W. E. LOONEY.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAR. 13, 1916.

1,338,185.

Patented Apr. 27, 1920

4 SHEETS—SHEET 1.

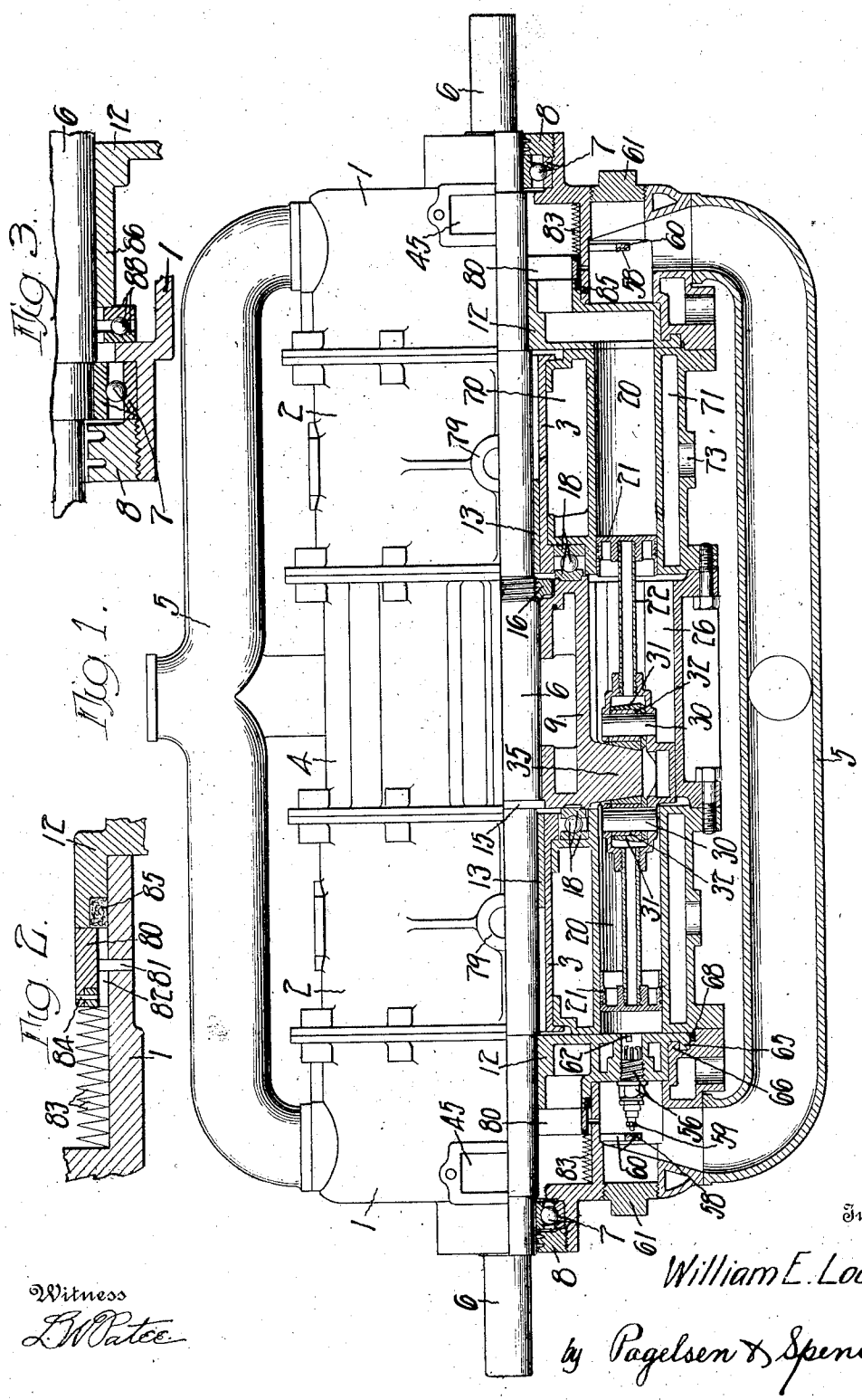


Fig. 1.

Fig. 3.

Fig. 2.

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4 SHEETS—SHEET 2.

