W. R. McKEEN, Jr.

ENGINE.

APPLICATION FILED AUG. 21, 1909.

1,017,008.

Patented Feb. 13, 1912.

4 SHEETS—SHEET 1.

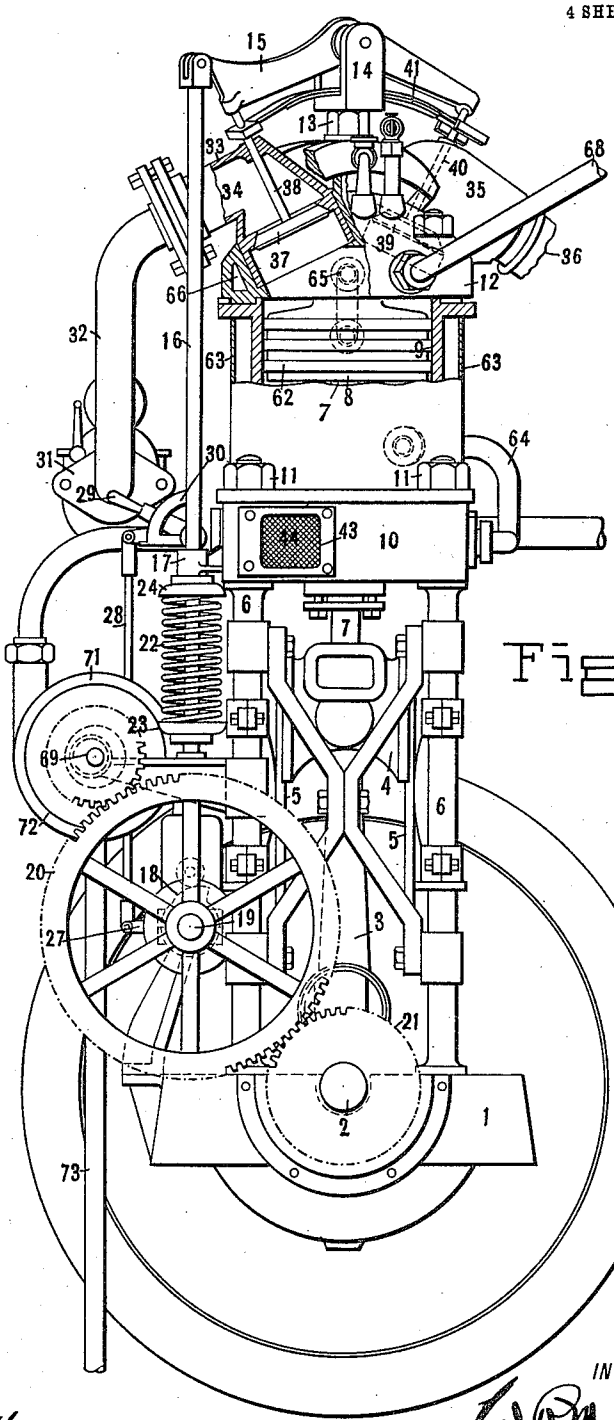

Fig. 1.

