

C. K. SALISBURY.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED JUNE 19, 1914.

Patented Mar. 20, 1917.

3 SHEETS—SHEET 1.

1,219,781.

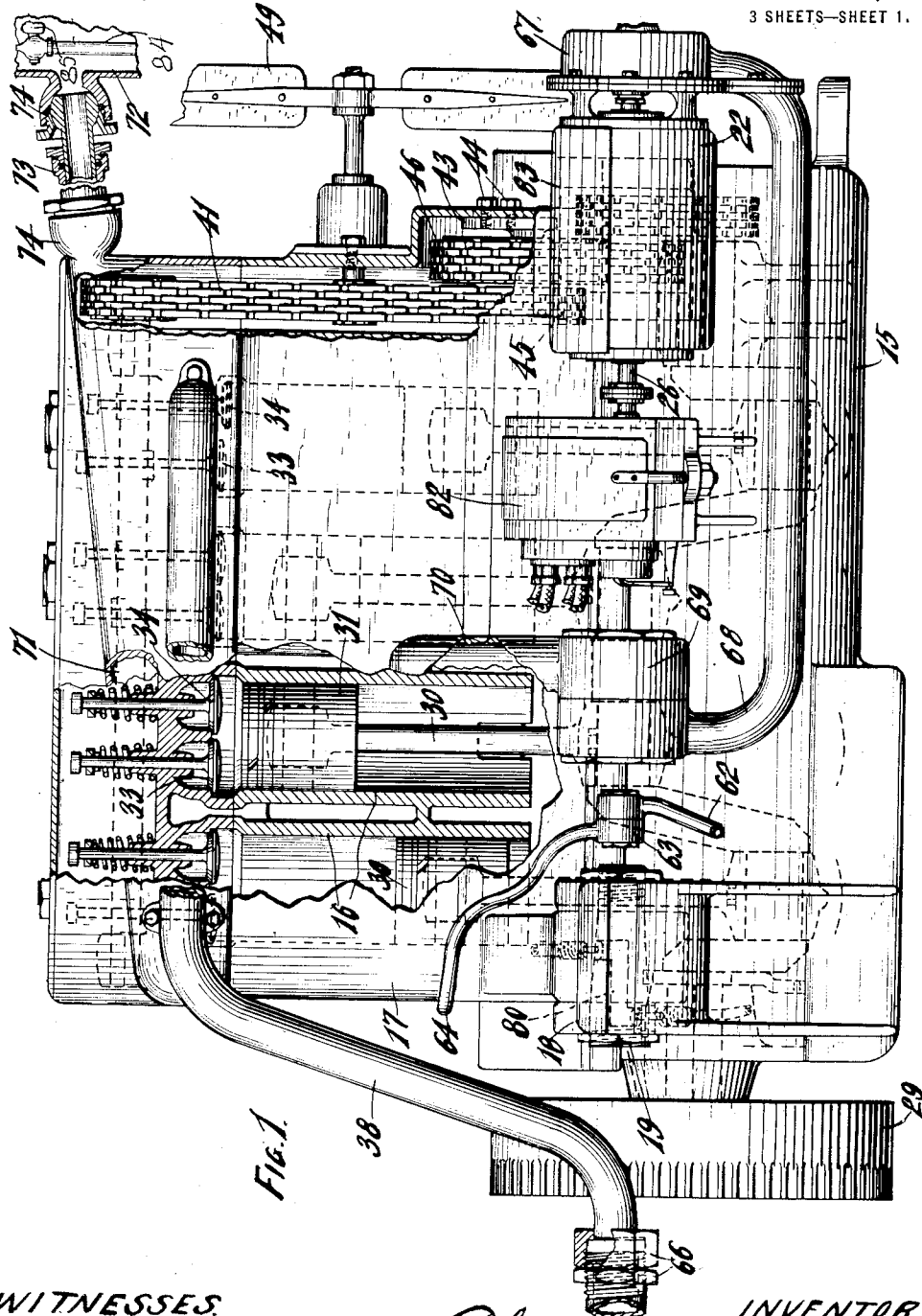


Fig. 1.