Fig 5

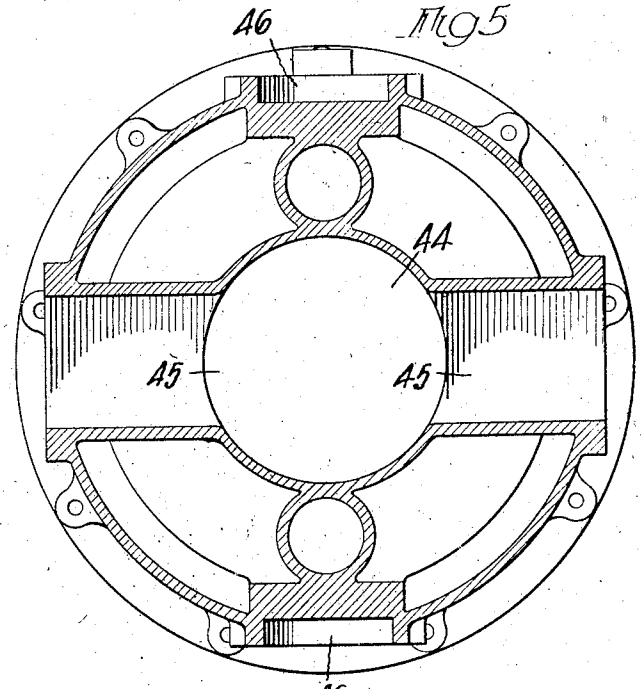


Fig 4

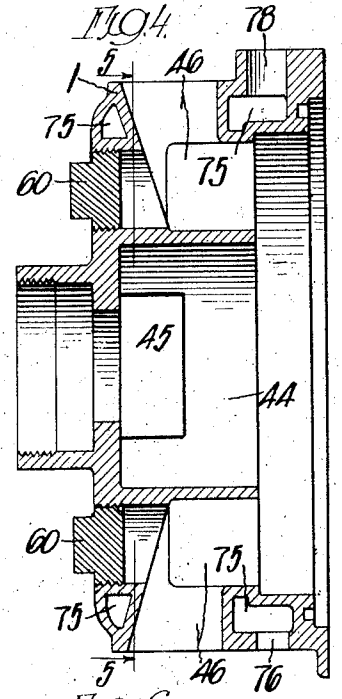


Fig 7

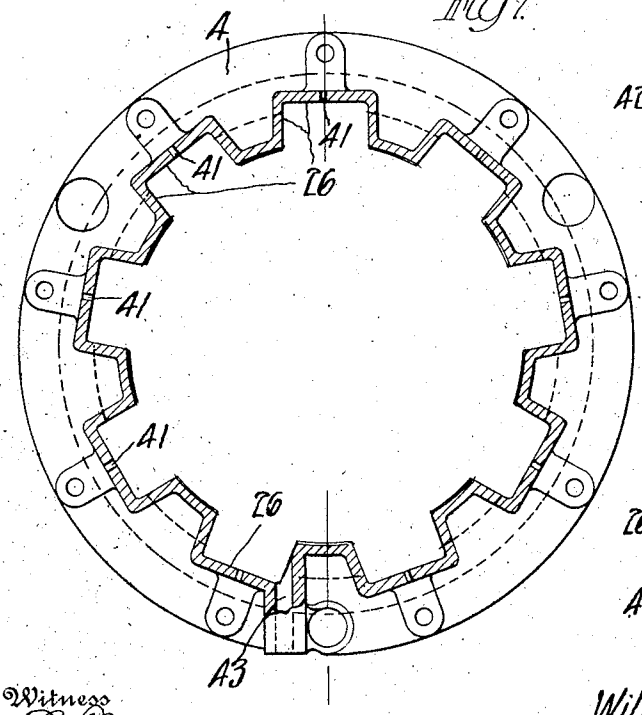
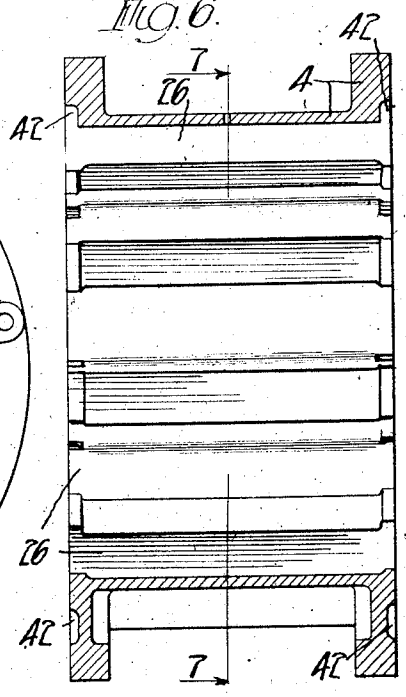


Fig 6



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4 SHEETS—SHEET 3.

