A. M. CLÉMENT.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED OCT. 28, 1910.

1,001,506. Patented Aug. 22, 1911.

4 SHEETS—SHEET 1.

Fig. 1.

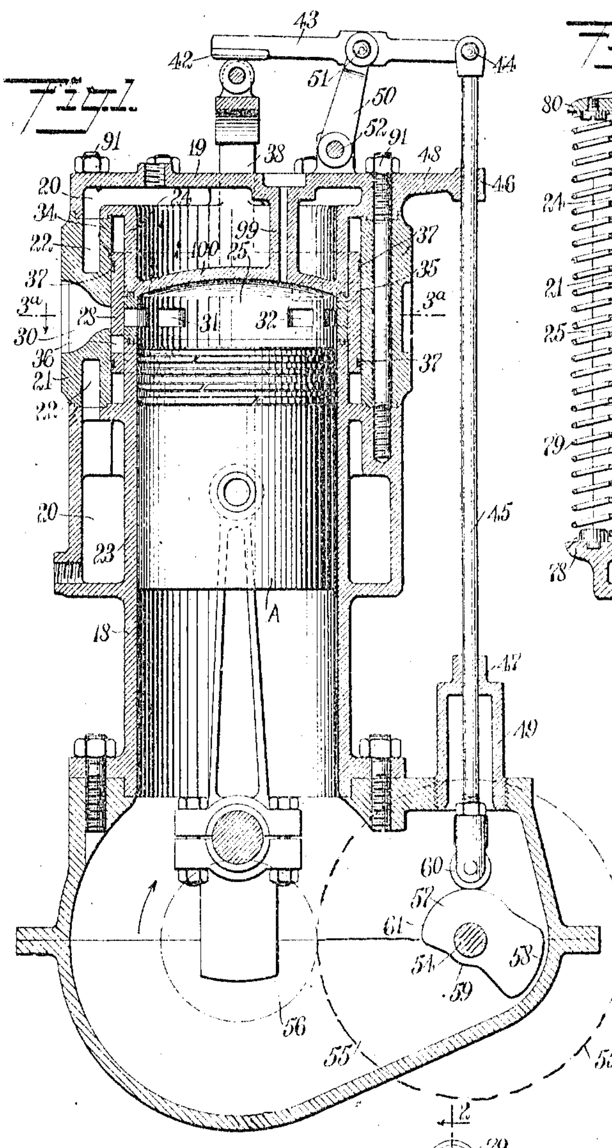


Fig. 2.

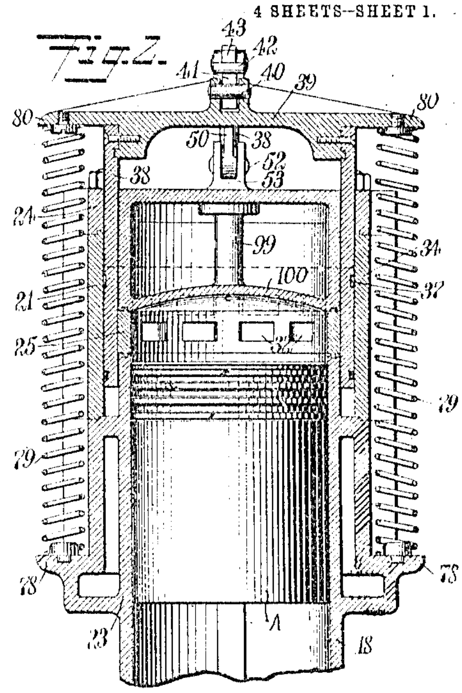


Fig. 4.

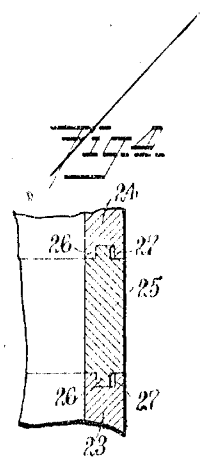
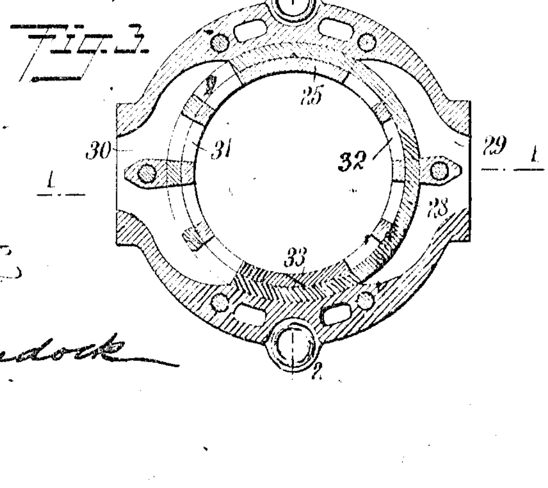


Fig. 3.



