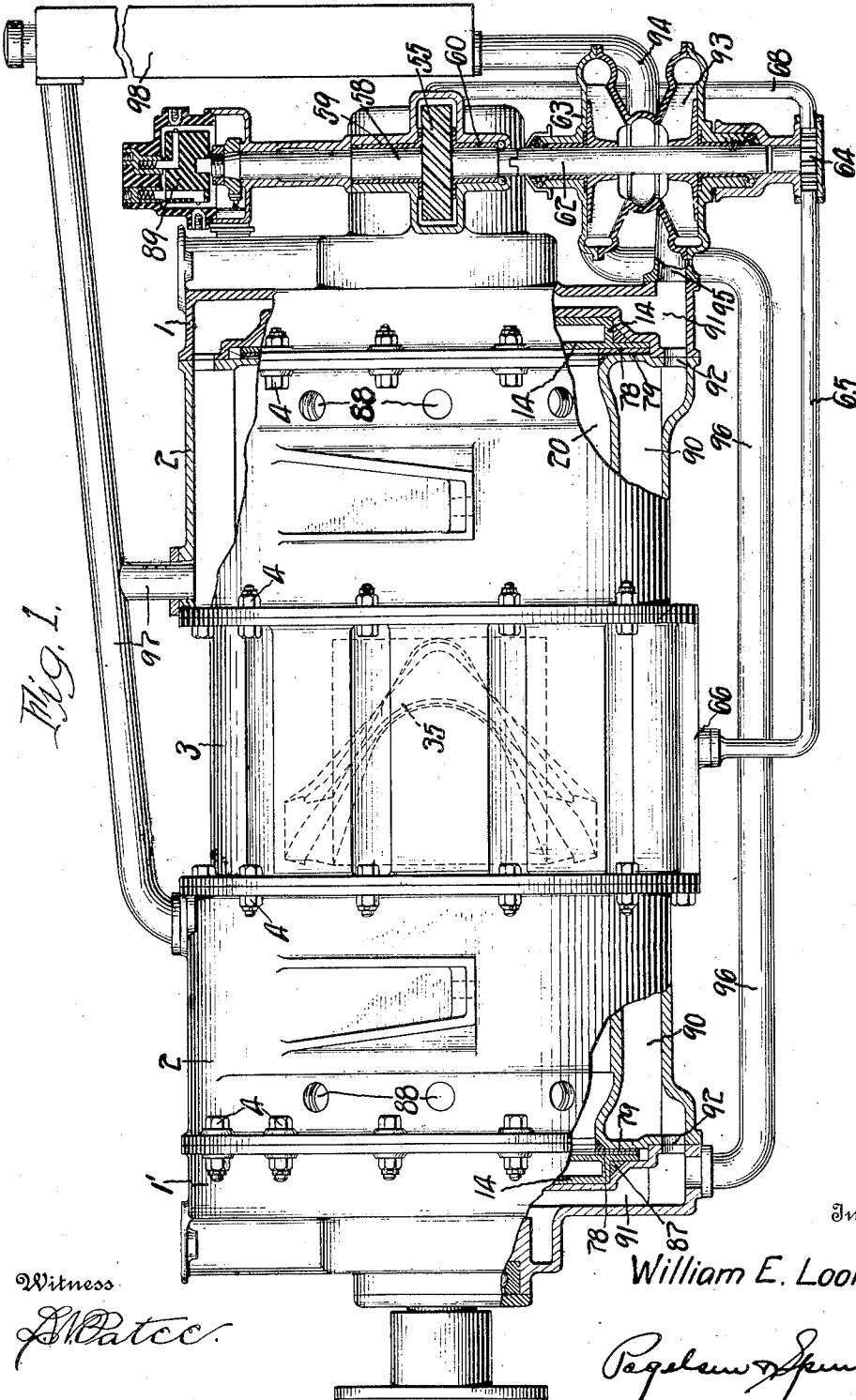


W. E. LOONEY.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED AUG. 10, 1917.

1,345,940.

Patented July 6, 1920.