WITNESSES

Katherine Holt
Margaret Forrestal

INVENTOR

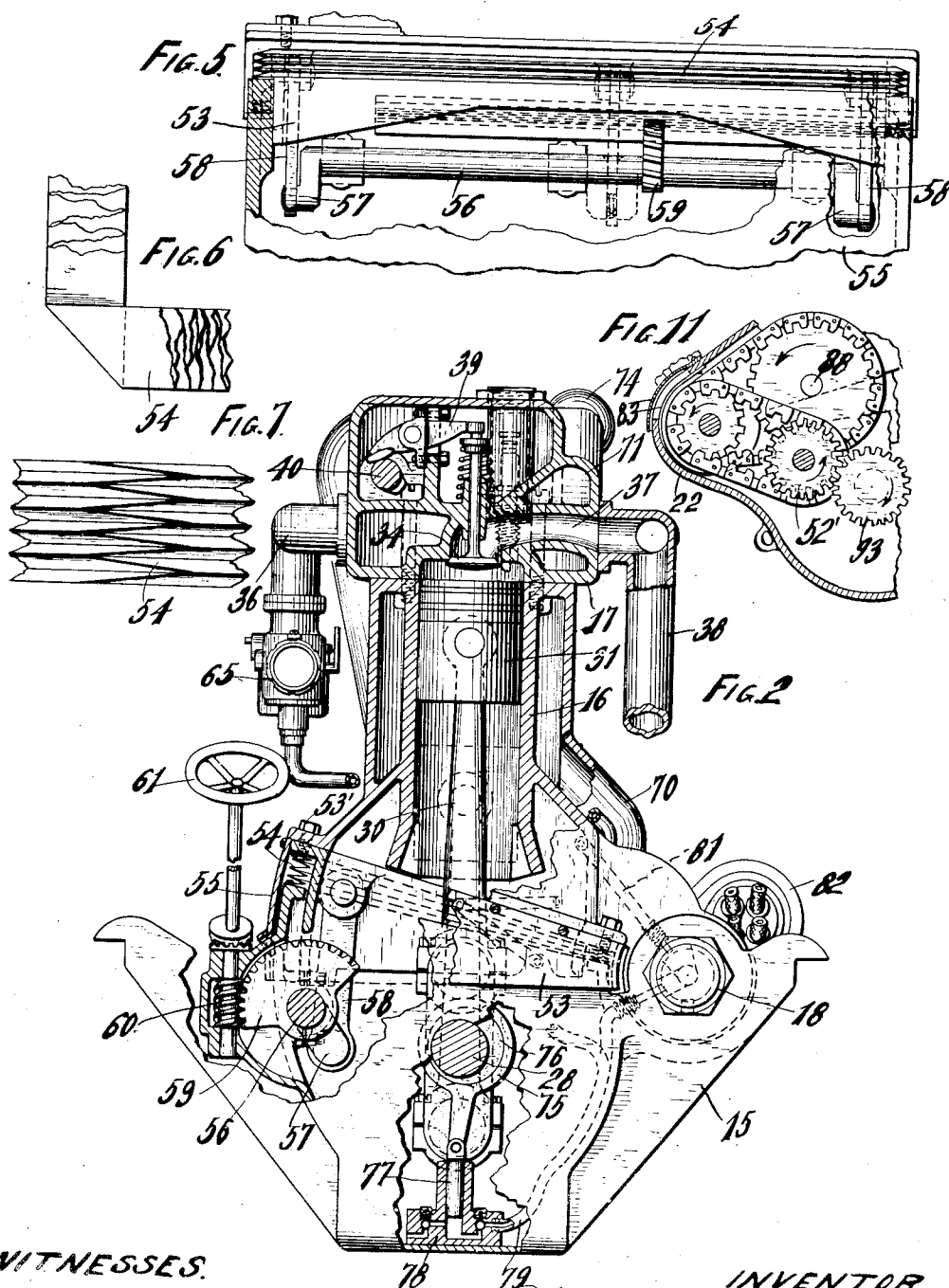
Charles K. Salisbury
By R. C. Caldwell
ATTORNEYS