Fig. 8.

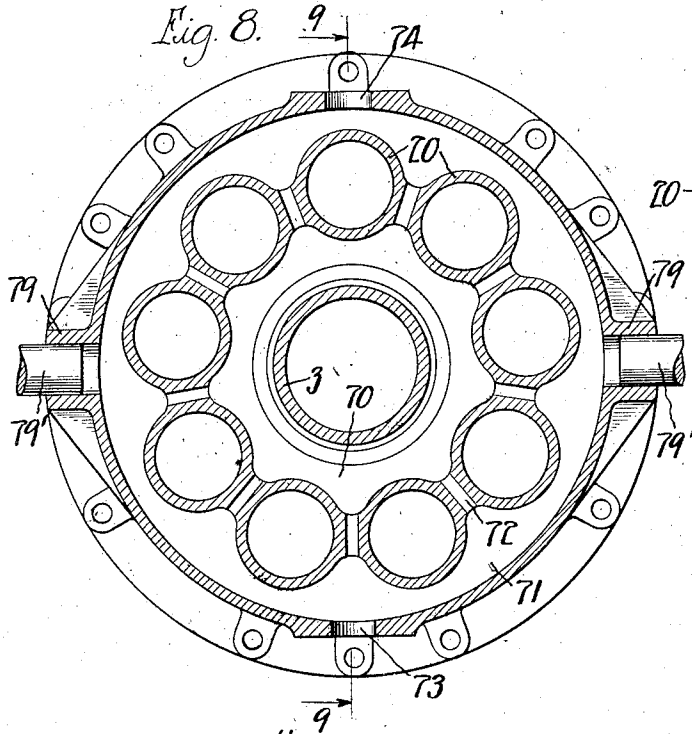
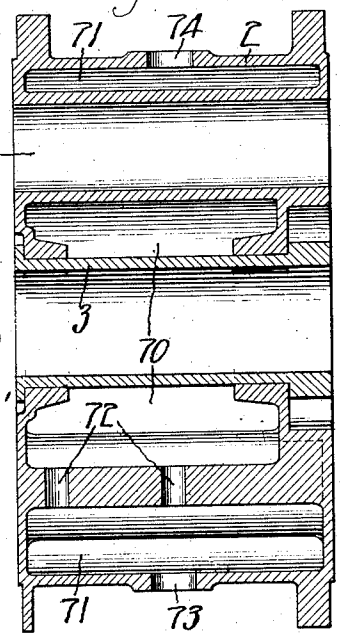


Fig. 9.



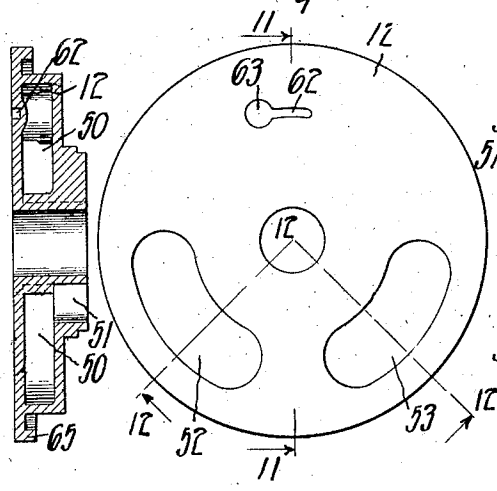


Fig. 11

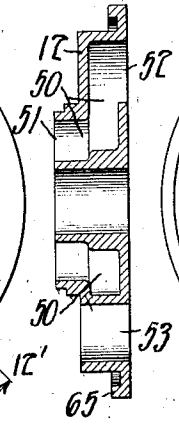


Fig. 10.