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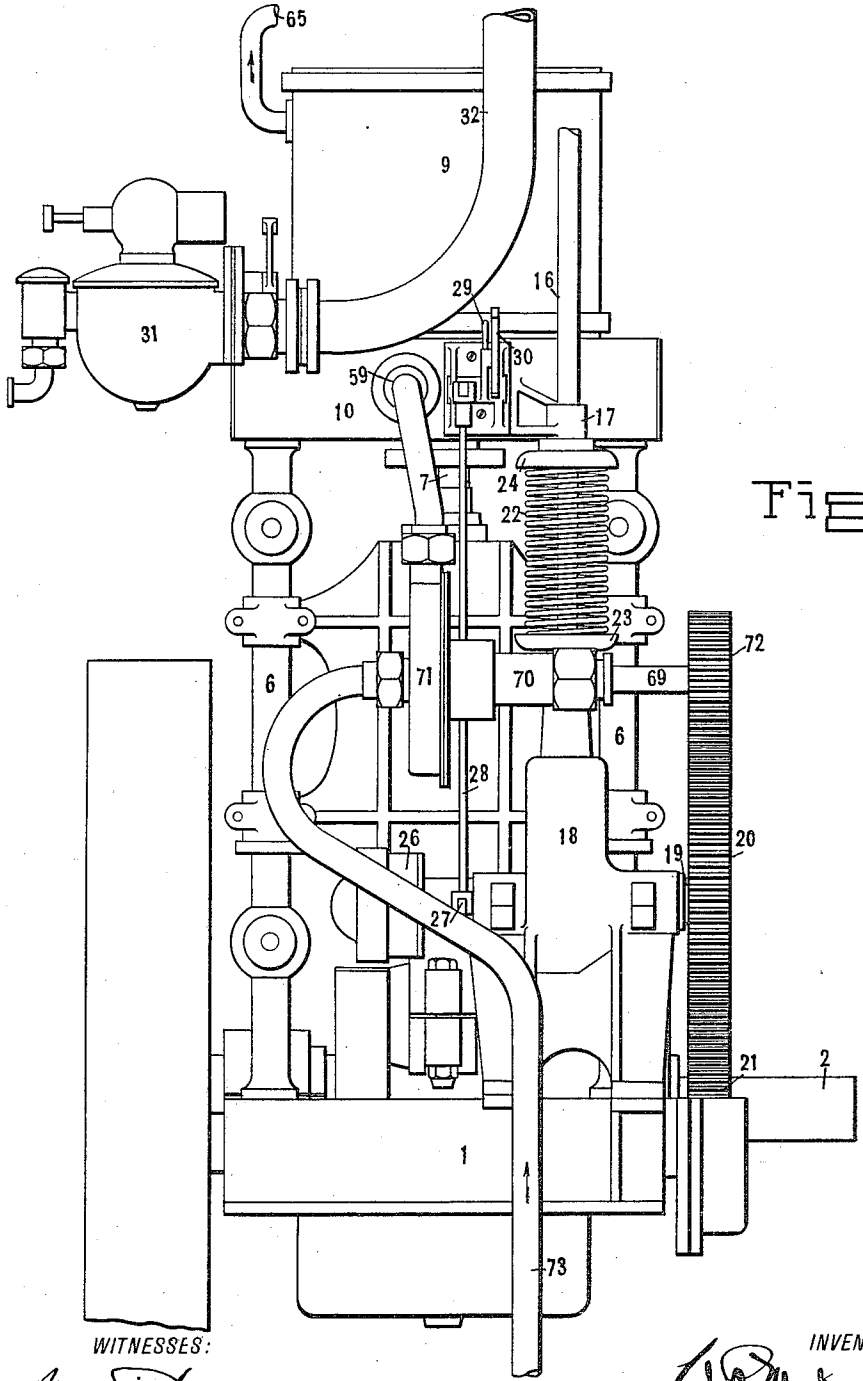

Fig. 2.

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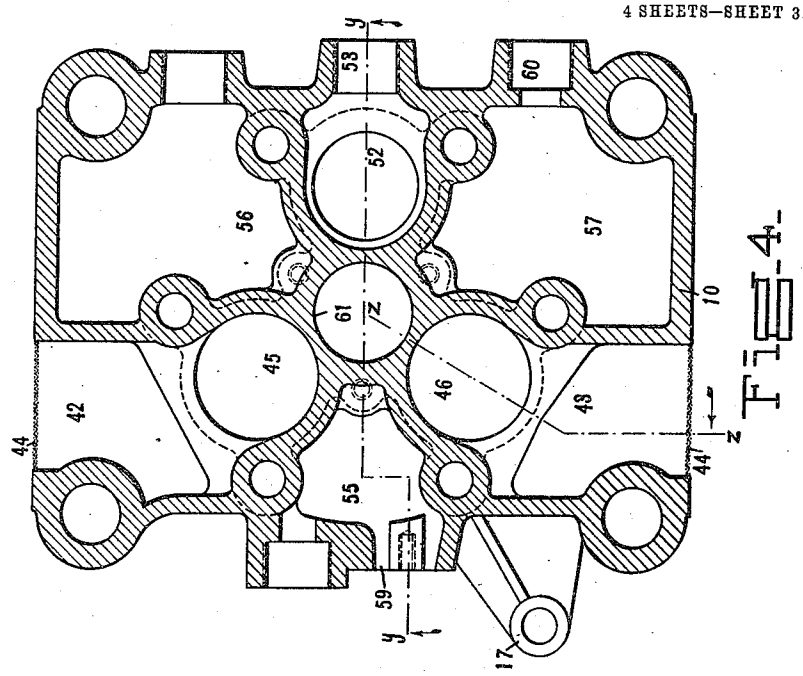