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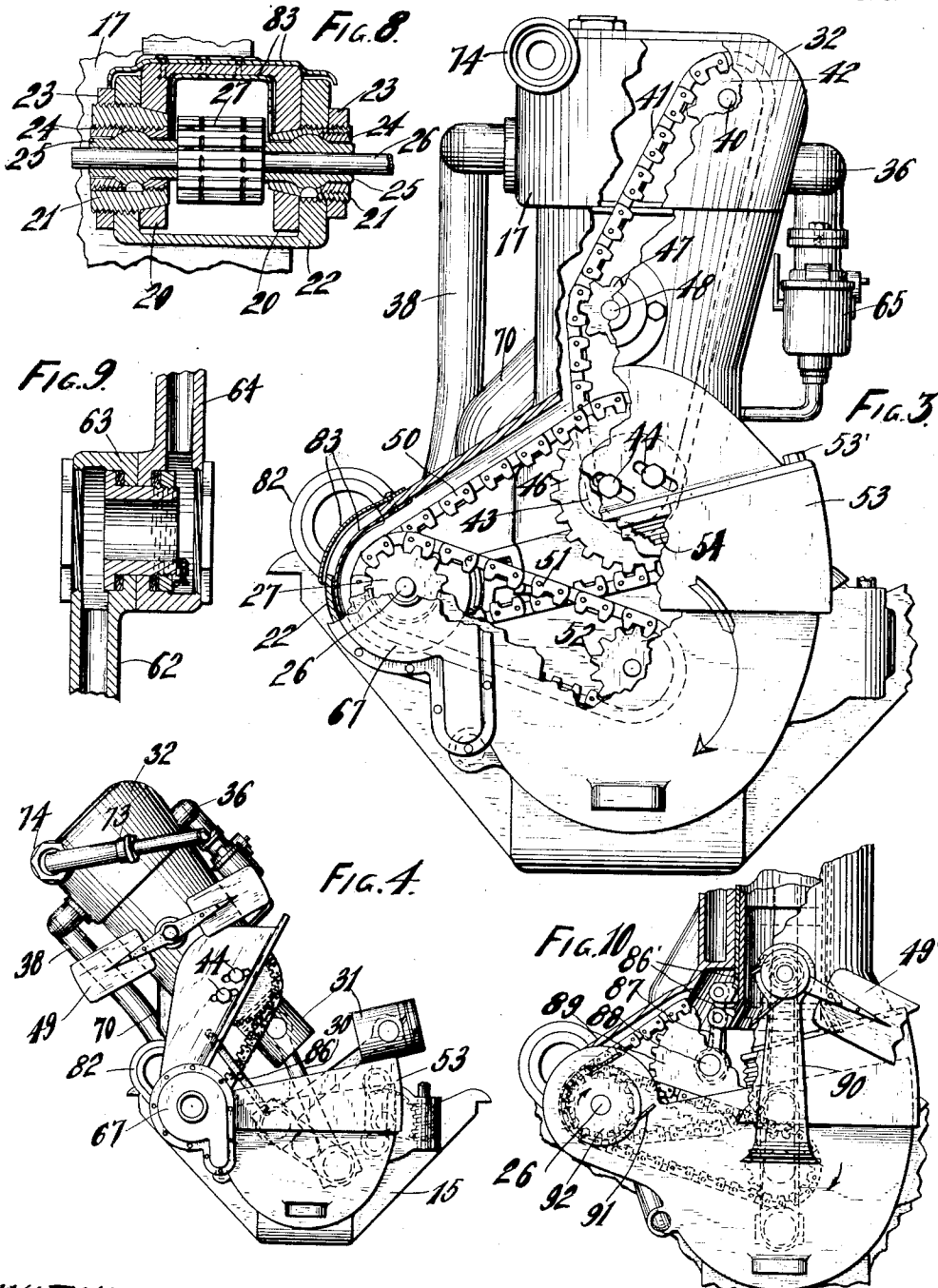
Charles K. Salisbury.
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3 SHEETS—SHEET 3.