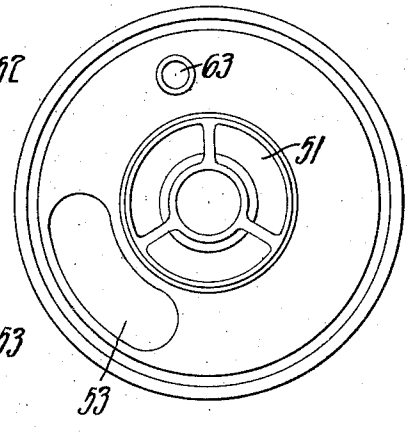


Fig. 12.

Fig. 13.

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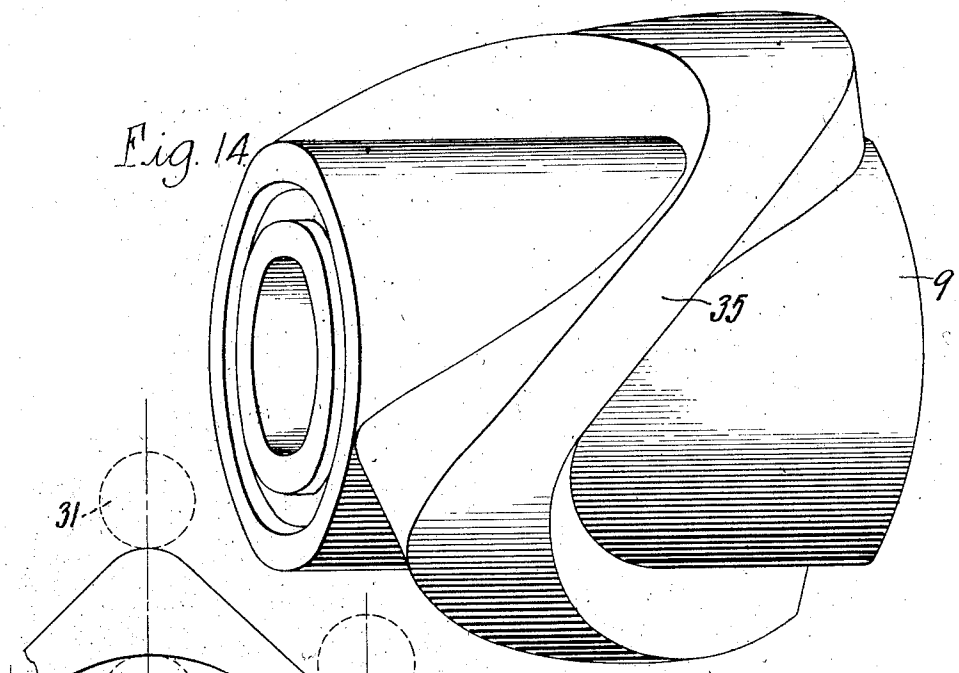
INTERNAL COMBUSTION ENGINE.

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4 SHEETS—SHEET 4

Fig. 14.



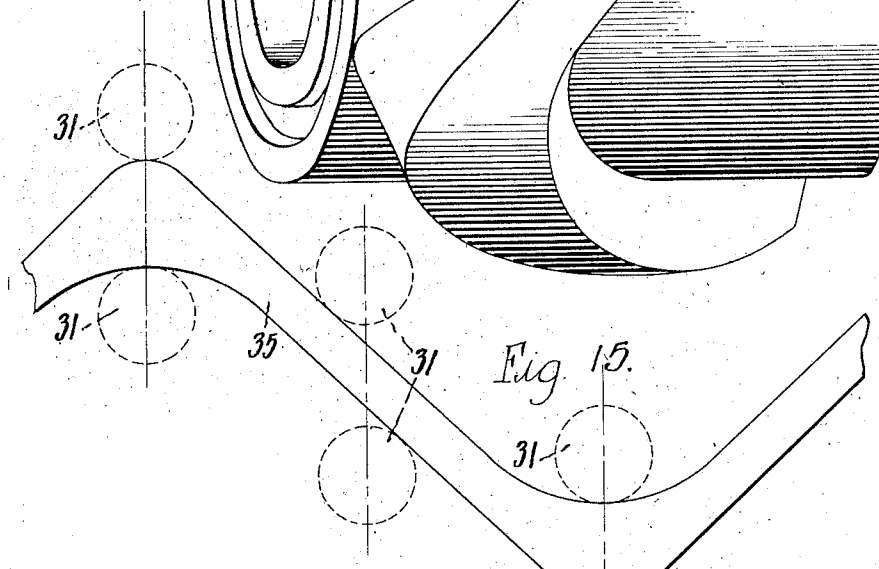


Fig. 15.