5 SHEETS—SHEET 1.

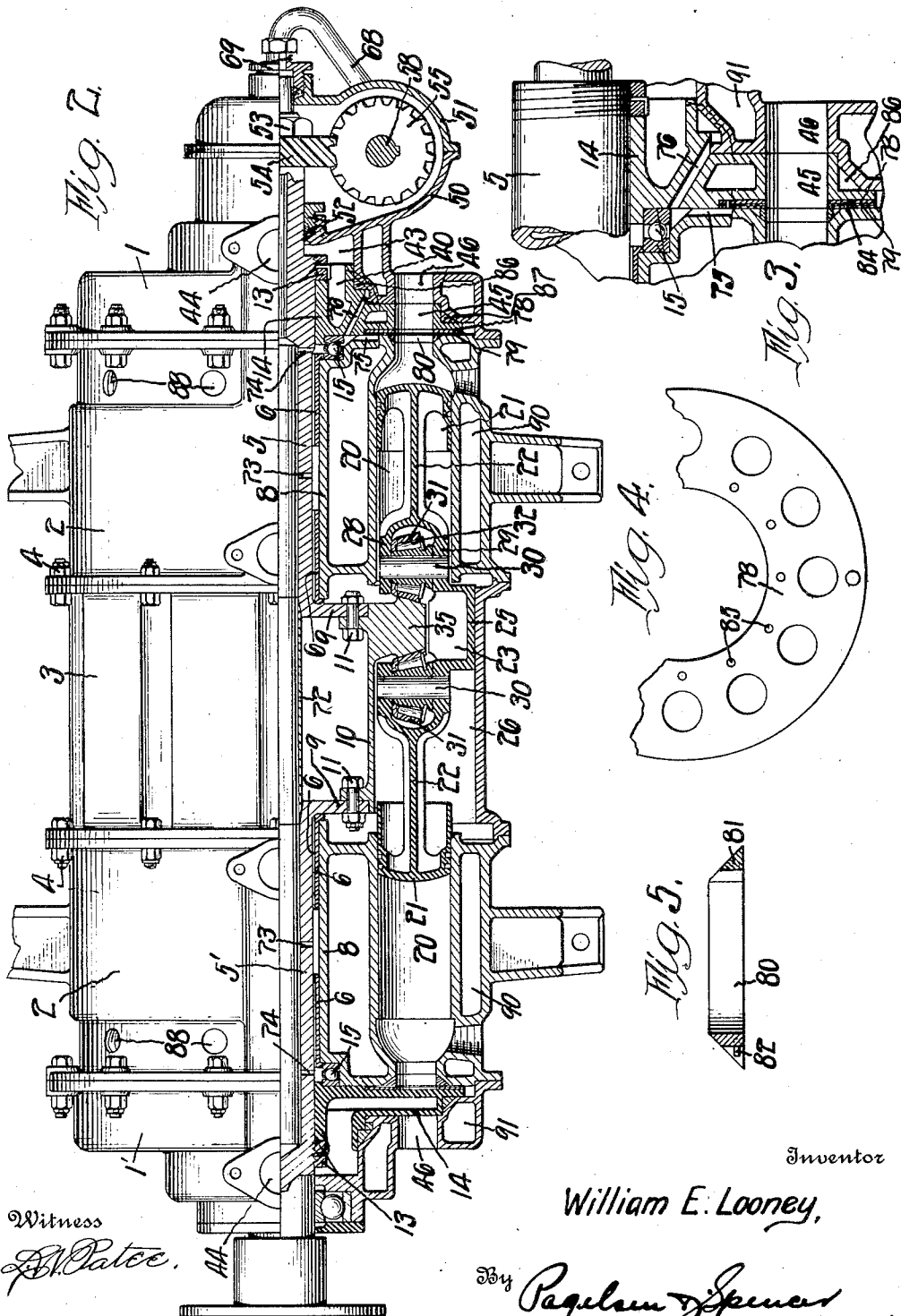


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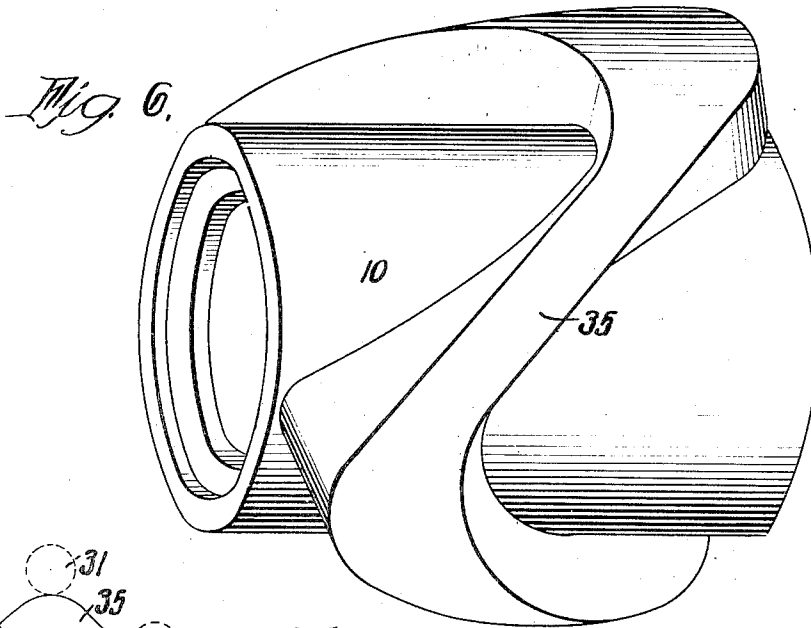
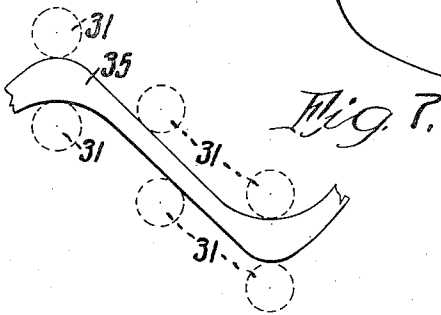
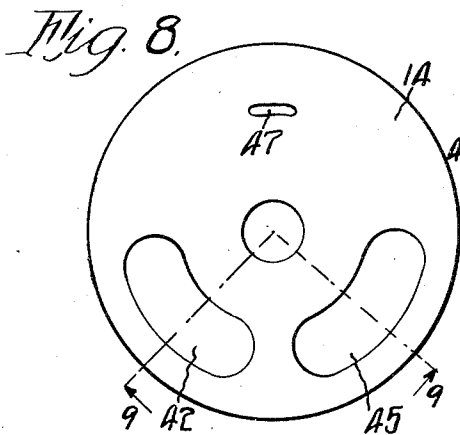