WITNESSES

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4 SHEETS—SHEET 2.

Fig. 5.

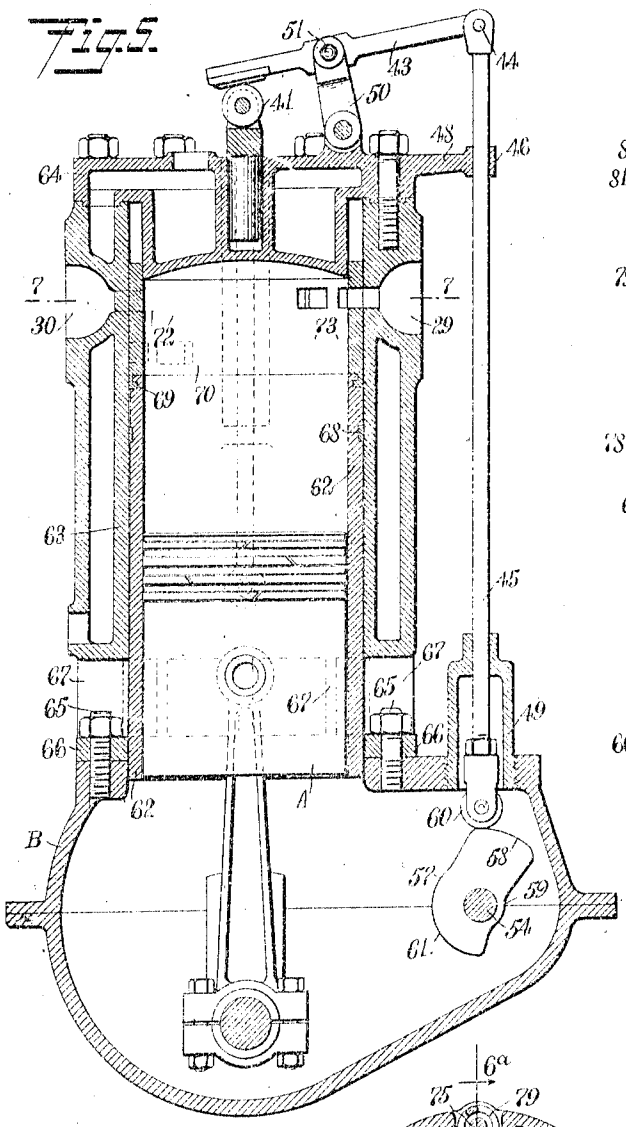


Fig. 6.

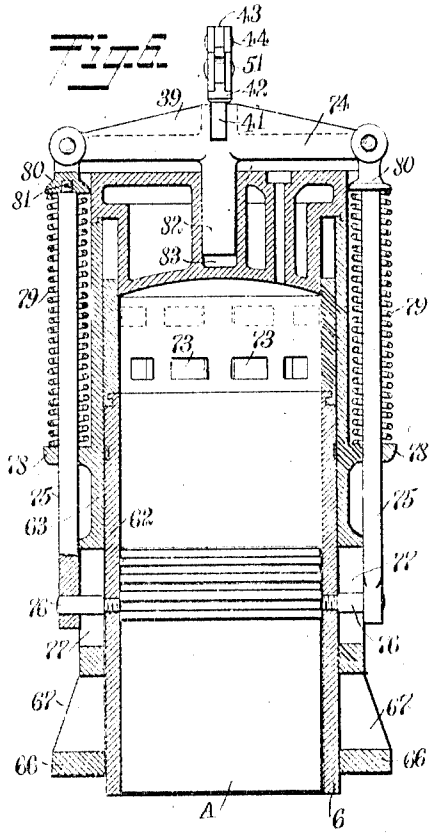


Fig. 8.