FIG. 4.

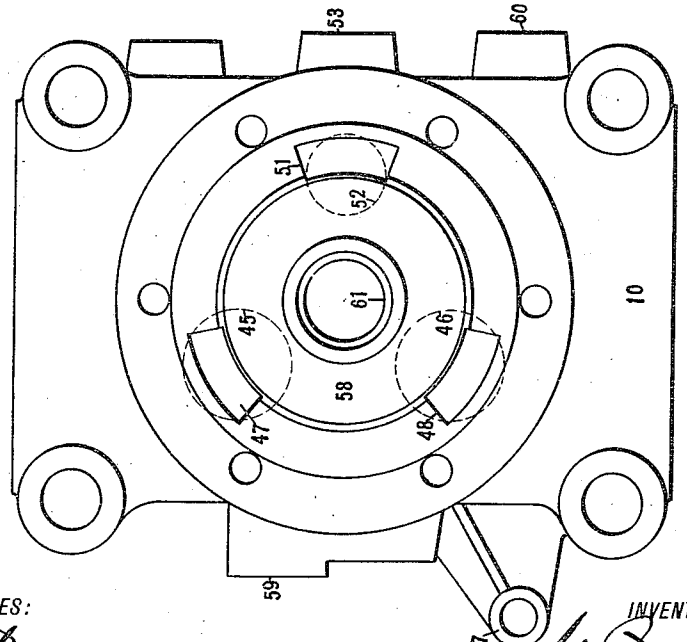

FIG. 3.

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4 SHEETS—SHEET 4.

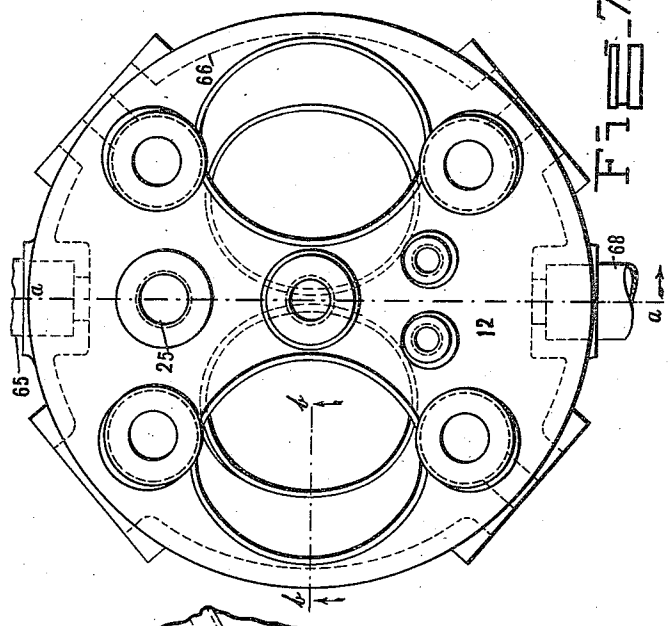

FIG. 7.

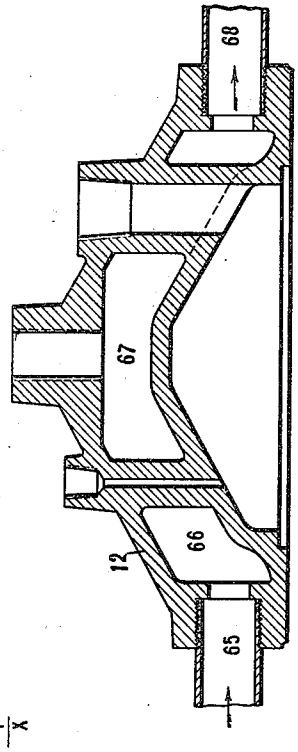

FIG. 8.