Fig. 16.

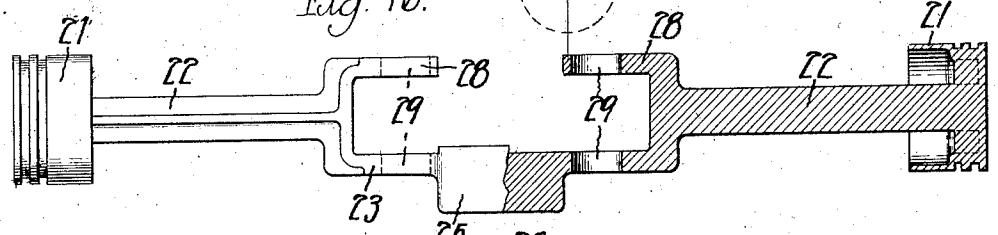
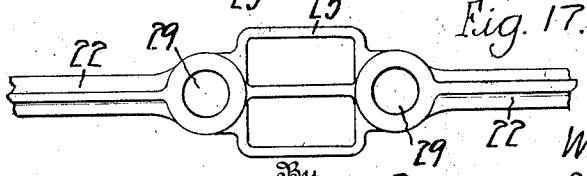


Fig. 17.



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

1,338,185. Specification of Letters Patent. Patented Apr. 27, 1920.

Application filed March 13, 1916. Serial No. 83,737.

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 a tapered cam track (as distinguished from a groove), together with oppositely disposed conical rollers carried by the cross-heads that join the piston rods of the corresponding pairs of pistons, the configuration of the cam faces being such that the rollers remain in contact therewith throughout the stroke, whereby knocking and binding are avoided; longitudinal guides for supporting the cross-heads where they bridge the cam; lubricating passages associated with the guides; improved means for igniting the mixtures in the cylinders successively after an initial ignition has been secured by spark plugs carried on the valves; means for conducting current to a spark plug carried by an inclosed rotating valve; means for maintaining a tight seal between the valves and the members in reference to which they rotate. The invention also consists in the details of construction shown, described and claimed.

In the drawings, Figure 1 is a half-plan half longitudinal section showing a preferred embodiment of the invention. Fig. 2 is an enlarged section showing the manner of sealing the joint between the valve and the casing. Fig. 3 is a similar section through a modified valve and associated parts. Fig. 4 is a longitudinal section through one of the combined intake and exhaust members. Fig. 5 is a section on the line 5—5 of Fig. 4. Fig. 6 is a longitudinal section through the cross head guide member. Fig. 7 is a section on the line 7—7 of Fig. 6. Fig. 8 is a cross section through one of the cylinder forming members. Fig. 9 is a section on the line 9—9 of Fig. 8. Fig. 10 is an elevation of one of the valve members. Fig. 11 is a section on the line 11—11 of Fig. 10. Fig. 12 is a composite section, the upper half being on the line 12—12 and the lower half being on the line 12—12′ of Fig. 10. Fig. 13 is an elevation taken from the left in Fig. 12. Fig. 14 is a perspective view of the cam member. Fig. 15 is a diagrammatic developed plan view showing the outline of the cam and the relation of its faces to the rollers on the pistons. Fig. 16 is a part elevation part section of one of the double piston rod and cross-head constructions. Fig. 17 is a fragmentary plan view corresponding thereto.

Similar reference characters refer to like parts throughout the several views.