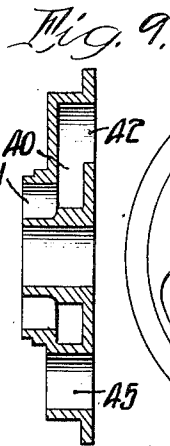
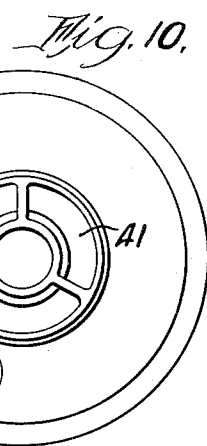


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5 SHEETS—SHEET 3.



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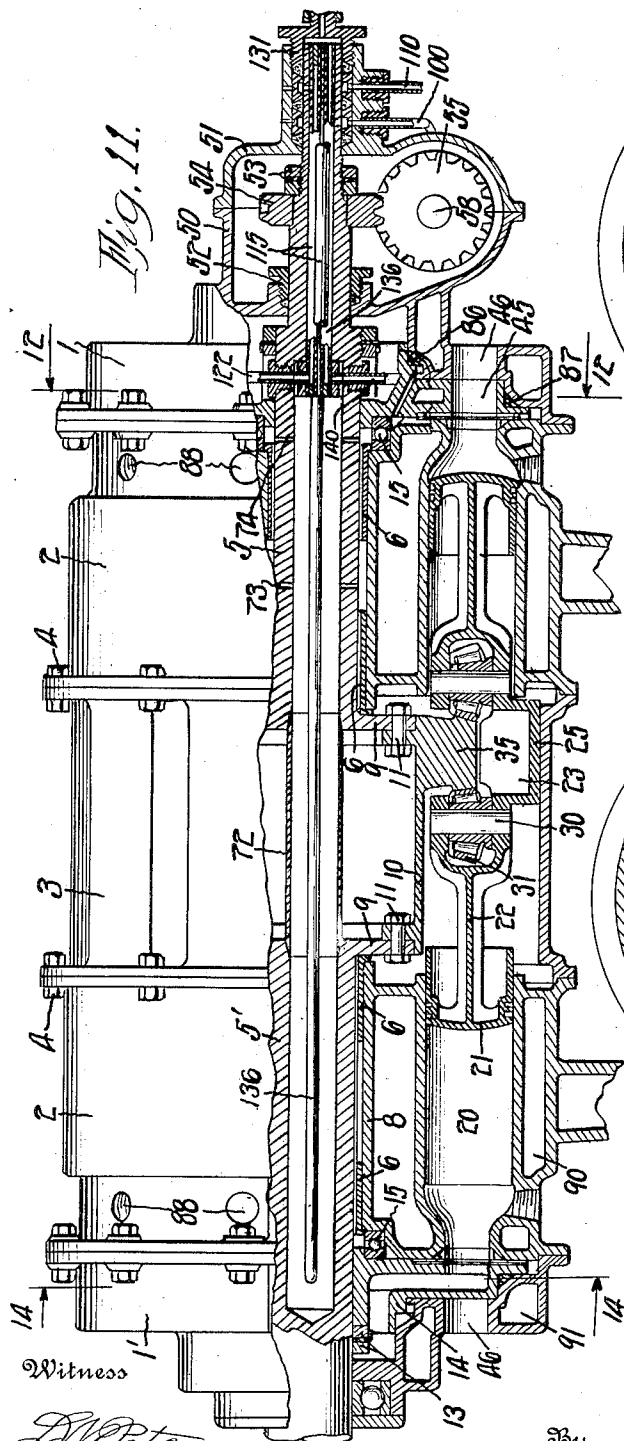