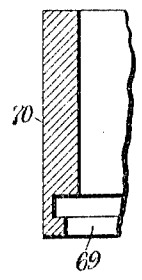
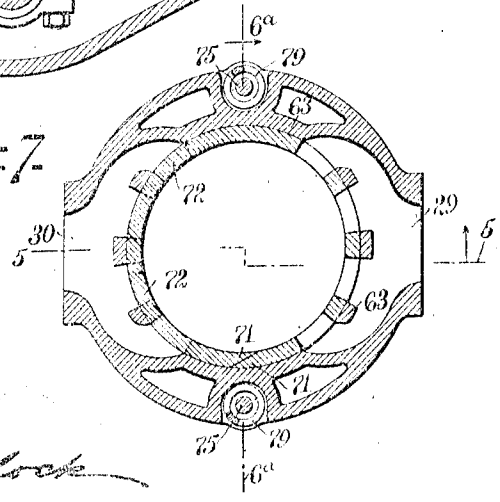


Fig. 7.



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4 SHEETS-SHEET 3.

Fig. 9.

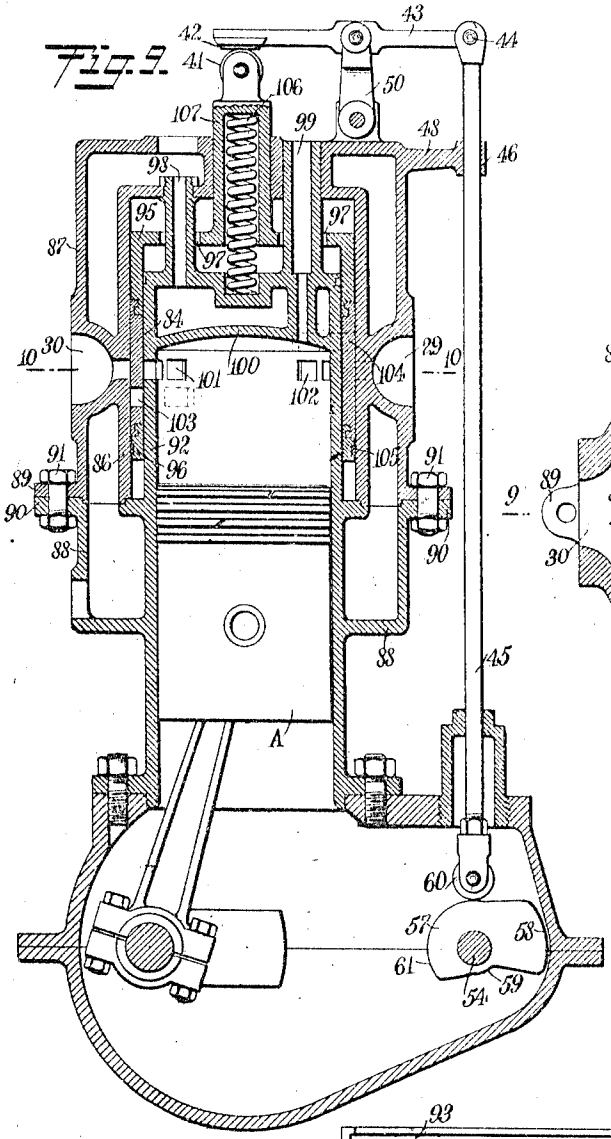


Fig. 10.

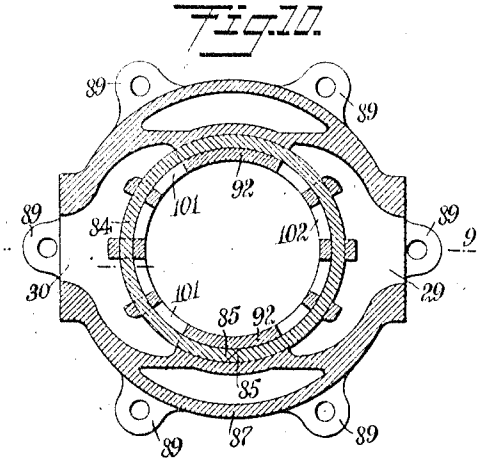
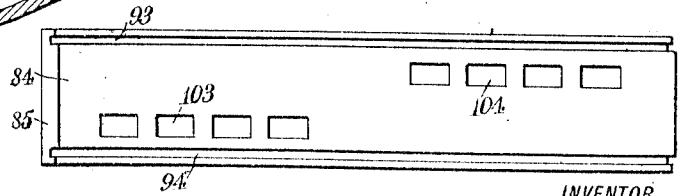


Fig. 11.



WITNESSES

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4 SHEETS—SHEET 4.

Fig. 12.