In the embodiment of the invention shown, the engine casing comprises the intake and exhaust members 1, 1, the cylinder members 2, 2 (which include the inner tubular portions 3, 3), and the cross-head guide member 4 bolted together in any desired way. The several parts mentioned and the exhaust manifolds 5 are fixed in position. Extending longitudinally through the casing is the engine shaft 6 (that may be supported in antifriction bearings 7 recessed into the members 1 and held in position by the threaded collars 8) to which the rotatable centrally arranged cam carrying member 9 is rigidly secured. Also secured to the shaft in such manner as to prevent relative rotation, although relative longitudinal movement may be allowed, are the valves 12. Bushings 13 may be interposed between the shaft and the inner portions 3 of the members 2, and the cam member may be locked against an annular shoulder 15 on the shaft by means of a threaded collar 16. The longitudinal thrust of the cam member is taken on the annular thrust bearings 18 located at either end thereof in appropriate annular grooves formed in the faces of the cylinder members. It will be understood, however, that the thrust may in some instances be transmitted to the shaft before being carried into the casing; such, for example, would be the case were thrust bearings interposed between the inner race ring of the bearings 7 and the corresponding collars 8. Torque from the engine shaft is, of course, taken off in any desired way.

It will be observed (Figs. 8 and 9), that each of the cylinder sections includes a plurality of cylinders 20 (as shown nine, although other numbers, for example, six or ten, may be used to advantage), and that the cylinders of one section are arranged in alinement with those of another. Reciprocating in the cylinders are pistons 21, Figs.

1, 16 and 17, of suitable construction, that are joined by means of the piston rods 22 (integral therewith in Figs. 16 and 17; separate in Fig. 1) 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 4 (Figs. 1, 6 and 7). The cross heads also include portions 28 parallel to and spaced from the body portion that, together with the latter, are perforated, as indicated at 29, to receive the cross head pins 30 upon which the conical rollers 31 are carried, hardened bushings 32 preferably being interposed.

These rollers ride upon the correspondingly inclined surfaces of a cam 35 preferably formed as an integral part of the member 9; this cam may be said, generally speaking, 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, but the construction will be more precisely understood from a consideration of Fig. 15. The dashed lines shown therein 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 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, such as might otherwise take place, is prevented.

As shown in Figs. 1, 6 and 7, the guide member 4 is grooved at 26 to correspond to the portions 25 of the cross heads, and these grooves may be lubricated through openings 41 by means of a pressure system (not shown) or in any other suitable manner. Such portions of the oil as is swept out through the ends of the grooves is deposited in the annular grooves 42 formed in the end faces of the guide member and escapes through openings 43 to which the pump (not shown) of the pressure system may be connected in an obvious manner.

The intake and exhaust members, Figs. 1, 4 and 5, are each preferably shaped to form a central tubular intake passage 44 to which a mixture of air and gas may be admitted, through either or both of the laterally extending passages 45, from any desired source (not shown); they also include exhaust passages 46 that are farther from the center of the engine shaft than the intake passages, and which communicate with the exhaust manifolds 5. While the intake and exhaust passages are shown in pairs (which renders the members duplicate and avoids the use of extra patterns), it is clear that but one of each may be used.

As stated heretofore, valves 12 (Figs. 1, 10, 11, 12 and 13) are interposed between the members 1 and 3. These valves each include an intake passage 50, the entrance opening 51 of which registers constantly with the passage 44; the exit opening is an arc-shaped port 52 in alinement with the end of the cylinders 20 and of such length as to fill the latter while the valve is passing thereover. An exhaust passage or port 53, also of arc shape, allows the burned gases to escape into the exhaust passages 46. At the proper point between the intake and exhaust ports, the valve is provided with a spark plug 56 which receives current from any suitable source through the annular conductor 58 with which the contact 59 on the plug is in engagement or in close relation—it will be understood that the conductor is supported and insulated in any preferred manner, for example, by the ring 60, Fig. 1. In order to allow for access to the spark plug, the members 1 are provided with removable threaded plugs 61. The face of the valve is provided with a circumferential groove 62 of sufficient length to lap over from one cylinder to the next following—as shown the groove extends from the opening 63 in which the spark plug is inserted, but it may be located otherwise and may vary in shape. One purpose of the groove is to afford a passage for allowing the flame from the nearly burned charge (which has been ignited by the spark plug) of the rearward one of any two cylinders to be communicated to the fresh charge in the cylinder next forwardly thereof, thus providing for a continuous firing of the charges independently of the spark plug after initial ignition has taken place. In order to insure a proper sealing of the joint between the valve and the member 1, they are, respectively, provided with overlapping annular flanges 65—66, and the member 1 may be grooved, outside of the flange 65 on the valve, to receive packing 68. The valves may be held in close engagement with the ends of the cylinders by means of rings 80 (Figs. 1 and 2) that are prevented from turning by pins 81 projecting from the members 1 and received in slots 82 cut across the periphery of the ring. Springs 83, seated against the outer wall of the members 1 and pin connected at 84 to the rings, thrust

the latter toward the corresponding valve, and the valves may be grooved to receive packing 85 whereby leakage through the joint is prevented. As shown in Fig. 3, the shank 86 of the valve may, however, be extended to bear directly on an annular ball bearing 88 that engages with the end wall of the intake-exhaust member.