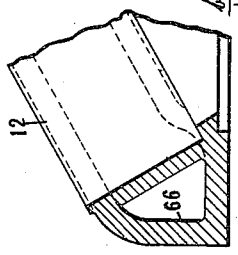

FIG. 9.

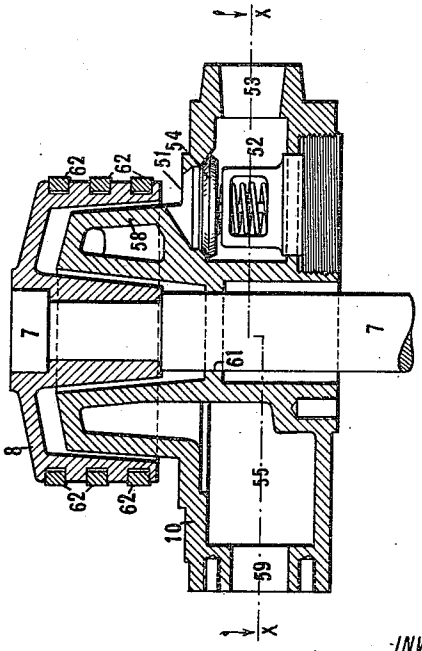

FIG. 5.

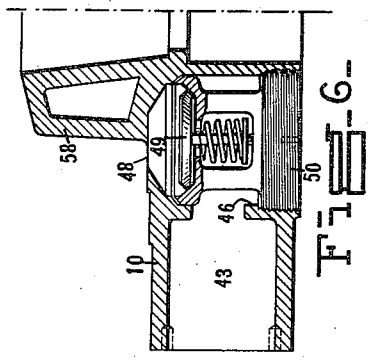

FIG. 6.

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UNITED STATES PATENT OFFICE.

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ENGINE.

1,017,008. Specification of Letters Patent. Patented Feb. 13, 1912.

Application filed August 21, 1909. Serial No. 513,915.

To all whom it may concern:

Be it known that I, WILLIAM R. McKEEN, Jr., a citizen of the United States, residing at Omaha, in the county of Douglas and State of Nebraska, have invented certain new and useful Improvements in Engines, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to engines.

One of the objects thereof is to provide simple and efficient means for compressing air or other fluid.

Another object is to provide means of the above type having few and simply related parts and of such compact construction as to occupy a minimum of space in use.

Another object is to provide a reliable internal combustion engine in which all parts are thoroughly cooled in action.

Another object is to provide a practical unitary piece of apparatus of durable, self-contained and non-complicated construction in which the energy of a hydrocarbon as fuel is economically utilized to compress air or other fluid.

Other objects will be in part obvious and in part pointed out hereinafter.

The invention accordingly consists in the features of construction, combinations of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings, wherein is shown one of various possible embodiments of this invention, Figure 1 is a front elevation, certain parts being broken away in order to show the structure more clearly; Fig. 2 is a side elevation of a portion of the apparatus shown in Fig. 1; Fig. 3 is a top plan view of the lower cylinder head; Fig. 4 is a sectional view of this head, taken substantially on the line *x*—*x* of Fig. 5; Fig. 5 is a vertical section through a cylinder head and piston, taken substantially on the line *y*—*y* of Fig. 4; Fig. 6 is a sectional view taken substantially on the line *z*—*z* of Fig. 4; Fig. 7 is a top plan view of the upper cylinder head; Fig. 8 is a sectional elevation, taken on a line *a*—*a* of Fig. 7; and Fig. 9 is a sectional view taken on line *b*—*b* of Fig. 7.

Similar reference characters refer to similar parts throughout the several views of the drawings.