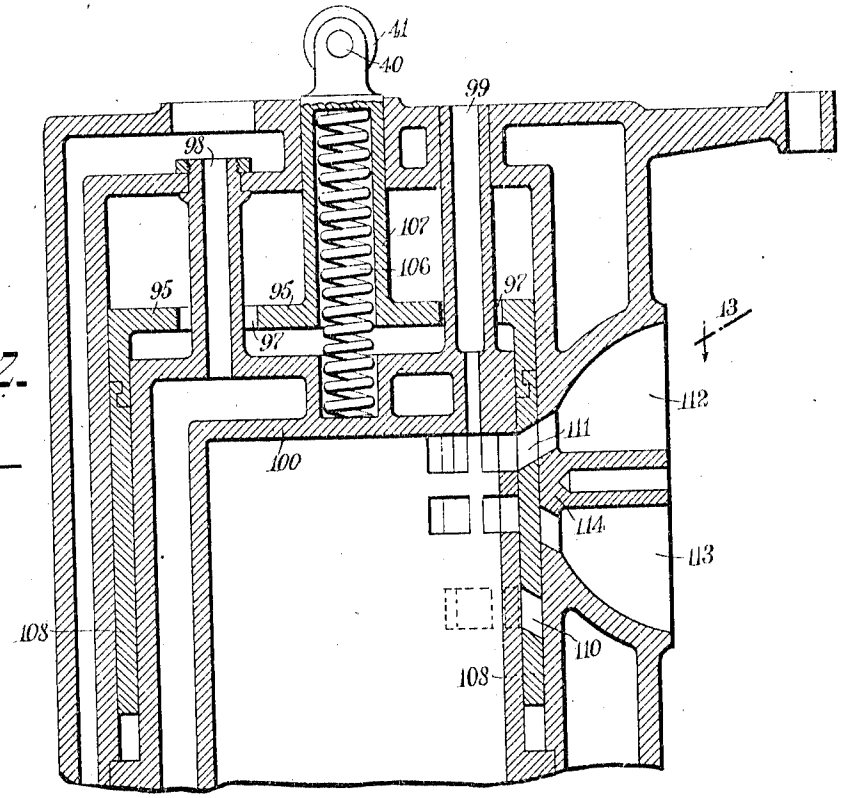
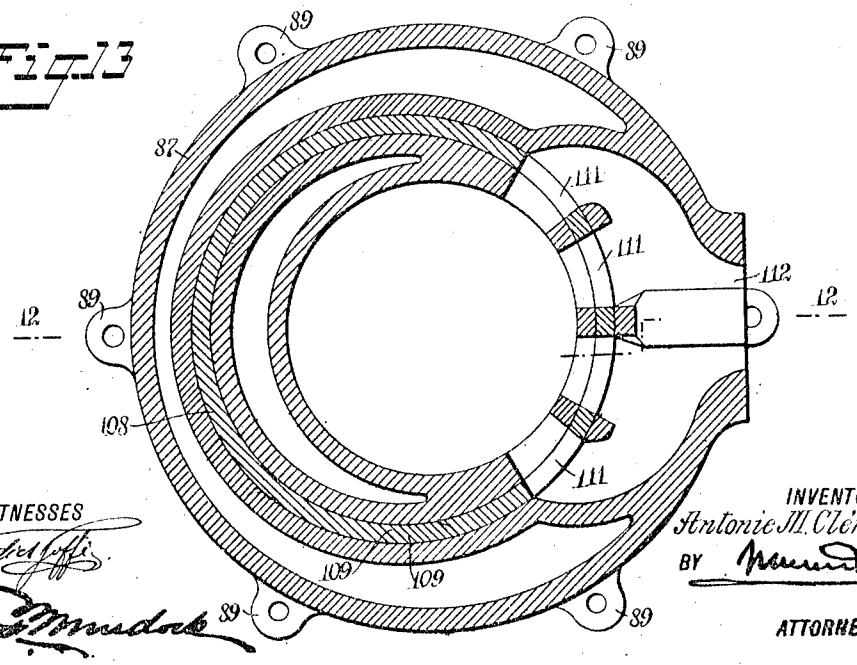


Fig. 13.



WITNESSES

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UNITED STATES PATENT OFFICE.

ANTOINE M. CLÉMENT, OF NEW YORK, N. Y.

INTERNAL-COMBUSTION ENGINE.

1,001,506. Specification of Letters Patent. Patented Aug. 22, 1911.

Application filed October 28, 1910. Serial No. 589,579.