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Margaret Forrestal

INVENTOR.

Charles K. Salisbury
By R. S. Caldwell.
ATTORNEY.

UNITED STATES PATENT OFFICE.

CHARLES K. SALISBURY, OF MILWAUKEE, WISCONSIN.

INTERNAL-COMBUSTION ENGINE.

1,219,781.

Specification of Letters Patent.

Patented Mar. 20, 1917.

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To all whom it may concern:

Be it known that I, CHARLES K. SALISBURY, a citizen of the United States, and resident of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a description, reference being had to the accompanying drawings, which are a part of this specification.

This invention has for its object to provide an internal combustion engine for automobile and the like purposes which will be capable of adjustment to vary the size of the combustion chamber by rocking the cylinder on a pivotal axis so as to increase or diminish the distance between the cylinder head and the crank shaft.

Another object of the invention is to utilize such a pivotal connection for the cylinders for the purpose of exposing the interior of the engine for examination or repairs.

Another object of the invention is to provide suitably jointed and flexible pipe connections for maintaining fuel, cooling water and lubricant communication with the engine parts notwithstanding such adjustments.

Another object of the invention is to perfect details of construction in an internal combustion engine of this type.

With the above and other objects in view the invention consists in the internal combustion engine as herein claimed and all equivalents.

Referring to the accompanying drawings in which like characters of reference indicate the same parts in the different views:

Figure 1 is a side elevation of an internal combustion engine constructed in accordance with this invention, parts being broken away to show the interior thereof;

Fig. 2 is a rear end view thereof with parts sectioned through one of the cylinders;

Fig. 3 is a front end view thereof with parts of the casing broken away to show the chain drive connections for the drive shaft, the fan shaft and the cam shaft;

Fig. 4 is a front end view with the cylinders thrown back for exposing the interior of the engine;

Fig. 5 is a detail side view partly in sec-

tion of the means for swinging the cylinders;

Figs. 6 and 7 are detail plan and side views respectively of the bellows-like flexible connection between the stationary and adjustable parts of the casing;

Fig. 8 is a detail view of the double sprocket wheel on the drive shaft;

Fig. 9 is a detail view through one of the pipe connection joints;

Fig. 10 is a detail view, partly in section, of a modification of the construction adapted for use with valves of the sliding sleeve type; or where the timing shaft is placed within the crank case; and

Fig. 11 is a similar view of a further modification in which the drive shaft is turned in the opposite direction to the crank shaft.

In these drawings 15 indicates a base forming the lower part of the crank casing and adapted for rigid connection with the frame of an automobile or the like. The cylinders 16, which may be of any desired number, are carried by an upper casing 17 forming a water jacket around them and also forming the upper part of the crank chamber, said upper casing 17 being pivotally mounted on the base 15 at one side of the engine so as to be capable of swinging thereon from a closed position, such as shown in Fig. 3, to an open position such as shown in Fig. 4. The pivotal connections for the upper casing are differently constructed, that at one end being an ordinary hinge joint 18 formed by a hinge lug projecting from the upper casing fitting between a pair of ears projecting from a bracket on the base with a taper pin 19 fitting therethrough, and that at the other end being of a special construction, shown in detail in Fig. 8, wherein a pair of pivot ears 20 project from the upper casing 17 and fit upon the conical inner ends of screw plugs 21 which are threaded in the ends of a cylindrical projection 22 on the base. The conical plugs 21 are held by lock nuts 23 and are tubular with bushings 24 threaded therein to form spherical bearings for spherical enlargements on sleeves 25 which are thus mounted to rock in any direction as a universal joint within the tubular plugs. These sleeves form self alining bearings for a shaft

carrying a double sprocket wheel 27, the purpose of which will be later explained. A crank shaft 28 is journaled in the base and carries a fly wheel 29 as usual, and has connecting rods 30 connecting the cranks thereof with pistons 31 working within the cylinders 16.