Fig. 11.

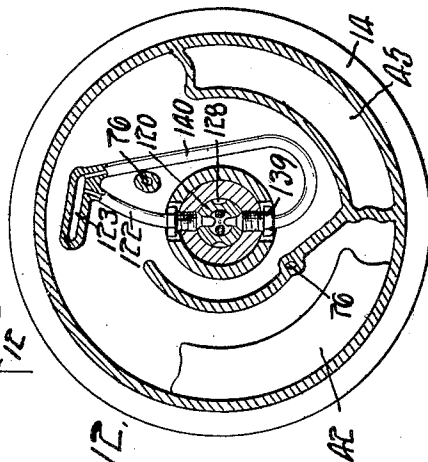


Fig. 12.

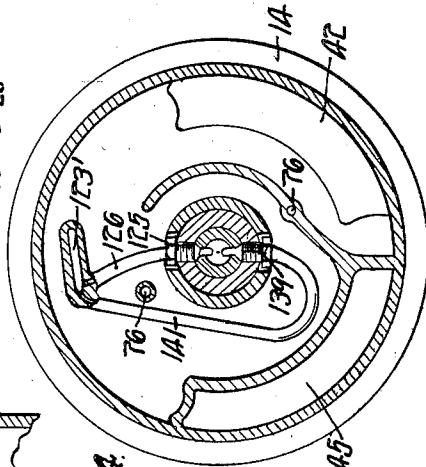


Fig. 13.

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D. V. Pater.

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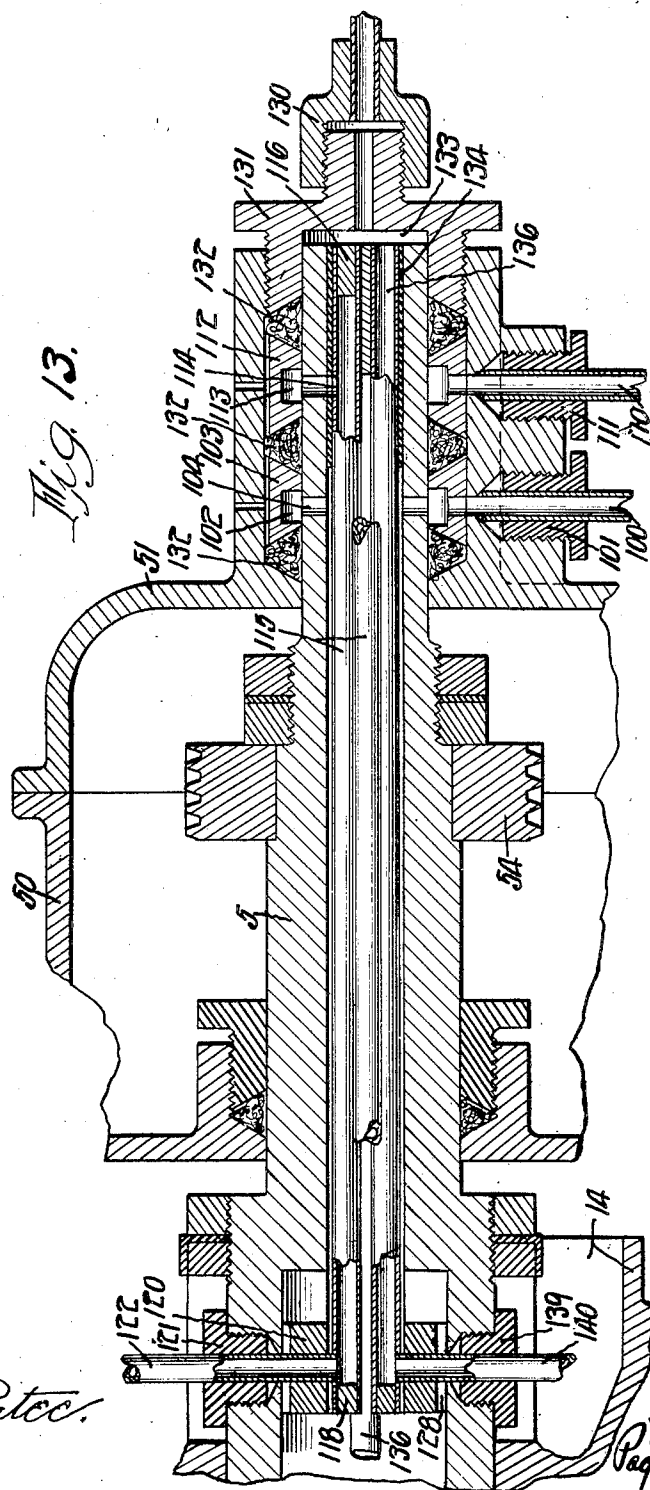
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5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