To all whom it may concern:

Be it known that I, ANTOINE M. CLÉMENT, a citizen of the Republic of France, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented a new and Improved Internal-Combustion Engine, of which the following is a full, clear, and exact description.

Among the principal objects which the present invention has in view are: to provide sliding valves arranged and constructed to avoid leakage of gas due to wear of the sliding parts; to provide a simplified construction for valves whereby expansion pressure is relieved therefrom during the movement thereof; to provide a valve member simple, durable and economical in construction; to provide a simplified valve operating mechanism; and to provide a valve operating mechanism embodying a single cam and simplified transmission mechanism connected therewith.

One embodiment of the present invention is disclosed in the structure illustrated in the accompanying drawings, in which like characters of reference denote corresponding parts in all the views, and in which—

Figure 1 is a vertical section of an internal combustion engine constructed and arranged in accordance with the present invention, the section being taken on the line 1—1 in Fig. 3; Fig. 2 is a vertical section of the upper end of the cylinder of an internal combustion engine, the section being taken on the line 2—2 in Fig. 3; Fig. 3 is a cross section taken on the line 3^a—3^a in Fig. 1, the valve plate raised to expose the exhaust ports of the engine; Fig. 4 is a vertical section, on an enlarged scale, showing the port ring and the cylinder walls adjacent thereto; Fig. 5 is a vertical section of an internal combustion engine, taken on the line 5—5 in Fig. 7, showing a modified form of a valve plate constructed and arranged in accordance with the present invention, and means for operating the same shown in position to expose the exhaust port on said engine; Fig. 6 is a vertical section, taken on the line 6^a—6^a in Fig. 7, of the upper portion of an engine constructed as in Fig. 5, showing the valve casing lifted to expose the intake port on said engine; Fig. 7 is a cross section taken on the line 7—7 in Fig. 5; Fig. 8 is a detail view, on an enlarged scale, of the valve ring employed in the modified form illustrated in Figs. 5 to 7 inclusive; Fig. 9 is a vertical section, taken on the line 9—9 in Fig. 10, of a modified form of the invention, showing the valve plate in closed relation to both the intake and exhaust ports; Fig. 10 is a cross section taken on the line 10—10 in Fig. 9; Fig. 11 is a detail view of a valve ring constructed as shown in Fig. 5, said ring being straightened to show the relation of the port openings; Fig. 12 is a vertical section taken on the line 12—12 in Fig. 13, showing a modified form of the invention; and Fig. 13 is a cross section taken on the line 13—13 in Fig. 12.

As shown in the accompanying drawings, and more particularly in Figs. 1 to 4 inclusive thereof, the cylinder is constructed in two sections 18 and 19. The sections 18 and 19 are provided with water jacket spaces 20, 20, and are clamped upon and held in line by an intermediate section 21. The meeting edges of the sections 18 and 19 and 21 are suitably machined, curved and tenoned, as shown in the drawings, to form water tight annular fittings for uniting the three sections. The space 22 formed between the inner and outer walls of the section 21 constitutes a continuation of the water jacket for the cylinder, and is in open communication with the jacket space, 20, 20 of the lower and upper sections 18 and 19. Between the edges of the inner walls 23—24 of the sections 18 and 19, is mounted a port ring 25. The juxtaposed edges of the walls 23—24 are grooved to receive annular flanges 26, 26. The grooves 27, 27 provided for the reception of the flanges 26, 26 are slightly wider than the thickness of the said flanges, thus providing for expansion of the ring 25 independent of the walls 23—24. The expansion of the ring 25 is outward against a valve ring 28. The ring 25 is disposed in the cylinder opposite an exhaust port chamber 29 and an intake port chamber 30, said chambers being throated to equal in vertical dimension the height of the series of ports 31 and 32 formed in the said ring. In the form of engine shown in Figs. 1 to 4 inclusive, the said ports 31 and 32, and chambers 29 and 30, are disposed in line and in the