A head casing 32 is mounted on the upper casing and forms the cylinder heads containing the intake valves 33 and exhaust valves 34, the former connected by passageways with an intake manifold 36, and the latter being connected by passageways 37 with an exhaust manifold 38. The valves are operated by rocker arms 39 actuated by cams on a cam shaft 40 extending lengthwise through the head casing and driven by a chain 41 passing around sprocket wheel 42 on said cam shaft. A plate 43 is adjustably secured within the upper casing by means of bolts 44 fitting in inclined slots of the upper casing, and a pair of sprocket wheels 45 and 46 are mounted on this plate and are connected together, the sprocket wheel 45 being smaller than sprocket wheel 46 and having the chain 41 passing therearound. The chain 41 also passes around a sprocket wheel 47 on a fan shaft 48 which passes through the casing and carries a fan 49 on its outer end. A chain 50 connects the sprocket wheel 46 with the double sprocket 27 and a chain 51 connects the double sprocket 27 with a sprocket wheel 52 on the crank shaft. Thus, the shaft 26 which is on the pivotal axis of the hinge connection of the upper casing is driven from the crank shaft at the speed thereof and serves to drive the cam shaft at one-half the speed of the crank shaft because of the sprocket wheel 46 driven from the shaft 26 being twice the size of the double sprocket 27 and because of the sprocket wheel 45 being of the same size as the sprocket wheel 42 on the cam shaft. This arrangement of driving connection from the crank shaft to the cam shaft permits of the swinging of the upper casing on the base without disturbing the operation of the engine.

A segmental apron frame 53 is detachably connected to the lower edge of the upper casing 17 and overlaps the upper edge of the base entirely around the same to prevent the formation of an opening between the upper casing and the base during the tilting adjustments of the upper casing, and in order that the inclosure may be effectively sealed against the admission of dust or the waste of oil from the crank case a bellows-like expansible packing 54 of thin sheet metal is secured in place between the upper edge of the base and the segmental apron frame 53, such bellows packing being folded in the manner of the fold of the leather bellows of a camera, as shown in Figs. 6 and 7. The bellows-like sheet metal packing lies

within the segmental apron frame 53 except at the front where it is on the outside of the curved apron flange thereof, a shield 55 being secured to the apron frame and bearing against the outside of the base to inclose the packing, as shown in Fig. 2.

A shaft 56 is journaled in the base and has cranks 57 at its ends, and if necessary at its intermediate portion, which cranks are connected by links 58 to the segmental apron frame 53 so that the turning of the shaft causes the links to lift or lower the upper casing on its pivotal connections, and a segmental worm wheel 59 on the shaft 56 engages a worm 60 operated by a hand wheel 61 within convenient reach of the driver so that such adjustment may be made at any time, even during the operation of the machine.

This pivotal adjustment of the cylinders with respect to the crank shaft, of course, necessitates an arrangement of the fuel, exhaust, lubrication and water connections that will permit of the adjustment without interruption of such connections. The gasoline supply pipe 62 has a pivotal connection 63, shown in detail in Fig. 9, with the feed pipe 64 leading to the carbureter 65 which is connected with the intake manifold 36. This pivotal connection 63 is located in alinement with the pivotal axis of the upper casing so that the gasoline supply is not interfered with by the adjustment and the exhaust manifold 38 has a swivel connection 66 also on this pivotal axis so that the exhaust connection is not interfered with by the adjustments. The water circulating pump 67 is driven by the shaft 26 which is on the pivotal axis of the upper casing 17, and the water pipe 68 therefrom has a pivotal connection 69, similar in detail to the pivotal connection 63 as shown in Fig. 9, with the water supply passageway 70 leading to the water jacket space surrounding the cylinders. The outlet from the water jacket space surrounding the cylinders is through an inclined passageway 71 in the head casing to the upper end of the radiator 72 by means of a telescopic pipe connection 73 having ball and socket joints 74 at the ends as shown in Fig. 1, thus permitting of an expansion or contraction of this connection during the adjustments of the upper casing. An eccentric strap 75 surrounding an eccentric 76 on the crank shaft is connected with a pump plunger 77 working in a valved pump casing 78 at the bottom of the crank case, and a tube 79 connects the pump casing with the bearing 18 which has a passageway 80 through the respective members thereof to form part of the oil conduit from which another tube 81 leads the oil to the parts to be lubricated on the swinging portion of the engine.