In order to render clearer certain features of this invention, it may here be noted that in the use of apparatus of the general nature with which this invention deals, space, and more particularly floor space, is at a premium and any features of construction which tend to a more compact and self-contained arrangement of the parts are correspondingly valuable. It may also be noted that in the effort to design apparatus of this nature which shall occupy but little space in use there is a tendency to crowding of parts which not only interferes with their accessibility and efficiency of action, but renders their cooling more difficult. It is, accordingly, one of the aims of this invention to provide apparatus which shall require a minimum of space, and shall, nevertheless, be characterized by efficient action and thorough cooling of all parts exposed to heat.

Referring now to Fig. 1 of the drawings, there is shown a supporting bed, or base 1 having journaled therein the crank shaft 2. Connected with the crank of this shaft by means of a suitable pitman 3 is a cross-head 4 traveling within the guides 5 mounted on the uprights or stanchions 6. The uprights or stanchions are connected in pairs by angular braces 6′ secured to the stanchions at their upper and lower parts and bolted together at the center. Rigid uprights are thus provided, presenting an open, skeleton-like structure, making the parts readily accessible and conducing to effective cooling. Leading from this cross-head is a piston rod 7 secured to a piston 8 in the cylinder 9. This cylinder is mounted upon the cylinder head 10, hereinafter described in detail, which is bolted as by the nuts 11 upon the upper ends of the stanchions 6. As shown in Figs. 2 and 3, the cylinder head 10 is substantially in the form of a parallelogram, with a slightly raised circular portion to receive the lower end of the cylinder, which is bolted or fastened thereto in any convenient manner. The elongation of the cylinder head affords space for openings to receive the uprights or stanchions 6, leaving the cylinder to be secured to the head by bolts or fastenings independent of the uprights, and hence permitting it to be detached, removed

and replaced without interfering with the rigidity of the supporting frame. The stanchions 6 are shouldered to afford bearing for the under side of the cylinder head, as seen in Figs. 1 and 2. Mounted upon cylinder 9 is an upper head 12, the construction of which also will hereinafter be described in detail. A support 13 is tapped within head 12 and within its bifurcated upper end 14 is pivoted a rocking lever 15, one end of which is pivotally connected with a sliding rod 16. This rod passes through a guide 17 cast upon the head 10 and co-acts with a cam 18 upon the countershaft 19 journaled upon the engine frame. Shaft 19 is driven from the crank shaft 2 by the gears 20 and 21, so proportioned as to turn the former shaft once during two complete revolutions of the latter. A spring 22 compressed between the collars 23 and 24 respectively fixed upon the rod 16 and guide 17, tends to urge the rod into its lowermost position and hold it in engagement with the cam 18.

It will be seen that by the above described mechanism the shaft 19 is rotated once for each complete cycle of the engine, assuming it to be of the four cycle type, and by properly proportioning the cam surface, the lever 15 is rocked to give the desired actuation of the engine valves as hereinafter set forth. The lever 15 is thus a unitary means for operating said valves.

A spark-plug 25 is positioned in the head 12 and properly connected with a commutator 26 upon a shaft 19. This commutator is adjusted by means of the crank 27 connected by link 28 with a bell crank lever 29 which co-acts with a suitable segment 30.

The charge is led to the cylinder from a carbureter 31 mounted upon the engine frame through a conduit 32 connecting with a conduit 33, which is so shaped as to provide a bend or turn 34 leading downwardly toward the cylinder. Similarly positioned upon the opposite side of the head 12 is a conduit 35 curved as shown and leading to the exhaust pipe 36.

Referring now to the valves positioned within the head 12, there is provided an inlet or admission valve 37, the stem 38 of which is inclined outwardly from the axis of the cylinder and passes through the conduit 33. Exhaust valve 39 is similarly positioned at the opposite side of the head, its stem 40 being inclined outwardly in the opposite direction and passing through the conduit 35. Both of these valve stems are secured to the respective ends of a flat leaf spring 41 mounted upon the support 13 at its bifurcated end as shown. This spring normally tends to draw both valves outwardly against their seats until it is overcome by the engagement of the rocking lever 15 with the valve stems.