same plane. The port ring 25 is constructed from spring material, and is set to expand beyond the diameter of the inner surface of the cylinder. The ring is provided with bevel ends 33, adapted to overlap, as shown best in Fig. 3 of the drawings. It will be observed that the outward pressure of the innermost end 33 at all times closes the joint between the said ends. It will also be observed that outward expansion of the ring 25 acts as a spring piston packing ring, and under all conditions of wear expands outwardly to fit the inner surface of the valve 28. It is to receive the valve ring 28 that the section 19 of the cylinder of the engine is provided with an intermediate wall 34. A clear space is formed between the walls 24 and 34, which are machined to form a raceway for the valve ring 28. It will be observed that the outer surface of the wall 24 and the inner surface of the wall 34, when the sections 19 and 21 are separate, afford easy access for the mechanical work to be performed upon them. The valve ring 28 is a rigid ring, fitted to the space between the walls 24 and 34, having a sliding contact with both walls. The length of the valve ring 28 is as desired, providing longitudinal sections for the exhaust ports 35 and the intake ports 36, and an intermediate section to close both sections simultaneously. When the valve ring 28 is lifted the intake ports 36 are disposed in positive relation to the ports 31. When the valve ring 28 is depressed to its lowermost position the exhaust ports 35 are disposed opposite the ports 32. Intermediate the two positions, and as shown in Figs. 1 and 2, the ports 31 and 32 are closed by the middle section of the valve ring 28. As stated, the port ring 25 is split and provided with lapped ends 33, the said ring expanding normally outward to close the joint between the ring 25 and the ring 28 under all conditions of wear. The joint between the external surface of the ring 28 and the internal surface of the wall 34 is closed by cylinder packing rings 37. The rings 37 are of usual or ordinary construction, and set to expand outward, thus closing the joint between the valve ring 28 and the wall 34 on both sides of the port chambers 29 and 30. The valve ring 28 is provided with laterally disposed longitudinally extended arms 38, 38. The arms 38, 38 are rigidly connected to a cross head 39, in the center whereof, mounted on a pivot pin 40, is a roller 41. The roller 41 is provided to receive a foot plate 42, which is mounted on the end of a rocking arm 43. The rocking arm 43 is pivotally connected by means of a pin 44 at the outer end to a valve lifter rod 45. The lifter rod 45 is guided in collars 46 and 47, the former being supported at the end of an extension 48, and the latter formed in the end of a cylinder 49. The even path of reciprocation on the part of the lifter rod 45 necessitates the employment of a rocking link 50, by which the pivot point 51, where the rocking arm 43 and the link 50 are connected, is permitted to move laterally, or to swing about a pivot pin 52, which is provided in lugs 53, cast with the cylinder section 19. The lifter rod 45 is operated from a cam shaft 54. The cam shaft 54 is operatively connected with the crank shaft by means of two-to-one gears 55 and 56. The cam 57 is plotted, substantially as shown in Fig. 1 of the drawings, having double extensions. The even curved surfaces 58 and 59 are concentric with the shaft 54. The said surfaces are disposed at different heights to lift the said rod 45 and thereby dispose the ring 28 in position where the ports 35 aline with the ports 32, and when the roller 60 rides the surface 58. The ports 36 are alined with the ports 31 when the roller 60 traverses the surface 59. In the rotation of the shaft 54 the surface 59 "leads" the surface 58 by an angle of 120°. Intermediate the surface 59 and the surface 58 is a surface 61, the radius whereof is intermediate the radii of the curve of the surfaces 59 and 59. It is during the ride of the roller 60 over the surface 59 that the engine takes a charge of explosive fuel. It is during the ride of the roller over the succeeding surface 61 that the piston of the engine compresses the charge, and iguition and explosion occur. It is when the roller 60 is passing over the succeeding surface 58 that the exhaust occurs. It will be noted from the foregoing that in the present construction the single cam 57 and transmission mechanism connected therewith operate the valve ring 28 to perform all the functions needed in engines of this type.

In Figs. 5 to 8 inclusive of the drawings is shown a modified form of the invention, wherein a slide sleeve 62 is provided to receive and guide the piston A. To accommodate this construction the cylinder is formed in two sections 63 and 64. The section 63 forms the barrel of the cylinder, and has provided therein the exhaust chamber 29 and the intake chamber 30. The section 63 is supported on the crank casing B by bolts 65, which are extended through a bolting seat ring 66, to which ring it is connected by means of fins 67. The fins 67 are arranged in separated position, substantially as shown in Figs. 5 and 6 of the drawings. The sleeve 62 is provided with a piston packing ring 68 arranged to close the passage between the said sleeve and the inner wall of the section 63. The sleeve 62 is at the upper end thereof provided with an external groove to receive a flange 69 formed on the lower edge of the port ring 70. The port ring 70 resembles the port ring 25 in that it is split to form overlapping end sections 71, 71, and in