WILLIAM E. LOONEY, OF DETROIT, MICHIGAN.

INTERNAL-COMBUSTION ENGINE.

1,345,940.

Specification of Letters Patent.

Patented July 6, 1920.

Application filed August 10, 1917. Serial No. 185,432.

To all whom it may concern:

Be it known that I, WILLIAM E. LOONEY, a citizen of the United States and residing at Detroit, in the county of Wayne and State of Michigan, have invented a new and Improved Internal-Combustion Engine, of which the following is a specification.

This invention relates to an internal combustion engine of the four cycle type wherein the force of the explosion is transmitted through a continuous cam from a series of oppositely arranged pairs of reciprocating pistons to an engine shaft, and among its important features are means for sealing the joint between the rotatable valve and the faces of fixed cylinders; a hollow engine shaft and means whereby the valves and the shaft bearings may be lubricated by oil which is pumped through the shaft; means for supplying fuel and air to the cylinders through the shaft to form a combustible mixture, and means for supplying air alone to the cylinders for starting purposes. The invention further consists in the details of construction shown, described and claimed.

In the drawings, Figure 1 is a side view, parts being broken away, showing one embodiment of the invention. Fig. 2 is a half-plan view, half central horizontal section corresponding thereto. Fig. 3 is an enlarged fragmentary section showing the valve sealing means more clearly. Fig. 4 is a fragmentary plan view of one of the shims. Fig. 5 is a section of one of the expansion rings which press the shims over against the valves. Fig. 6 is a perspective view of the cam member and Fig. 7 is a fragmentary diagrammatic developed plan view showing the outline of the cam and the relation of its faces to the rollers of the pistons. Fig. 8 is an elevation of one of the valves. Fig. 9 is a section on the line 9—9 of Fig. 8. Fig. 10 is an elevation looking from the left in Fig. 9. Fig. 11 is a view similar to Fig. 2 showing a modification. Fig. 12 is a section of the valve on the line 12—12 of Fig. 11. Fig. 13 is an enlarged longitudinal section, corresponding to the right hand end of Fig. 11, showing more clearly the oil, air and fuel passages. Fig. 14 is a section on the line 14—14 of Fig. 11 showing the fuel and air passages in the valve.

The fixed engine casing comprises the

heads 1 and 1', the cylinder members 2, and the cross head guide member 3, all suitably connected by bolts 4. Extending longitudinally through the casing is the hollow engine shaft which is formed of two similar sections 5 and 5' that turn in bearings 6 carried by the inner wall 8 of the corresponding cylinder member 2 and have their inner ends flanged at 9 and connected to a cam member 10 by the bolts 11. Thus the shaft sections and the cam member turn together as a single shaft. Longitudinal thrust to which the shaft is subjected is transmitted through the nuts 13, the valves 14 and thrust bearings 15 to the corresponding cylinder member.