Referring now to the construction of the lower cylinder head, shown in Figs. 3, 4, 5 and 6 of the drawings, it is to be noted that this head is to be cast in a single piece and provides two air inlet passages 42 and 43 leading from opposite sides of the head and protected by suitable screens 44. These passages lead to valve chambers 45 and 46, respectively, and thence upwardly through the ports 47 and 48, as shown in Fig. 3, to the lower or crank end of the cylinder. Within the valve chambers 45 and 46 are mounted valves 49 spring-pressed against their seats and removable through the opening 50 in the lower surface of the cylinder head. These valves, as shown in the drawings, are so formed and positioned as to permit the ready entry of air but prevent its discharge. By providing a plurality of air inlets of ample capacity, free entrance of air is insured, and but slight retarding effect is produced upon the piston during the inlet stroke of the compressor. The discharge port 51, which is substantially equally spaced about the piston rod with respect to ports 47 and 48, leads through a valve chamber 52 to a discharge passage 53 and thence to any desired form of reservoir. Within valve chamber 52 is a spring pressed valve 54 so formed as to permit the passage of the compressed air from the cylinder, but prevent its reëntry upon the up-stroke of the piston. It will be seen upon referring to Figs. 5 and 6 that the valves 49 and 54 are provided each with a cage or frame, spring, etc., the lower end of the cage being externally threaded so as to screw into a correspondingly threaded opening in the outer or lower wall of the cylinder head, and to lie flush therewith. This arrangement is convenient in that any valve may be readily removed and replaced by another, permitting the compressor to be continued in use while a defective or worn valve is repaired. It also avoids any projection whatever beyond the outer wall of the cylinder head, and thus obviates any chance of injury to the valves through accidental contact therewith, everything pertaining to the valves being housed within the cylinder head. The screw thread being on the outer portion of the cage or frame of the valve, and the threaded portion being shouldered to fit against a corresponding shoulder in the cylinder head, as best shown in Fig. 5, a perfectly tight joint is readily secured without the use of packing, jam-nuts, or the like. Also formed in the cylinder head 10 are water chambers 55, 56 and 57, the chamber 55 being located between the valve chambers 45 and 46, and the chambers 56 and 57 being on opposite sides of the valve chamber 52, and separated from the chamber 55 by the walls of the valve chambers 45, 46, and of central opening 61. It is desirable that the vertical measurement of

the head be kept within reasonable limits, and that communication between the several water chambers be provided within said head. I therefore provide said cylinder head 10 with an annular upward or inward projection 58, within which is formed a passage, or series of passages, opening from the chamber 55 into the chamber 56, and from the chamber 56 into the chamber 57, so that the cooling water entering by the port or opening 59 may pass into the chamber 55, thence through the interior of projection 58 to the chamber 56, thence through a second passage within the projection 58 to the chamber 57, finally escaping by the outlet 60. To the end that the projection 58 may not necessitate increase of the longitudinal or axial measurement of the cylinder, but that the piston 8 may nevertheless descend to the bottom of the cylinder, said piston is made of bell shape, as shown in Fig. 5, thus giving to its perimeter a proper length of bearing or contact with the interior of the cylinder, yet permitting it to fit down closely over the projection 58, and descend to, or practically to, the cylinder head 10. The exterior of the projection 58 and the interior of the piston are both conical or tapering, so that clearance may be afforded between them for escape of air until the moment that the piston reaches its lowermost position. By this expedient I avoid the presence of a resisting air cushion between the projection 58 and the interior of the piston, and I insure the substantially complete discharge of air from within the cylinder. It will be observed upon reference to Figs. 5 and 6, that the projection 58 overhangs the ports 47, 48 and 51 of the valves 49 and 54, and to compensate for any reduction in area of the outlets incident to such overhang, the overhanging wall is preferably inclined upward as shown in Fig. 5, and the ports are extended or elongated circumferentially, as best seen in Fig. 3. The piston 8 is secured to a rod 7 which extends through a suitable aperture 61 in the lower head, and is provided with the usual packing rings 62.

The cylinder 9 is jacketed at 63 and receives jacket water through the pipe 64 from the outlet port 60, discharging the same from the upper opposite side of the cylinder through a suitable pipe connection into the upper head 12. Head 12 is formed to provide a water inlet 65 from which suitable passages 66 lead about the valve chambers and between the same, as indicated at 67, to a discharge pipe 68.