that the ring is formed to a natural diameter greater than the diameter of the interior surface of the section 63. When the said ring 63 is contracted to permit its disposition within the section 63, it exerts a normal outward expansion against the inner surface of the said section. The ring 70, in its operation, is substituted for the valve ring 28, the port openings 72, 72 in the said ring 70 corresponding with the intake ports 36, and the port openings 73, 73 corresponding with the exhaust ports 35. Whereas, in the form shown in Figs. 1 to 4 inclusive the valve ring 28 moves, in the modified form shown in Figs. 5 to 8 inclusive, the port ring 70 is moved. The port ring 70 is moved by reason of its attachment to the sleeve 62. The sleeve 62 is connected to a cross head 74 by means of connecting rods 75, 75, which are anchored to the sleeve 62 by pins 76, 76. To permit the reciprocation of the pins 76 the cylinder section 63 has formed in the side wall thereof openings 77, 77. From the side walls of the cylinder section 63 are extended brackets 78, 78, perforated to receive in guiding relation the connecting rods 75, 75, and to form platforms to receive the lower end of spiral springs 79, 79. The springs 79, 79 are threaded over the rods 75, 75, and rest under cap couplings 80, 80. The cap couplings 80, 80 are connected to the rods 75, 75 by means of the screw threaded ends 81 formed at the ends of the rods 75. To guide the cross head 74 in its action it is provided with a plunger 82, which is reciprocated in a socket 83 formed in the upper section 64 of the cylinder. The sleeve 62 and the connected port ring 70 are reciprocated by means of a timing mechanism and transmission devices connected therewith, resembling in construction and function those shown in Figs. 1 to 4 inclusive.

In Figs. 9 to 11 of the drawings is shown a modified form of the invention, wherein the valve ring 84 is split, the end sections 85, 85 overlapping in a manner similar to the ends 71, 71. The resilient set of the ring 84 is, as in the ring 70, outward to hug the inner wall 86, with which the upper section 87 of the modified cylinder shown in Fig. 9 is provided. The modified cylinder is provided with the upper section 87 and a lower section 88, the two sections being provided with and secured by bolting flanges 89 and 90, the bolts 91, 91 passing through the said flanges. Extended above the line of junction of the cylinder sections is an inner cylinder wall 92, spaced from the wall 86, as shown in Figs. 9 and 10, to receive in guided relation the said ring 84. In this respect the construction resembles closely the construction illustrated in Fig. 1. The ring 84 is provided with annular grooves 93—94, for attachment to the cap 95 and the packing collar 96 respectively. The cap 95 is provided with perforations 97, 97, through which are extended tubes 98 and 99. The tubes 98 and 99 are erected upon the structure of the cylinder head 100. The tube 98 is connected with the external chambers of the water circulating system, while the tube 99 is provided for the introduction of the igniting devices. In this form of the invention the intake ports 101 and exhaust ports 102 are disposed in the same plane, while the port openings 103 and 104 are disposed at opposite edges of the ring 84. In the reciprocation which is imparted to the ring 84 by the timing mechanism hereinabove described, the openings 103 and 104 are disposed in line with the ports 101 and 102 respectively. The collar 96 is a split ring, having in the outer surface thereof a groove formed to receive and hold a contraction spring 105. The collar 96 is divided longitudinally and is formed by taking the temper out of the collar after the same has been turned. The method of taking the temper is that usual in constructions of similar character, and is accomplished by hammering the collar while mounted upon a mandrel. The spring 105 is formed of sufficient strength to contract the collar 96, causing the same to hug the wall of the cylinder of the engine and thus prevent leakage between the said collar and cylinder. In this manner, by providing the resilient valve ring, the set of which is to expand the same, and the collar 96, which is contracted, the passage in which the valve operates is closed at both walls.

A further modification of construction illustrated in the drawings, and in Fig. 9, is the installation of the spiral spring 106 in a hollow tube 107 formed upon the head of the cap 95. At the top of the cap 95 is mounted the roller 41 to receive the impact of the foot plate 42. The normal operation of the spring 106 is to lift the cap 95 and ring 84 connected therewith. The depression of the said cap and ring is regulated by the timing mechanism embodying the lifter rod 45 and the elements connected therewith, as above described.

In Figs. 12 and 13 of the drawings is shown a further modification of the invention. In this modification the port ring 103 is split to form overlapped end sections 109, 109, and is connected, as shown in Fig. 9, with the cap 95. The modification herein shown consists in that the intake ports 110 are disposed in longitudinal alinement with the exhaust ports 111. The cylinder structure is modified to accommodate the arrangement by placing the exhaust port chamber 112 in longitudinal alinement with the intake port chamber 113, the two chambers being divided by a partition wall 114.