Each of the cylinder sections includes a plurality of cylinders 20, the number of which may vary, and the cylinders of one section are alined with those of the other. Reciprocating in the cylinders are the pistons 21 that are joined by piston rods 22 to the body portions of cross heads 23, each of which includes a guide element 25 that slides in a corresponding guide 26 formed in the member 3. The cross heads also include portions 28—29 (parallel to the body portion) that are perforated to receive the pins 30 upon which the conical rollers 31 are carried, rollers 32 being interposed.

The cam member has formed integrally therewith an outwardly tapering cam 35 that extends from end to end thereof once each 90° of the circumference; this cam may be said to be of a continuous double V or wave configuration, the main portions lying at angles of substantially 45° to the axis of the cam member. The construction will be better understood from a consideration of Figs. 6 and 7. The dashed lines shown in Fig. 7 indicate several positions of the different sets of the rollers in their reciprocatory movement relative to the cam, it being remembered that the cam moves through between the rollers and that the latter are incapable of movement in a direction at right angles to the line joining the centers of each pair. The distance between the faces of the cam at the peaks, that is, at the turning points of the V bends or waves, is equal to the distance between the centers of the rollers minus the sum of the radii thereof; and at other points this distance is such that the rollers are always in contact with the respective faces. Since

the rollers are of conical form and since the cam surfaces are correspondingly inclined, it follows that binding is entirely avoided; at the same time the cross head may be so
 5 proportioned as to cause the rollers to tightly embrace these faces, even to the extent of establishing a slight inward thrust of the portion 25 against the guide, whereby knocking of the rollers against the cam,
 10 such as might otherwise take place, is prevented.

The valves are best shown in Figs. 8, 9 and 10, from which it will be seen that each is hollow and forms two passages, one the
 15 intake 40 having an inlet opening 41 and an outlet opening 42. The first registers constantly with the chamber 43 to which fuel mixture is delivered from a suitable carbureter (not shown) through the pas-
 20 sage 44, and the second or outlet opening sweeps successively across the heads of the cylinder to feed the fuel mixture thereto. In like manner the exhaust passage 45 suc-
 25 cessively connects the cylinders with the corresponding exhaust passage 46 in the head to allow the escape of the burned gases. As indicated in Fig. 8, the faces of the valves nearest the cylinders may be
 30 provided with a passage or pocket 47 of length sufficient to overlap between any two of the cylinders, thus bringing the flame from a rearward cylinder into communica-
 35 tion with the combustible mixture in the cylinder next ahead.

Lubricating features.—The head 1 has formed integrally therewith one section 50 of a gear casing which also comprises a second section 51, and a gland 52 prevents the escape of fuel mixture from the cham-
 40 ber 43 to the interior of the gear casing. The shaft section 5 is hollow throughout its length and its end portion is reduced and threaded within the gear casing to receive a nut 53 whereby a gear 54 is secured
 45 to rotate therewith. Meshing with the gear 54 is a gear 55 which is fixed to a vertical shaft 58 carried in bearings 59—60 in the gear casing. A continuation 62 of the shaft 58 passes through a casing 63 of a pump
 50 of the water circulating system (more fully described hereinafter) and drives a gear pump 64 which sucks oil through the pipe 65 from a sump 66 at the lower side of the guide member 3. The delivery pipe 68 of
 55 the pump leads to a gland 69, Fig. 2, (in the end of the gear casing 51) in which the extreme outer end of the shaft section 5 turns. Thus the oil passes into the hollow shaft without escaping into the gear cham-
 60 ber. The two shaft sections 5, 5' are preferably joined between the flanges 9 by a tube 72 so that the oil does not escape into the larger surrounding chamber but is conducted directly from the section 5 to the
 65 section 5'. Each of the shaft sections is

provided with suitable holes 73, 74 through which the oil passes outwardly to the bearings 6 and 15 and through the latter and the grooves 75 and passages 76 to the faces and the end portions of the valves. The
 70 valve faces are cut out to receive the annular shims 78 and 79 (preferably of greater and lesser thickness, respectively), the latter being nearest the cylinders, and the entrance to each of the cylinders is cut out
 75 to receive resilient packing rings of triangular cross-section which tend to expand and crowd themselves over slightly against the shims to thus maintain a tight seal. These last mentioned rings may be formed
 80 of an inner ring 80 and an outer ring 81 (Fig. 5), the latter of which may be split to receive a pin 82 whereby they are prevented from rotating in respect to one another. The former may also be split to al-
 85 low expansion. The construction may of course be varied widely. As the shims are prevented from rotating in respect to the cylinders by means of pins 84 or otherwise (Fig. 3), they are pierced at 85 (Fig. 4) to
 90 allow oil to pass from the grooves 75 to the face of the valves.