The magneto 82 is mounted on a bracket on the base and is driven from the shaft 26.

The space which is left between the cylindrical projection 22 of the base and the upper casing 17 to permit of the swinging of the upper casing is closed by curved plates 83 secured to the upper casing and fitting inside and outside of the curved wall of said projection 22. The overflow pipe 84 from the radiator is provided with a petcock 85 which may be closed at the time of opening the engine casing for inspection, as shown in Fig. 4, and thus prevent the draining of the water from the parts which may be raised above the level of the overflow pipe at such time.

In operation the engine is the same as the ordinary four cycle gas engine, the various features of mechanical construction in which it differs therefrom being designed to permit of the swinging of the cylinders with respect to the crank shaft. This swinging may be effected by the driver during the running of the engine by turning the hand wheel 61 and thereby turning the shaft 56 to cause the links 58 to swing the upper casing on its pivotal connections 18 and 20. The swinging of the upper casing in this manner moves the cylinder heads nearer to or farther from the crank shaft, thus diminishing or increasing the amount of space between the head of each cylinder and its piston at the end of the upper stroke of the piston and consequently varying the volume of the explosion chamber.

It is well understood that in order to obtain maximum efficiency in an explosive engine the mixture of air and gas should be subjected to the same degree of compression irrespective of the variation in volume thereof. With an engine having an explosion chamber incapable of adjustment as to size a full charge of explosive mixture drawn in with the throttle open will receive a greater compression than a partial charge drawn in with the throttle closed owing to the greater volume of the mixture in the first case and the fact that it is compressed to occupy the same space in both cases. Thus, if the engine is designed with a combustion chamber of a size which will cause the charge to be compressed to the degree for giving greatest efficiency on full load when the throttle is open it will not develop sufficient compression of a partial charge when running at high speed or with less than full load with a partially closed throttle.

With the engine of the present invention efficiency may be obtained in the various running speeds of the engine, for the charge whether it be large or small may be given the same degree of compression by adjusting the size of the combustion chamber to suit the volume of the charge. Furthermore this adjustment may be accomplished

without affecting the various pipe connections of the engine or the driving connection for the parts and without opening the crank casing to admit dust or permit the loss of lubricant.

Another advantage for the pivotal cylinder construction is that it affords an opportunity for ready inspection of the interior of the engine, it being only necessary to remove the bolts 53' and thus disconnect the upper casing 17 from the segmental apron frame 53 when the entire upper structure may be thrown back to the position shown in Fig. 4 where it is held by toggle link stays 86 connecting the base with the upper casing. In this position of the parts the pistons may be withdrawn from the cylinders by turning the crank shaft and thus exposing them and the interior of the cylinders for cleaning or repairs and opening up the entire interior of the crank case for adjustments or any other purpose.

With the direction of rotation of the crank shaft as indicated by the arrow in Fig. 3 and the cylinders with their axes in the plane of the crank shaft when the combustion chambers are reduced to approximately the smallest adjustment, the axes of the cylinders will assume an offset position with relation to the crank shaft on the right side thereof when an adjustment is made to increase the volume of the combustion chambers, the amount of offset varying with the degree of adjustment so that as the combustion chambers are increased in volume to receive larger charges of explosive mixture the offset of the cylinders with relation to the crank shaft is increased.