As will be observed in Figs. 1, 8 and 9, the cylinder members 3 inclose inner chambers 70 and outer chambers 71 joined by passages 72 whereby cooling water admitted to and escaping from the outer chamber through the passages 73 and 74 from any suitable circulating system (not shown) may be utilized to cool the cylinders. Similarly the members 1 may inclose passages 75, having inlets 76 and outlets 78 for cooling water. The members 2 may be bossed and flanged at 79 to receive supports 79′ (Fig. 9) upon which the engine may be carried.

Operation.

The combustible mixture supplied to the members 1 from any desired source passes in through the passages 45—44 to the passages 50 of the rotating valves, and from them is successively distributed to the cylinders as the ports 52 register therewith. It will, of course, be understood that corresponding points of the valves are placed 90° apart around the engine shaft, which causes phases in the heat cycle of the cylinders at one end to lag 90° behind corresponding phases of the opposite cylinders. Ignition once having taken place from the spark plugs 56, is communicated from cylinder to cylinder through the grooves 62, thus forming a means supplementary or additional to the plug for causing the explosions whereby a more certain and uniform action is insured.

The piston impulses, transmitted to the cam member through the rollers 31, cause the member and the engine shaft to rotate in an obvious manner. The operation of the remaining elements is apparent or has been already pointed out.

It is obvious that the details may be changed considerably without departing from the spirit of the invention; and I do not, therefore, wish to be limited otherwise than as indicated by the subjoined claims.

I claim:

1. An internal combustion engine comprising a rotatable engine shaft, a wave-like cam rigid and co-axial therewith, a pair of fixed opposed engine cylinders arranged parallel with the engine shaft, said cylinders forming combustion chambers, pistons for the cylinders, means joining the pistons, said means including a cross-head, antifriction members carried by the cross-head and engaging opposite faces of the cam, a casing inclosing the cam and associated parts, said casing including a groove therein parallel to the engine shaft and closed to the exterior of the casing in which the cross-head slides.

2. An internal combustion engine comprising a rotatable engine shaft, a wave-like cam rigid and co-axial therewith, a plurality of pairs of fixed opposed engine cylinders arranged parallel with the engine shaft, said cylinders forming combustion chambers, pistons for the cylinders, means joining the members of each pair of pistons, each of said means including a cross-head, anti-friction members carried by said cross-heads and engaging opposite faces of the cam, a casing including guides, parallel to the engine shaft, in which the several cross-heads slide, said casing also including a circumferential channel into which the guides open at their ends in which lubricant for the guides may collect.

3. An internal combustion engine comprising an engine shaft, a wave-like cam rigid and co-axial therewith, a fixed engine cylinder arranged parallel with the engine shaft, said cylinder forming a combustion chamber, a piston and a piston rod for the cylinder, anti-friction means whereby a thrust of the piston rod is imparted to the cam to cause rotative movement thereof, and a valve, rotatable with the engine shaft, for controlling the admission of combustible mixture to the cylinder, a spark plug carried by said valve, and means for conducting current to the plug to cause ignition of the mixture.

4. An internal combustion engine comprising an engine shaft, a wave-like cam rigid and co-axial therewith, a series of fixed engine cylinders spaced around the shaft and parallel thereto, said cylinders forming combustion chambers, pistons and piston rods for the cylinders, anti-friction means whereby thrusts of the piston rods are imparted to the cam to cause rotative movement thereof, a valve, rotatable with the engine shaft, for controlling the admission of combustible mixture to the cylinders, means carried by said valve for igniting the charge in one of the cylinders, said valve including a passage whereby the ignited charge is brought into communication with a fresh charge in the cylinder next ahead to cause ignition thereof.

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