The joint between the valve and the corresponding head may be sealed, outside of the ends of the grooves 76, by an expansion
 95 ring 86 similar to the ring 80—81, and a ring 87 may likewise be employed near the outer edge of the valve.

Each of the cylinders is tapped at 88 to receive suitable spark plugs (not shown) 100 to which current may be supplied by a timing device 89 (Fig. 1) driven by the shaft 58. As the details of this device form no part of the present invention, they will not be specifically described. Any suitable timing
 105 device may be used.

The hollow cylinder members and heads form water chambers 90—91 (connected by passages 92, Fig. 1) to which cooling water may be supplied by a double centrifugal
 110 pump 93 having a single inlet pipe 94 and the outlet pipes 95—96, one leading to each end of the engine. From the jacket the water flows through the pipe 97 to the radiator 98 and back to the inlet pipe 94. 115

Modification, Figs. 11 to 14.—In this instance the shaft 5, 5' receives its lubricating oil through a feed pipe 100 that enters the gear casing laterally through a gland 101 which communicates with a circumfer-
 120 ential groove 102 in the inner surface of a stationary ring 103. From the latter it passes into the shaft through holes 104; its distribution to the bearings is substantially the same as previously described. 125

In like manner air for starting the engine is admitted through a pipe 110, gland 111, stationary ring 112 having a groove 113 and the holes 114 to two pipes 115 (one for each set of cylinders) that extend longi- 130

5 tudinally of the shaft. Both ends of these pipes are plugged as indicated at 116 and 118; and one of them communicates through a hole in a block 120 that fits closely to the bore of the shaft, and a gland 121 and pipe or passage 122 with a chamber or passage 123 in the corresponding valve. Likewise the other pipe 115 leads through a similar gland 125 and pipe or passage 126 to a chamber 123' in the other valve.

10 The block 120 is milled or grooved at 128 to allow free passage of the lubricating oil; the end of the shaft section 5' is closed (Fig. 11).

15 Liquid fuel is supplied to the valve chambers 123 and 123' in the same general way, coming in measured quantities through the fittings 130 and 131 (the latter of which is threaded into the section 51 of the gear casing and serves to compress the rings 103—112 and the packing 132) to a chamber 133 which is separated from the chamber for the lubricating oil in any suitable way, say by the plug 134. From the chamber 133 the fuel passes through the pipe 136, the gland 139 and the pipe or passage 140 to the chamber 123; it also passes through the other pipe 136 and the passage 141 to the chamber 123'.

30 Both the chambers or passages 123 and 123' are so positioned in the valve as to sweep across the ends of the cylinders; consequently when air alone is supplied, the engine is caused to start, and when both air and fuel are supplied, a combustible mixture is formed in each of the chambers, from which it is distributed successively to the proper cylinders, as will be readily understood. These passages likewise serve to transmit flame from the rear cylinder to the cylinder next ahead, as explained with reference to the passage 47.

In accordance with the patent statutes, I have shown and described what I regard as the most desirable embodiments of my invention. I am aware, however, that many changes may be made in the actual details of construction and do not wish, therefore, to be limited except as indicated by the claims.

I claim:—

1. An internal combustion engine comprising a rotatable engine shaft, a wave-like cam rigid and co-axial therewith, a plurality of cylinders arranged parallel with the engine shaft, said cylinders forming combustion chambers, pistons for the cylinders, rollers carried by the piston and engaging the cam, a head common to the cylinders, a valve secured to the shaft and interposed between the head and the cylinders, and an annular shim fixed to the cylinders and interposed between the latter and the valve.

2. An internal combustion engine com-

prising a rotatable engine shaft, a wave-like cam rigid and co-axial therewith, a plurality of cylinders arranged parallel with the engine shaft, said cylinders forming combustion chambers, pistons for the cylinders, rollers carried by the piston and engaging the cam, a head common to the cylinders, a valve secured to the shaft and interposed between the head and the cylinders, each of the cylinders being provided with an annular wedge ring at its end next to the valve, the parts being so constructed and arranged that the ring presses toward the valve to seal the joint.