Mounted upon a shaft 69 journaled within the bearings 70 upon the engine frame, is a pump 71 driven by gear 72 from the gear 20. This pump draws water through the pipe 73 from a radiator or other suitable source and discharges it within the lower head 10, through which it passes to the cylinder 9 and thence to the head 12, as above described, the discharge pipe 68 leading to a radiator or other suitable cooling means.

The operation of the above described apparatus of this invention is substantially as follows: Upon suitable compression being obtained on the upper or head end of the cylinder, as by a hand-crank or other means, the charge is ignited from plug 25 and the piston travels downwardly, giving a working stroke. Cam 18 is so formed and positioned as to open the exhaust valve 39 at a proper point and permit exhaust of the burned gases, whereupon the lever 15 is rocked to its mid position, permitting spring 41 to draw this valve back against its seat. Upon the next down stroke of the engine the rod 16 is so moved by cam 18 as to depress inlet valve 37, thus permitting the admission of a fresh charge to the cylinder, this valve likewise being released by lever 15 and drawn back by spring 41 to its seat at the desired point of cut off. The next upward stroke compresses the charge to ignition, as above set forth. This series of operations is repeated, the spark being adjusted if necessary, through the lever 29, and the engine being otherwise run under the internal combustion principle. The lower end of the cylinder during this action of the piston performs the functions of an air compressor, drawing in air through the ports 47 and 48 upon each upward stroke of the piston and compressing the same to the desired degree upon each down stroke, the compressed air being discharged through the passage 53. During the action of the engine, the pump 71 is continuously operated and forces water through the various passages, as above described, maintaining all parts in cooled condition.

It will thus be seen that there is provided apparatus in which the several objects of this invention are fully achieved.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense. It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween, in so far as these features may be comprehended and claimed in a single application. Under requirement of the Patent Office, the present application is confined to the matter set forth in the following claims.

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

1. In an apparatus of the nature described, in combination, a cylinder head having air inlet and discharge passage extending laterally into the head and thence into the cylinder; a central opening for the passage of a piston rod; water chambers intermediate the air passages; an inlet opening into the first of said water chambers; an outlet opening from the last of said chambers; and a raised circular projection adapted to extend into the cylinder, and containing passages connecting the water chambers in series, substantially as described.

2. In an apparatus of the nature described, a cylinder; a cylinder head having an inner and an outer wall; and an annular projection from said inner wall into the cylinder, said head being provided with a series of passages extending from one wall of the cylinder head to the other, and having intervening water chambers connected one with another in series by passages formed in said annular projection.

3. In an apparatus of the nature described, the combination of a cylinder; a cylinder head provided with air inlet and discharge passages extending through the head from face to face; water chambers intermediate said air passages; a conical or tapering projection rising from the inner face of the cylinder head, and provided with passages connecting the water chambers in series; and a piston within said cylinder of substantially bell shape, to fit closely over and about the projection of the cylinder head.

4. In apparatus of the nature described, a cylinder head of hollow form provided with air inlet and discharge passages, and with valve openings extending through the two walls of the cylinder head and opening into the cylinder, the walls of said passages dividing the cylinder head into separate water chambers; and an annular projection from the inner wall of the cylinder head extending into the cylinder, overhanging the air ports, and containing pasages connecting the water chambers in series, the ports opening into the cylinder being circumferentially elongated, substantially as described.

5. In apparatus of the nature described, the combination of a cylinder having hollow heads and a jacketed body communicating one with another, a rotary pump geared to the main shaft of the engine to be driven thereby; a pipe connecting the casing of the pump with one of the cylinder heads; and a discharge pipe opening from the other cylinder head, whereby water from the pump is caused to pass in succession through one cylinder head, thence through the cylinder jacket, thence through the other cylinder head, and finally to escape therefrom.

In testimony whereof I affix my signature, in the presence of two witnesses.

WILLIAM RILEY McKEEN, Jr.

Witnesses:

Frank Jacob Jumper,

Warren Dean Burton.