In the operation of the various forms of the invention illustrated in the accompany-

ing drawings and herein described, the port rings 25 and the valve rings 70, 84 and 108 expand outwardly to close the joint between the cylinder wall and the said port ring. In this manner is insured a closed joint adjacent the ports and valves therefor which operates to prevent the admission of explosive fuel or air due to the direct and positive suction of the piston, and thus provides an absolute control of the proportions designed for the explosion.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an internal combustion engine embodying a reciprocating valve member, a port ring having port openings therein; and resilient means for expanding said ring outward against said valve member.

2. In an internal combustion engine embodying a reciprocating valve member, a resilient ring having port openings therein adapted to aline with the valve openings, said ring being adapted to expand outwardly to close the joint between said valve member and said ring.

3. In an internal combustion engine, a cylinder comprising a plurality of body sections separated longitudinally; an interposed resilient port section movably mounted between said body sections, said port section being adapted to expand outward from the interior of said body sections; a valve member surrounding said body and port sections; and a timed mechanism for reciprocating said valve member.

4. In an internal combustion engine, a cylinder comprising a plurality of body sections separated longitudinally; an interposed resilient port section movably mounted between said body sections, said port section being adapted to expand outward from the interior of said body sections; a valve member surrounding said body and port sections; a timed mechanism for reciprocating said valve member; and means for drawing the said body sections toward each other.

5. In an internal combustion engine, a cylinder comprising a plurality of body sections separated longitudinally; an interposed resilient port section movably mounted between said body sections, said port section being adapted to expand outward from the interior of said body sections; a valve member surrounding said body and port sections; a timed mechanism for reciprocating said valve member; and screw threaded means for drawing said body sections toward each other.

6. In an internal combustion engine, a cylinder comprising a plurality of body sections separated longitudinally, and provided with intake and exhaust port openings; a valve ring mounted within said cylinder and having ports adapted to aline with said port openings, said valve ring being constructed from resilient material set to normally expand against the side wall of said cylinder; and a timed mechanism for reciprocating said valve.

7. In an internal combustion engine, a cylinder comprising a plurality of body sections separated longitudinally, and provided with intake and exhaust port openings; a split spring ring having port openings formed in the side walls thereof adapted to aline with the said port openings in said body sections, said ring being disposed within said body sections; and a timed mechanism for reciprocating said ring in said body sections.

8. In an internal combustion engine, a cylinder comprising a plurality of separable body sections, one of said sections forming the head of the explosion cylinder and having a projected portion adapted to extend to within the other of said body sections to form an annular groove therebetween, the other of said body sections having formed therein intake and exhaust port openings; a cylindrical sleeve adapted to slide within said body sections; a split spring ring operatively connected with said sleeve to move therewith, said ring being provided with port openings to aline with said intake and exhaust port openings; and a timed mechanism for reciprocating said sleeve.

9. In an internal combustion engine having intake and exhaust ports formed in the cylindrical wall thereof, a valve mechanism, comprising a guide wall surrounding said cylindrical wall, spaced from said cylindrical wall to form an annular passage; a split valve ring disposed in said annular space adapted to expand outward against said guide wall; a rigid collar movably attached to said valve ring to fit said cylindrical wall; and an expansible packing ring mounted in said collar.

10. In an internal combustion engine having intake and exhaust ports formed in the cylindrical wall thereof, a valve mechanism, comprising a guide wall surrounding said cylindrical wall, spaced from said cylindrical wall to form an annular passage; a split valve ring disposed in said annular space adapted to expand outward against said guide wall; a plurality of rigid collars movably attached to said valve ring and at both ends thereof to fit the said cylindrical wall; and a plurality of expansible packing rings mounted in said collars.

11. In an internal combustion engine having intake and exhaust ports formed in the cylindrical wall thereof; a guide wall disposed opposite the said ports concentric with said cylindrical wall and separated therefrom to form an annular guide pas-

sage; an expansible valve ring having port openings adapted to aline with said intake and exhaust ports, said ring adapted to expand outward against said guide wall; and a plurality of sliding collars operatively connected with said valve ring and slidingly mounted on said cylindrical wall.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

ANTOINE M. CLÉMENT.

Witnesses:

E. F. MURDOCK,

PHILIP D. ROLLHAUS.