3. An internal combustion engine comprising a rotatable engine shaft, a wave-like cam rigid and co-axial therewith, a plurality of cylinders arranged parallel with the engine shaft, said cylinders forming combustion chambers, pistons for the cylinders, rollers carried by the piston and engaging the cam, a head common to the cylinders, a valve secured to the shaft and interposed between the head and the cylinders, and an annular expansion ring interposed between the valve and the head, said ring being so constructed and arranged that it tends to wedge itself longitudinally of the shaft to seal the joint between the valve and the head.

4. An internal combustion engine including a rotatable shaft, a wave-like cam secured thereto and co-axial therewith, cylinders parallel with the shaft, pistons for the cylinders, said pistons being arranged to cause the cam to turn with the shaft, a combined intake and exhaust valve fixed to the shaft, an antifriction thrust bearing interposed between the valve and the cylinders, and means for feeding lubricating oil through the bearing to the valve.

5. An internal combustion engine including a rotatable shaft, a wave-like cam secured thereto and co-axial therewith, cylinders parallel with the shaft, pistons for the cylinders, said pistons being arranged to cause the cam to turn with the shaft, a combined intake and exhaust valve fixed to the shaft, an antifriction thrust bearing interposed between the valve and the cylinders, said shaft being hollow, and means for feeding oil through the hollow shaft to the bearing and the valve.

6. An internal combustion engine comprising an engine shaft, a plurality of cylinders arranged about the shaft in parallel relation thereto, said cylinders having a common head, pistons for the cylinders, means whereby the reciprocation of the pistons causes the shaft to rotate, a combined intake and exhaust valve for the cylinders, said valve being fixed to the shaft and being located between the ends of the cylinders and their common head, and means for feeding lubricant to the face of the valve

nearest the cylinders and through the valve to the face adjacent the common cylinder head.

7. An internal combustion engine comprising a hollow shaft, a plurality of cylinders arranged about the shaft in parallel relation thereto, pistons for the cylinders, means whereby the pistons cause the shaft to turn, a valve fixed to the shaft and arranged to sweep across the ends of the cylinders, and means for conducting air under pressure through the shaft and the valve to start the engine.

8. An internal combustion engine comprising a hollow shaft, a plurality of cylinders arranged about the shaft in parallel relation thereto, pistons for the cylinders, means whereby the pistons cause the shaft to turn, a valve fixed to the shaft and arranged to sweep across the ends of the cylinders, and means for separately conducting fuel and air through the shaft to the valve and there commingling said fuel and air to form a combustible mixture.

9. An internal combustion engine comprising a pair of spaced alined hollow shaft sections, a cam member interposed between the sections and rigidly connected thereto, the wall of said cam member being spaced considerably from the common axis of the shaft sections, a pair of cylinder forming members in which the shaft sections are respectively supported, bearings between the shaft sections and the supports therefor, pistons in the cylinders whereby the cam member and the shaft sections are caused to rotate, and a sleeve extending across between the adjacent ends of the shaft sections to conduct oil from one of the sections to the other to lubricate the bearings.

10. An internal combustion engine comprising a hollow rotatable engine shaft, a plurality of pairs of fixed opposed engine cylinders parallel with the shaft, pistons reciprocating in the cylinders, separate valves for the sets of cylinders, an internally

grooved ring surrounding one end of the shaft, a pipe extending longitudinally in the shaft, said pipe being in communication with the groove and with the interior of one of the valves, whereby a fluid upon which the operation of the engine depends may be admitted to the valve.

11. An internal combustion engine comprising a pair of spaced members each forming a plurality of cylinders and a water chamber surrounding said cylinders, an engine shaft carried by the members and rotatable in respect thereto, said shaft and cylinders being parallel, means for circulating water through the water chambers, said means comprising a shaft arranged at right angles to the engine shaft, and pump means having a single intake and a double outlet the branches of which lead to the corresponding water chamber.

12. An engine comprising a hollow shaft and a plurality of cylinders parallel thereto and spaced around said shaft, a pipe passing through said shaft and adapted to conduct a fluid on which the operation of the engine depends, a ring around said shaft, said shaft and ring constituting two members one of which has a groove circumferentially of the shaft and in communication with said pipe, and fluid conducting means, external to the shaft, leading to said groove.

13. An engine comprising a rotatable shaft and a plurality of angularly spaced cylinders parallel thereto and constrained against rotation in respect to said shaft, there being a passage within said shaft and extending longitudinally thereof through which a fluid on which the operation of the engine depends may pass, means for forming a ring-like passage about said shaft and in communication with said longitudinally extending passage, and means for forming a third passage external to the shaft and also in communication with said ring-like passage.

WILLIAM E. LOONEY.