In Fig. 10 a modification of the invention is shown, wherein the sleeve type of valve is used. In this construction the valve sleeves 86' are operated from eccentrics 87 on a shaft 88 carrying a sprocket wheel 89 which is driven by the chain 50 in place of the sprocket wheel 46 of the other construction. In this form of the device the fan 49 may be mounted on a standard 90 extending upwardly from the base, the fan being driven by a belt 91 from a pulley 92 on the shaft 26. With this construction the valve operating shaft 88 rotates in the same direction as the crank shaft, but in Fig. 11 it is shown that the shaft 88 may be rotated in the opposite direction to the crank shaft by substituting a gear and sprocket wheel 52' on a suitably mounted stud for the sprocket wheel 52 and driving said gear and sprocket wheel 52' by means of a gear wheel 93 on the crank shaft.

The inlet and exhaust valves will both open and close earlier in the cycle of operation of the engine when adjustment is made to increase the capacity of the explosion chambers when the construction is such that the shaft 26 rotates in the same direction as

the crank shaft and with the crank shaft turning in the direction indicated in Fig. 3. This condition is changed, however, and the opening and closing of the valves will occur later in the cycle of operation of the engine when the shaft 26 is rotated in the opposite direction to the crank shaft in the manner shown in Fig. 11.

The upper casing 17 should be hinged to the base at at least two points as far apart longitudinally as possible. The adjustable support for the segmental apron frame 53 by means of the links 58 at the opposite side of the crank case should also be at two points at least and as far apart longitudinally of the engine as possible, and to make the supports rigid throughout the various adjustments it is necessary that there be no end movement possible in either the hinge connections or the adjustable supports. To this end the hinge connections are made secure by the adjustable tapered bearings thereof and the end movement at the opposite side is prevented by the close sliding fit between the ends of the segmental apron frame 53 and the inside of the crank case against which it fits as shown in Fig. 5.

Any system of valves other than that shown may be used with this engine and the valve driving mechanism herein shown suitably modified for the proper driving thereof. Any other form of driving connection may be employed instead of the silent chain type shown, due regard being given to the direction of rotation of the valve shaft 40 and the half time shaft 26 to insure the correct action of the valves when the combustion chambers are adjusted to their maximum or minimum capacity.

What I claim as new and desire to secure by Letters Patent is:

1. In an internal combustion engine, a base, a crank shaft mounted in the base, a cylinder pivotally mounted on the base, a piston fitting within the cylinder and connected with the crank shaft and cylinder adjusting and clamping means for swinging the cylinder on the base to vary the volume of the combustion chamber, said means serving to maintain the cylinder rigid with the base for any volume adjustment of the combustion chamber, and relatively fixed means for gearing the crank shaft to driven mechanism.

2. In an internal combustion engine, a base, a relatively fixed crank shaft mounted in the base and having gear driving connections, a cylinder pivotally mounted on the base, a piston fitting within the cylinder and connected with the crank shaft, and means for swinging the cylinder on the base during operation of the engine to vary the volume of the combustion chamber therein.

3. In an internal combustion engine, a base, a crank shaft journaled in the base,

a cylinder pivotally mounted on the base, a piston fitting within the cylinder and connected with the crank shaft, valve mechanism carried by the cylinder, valve operating means on the pivotal axis of the cylinder driven from the crank shaft and operating the valve mechanism, and means for swinging the cylinder on its pivotal connection with the base to vary the size of the explosion chamber thereof.

4. In an internal combustion engine, a base, a crank shaft journaled therein, an upper casing containing a cylinder pivotally mounted on the base, a piston fitting in the cylinder and connected with the crank shaft, a segmental apron frame surrounding the opening of the base and detachably connected with the upper casing, and means for adjusting the position of the segmental apron frame with relation to the base for varying the size of the combustion chamber of the cylinder.

5. In an internal combustion engine, a base, a crank shaft journaled therein, an upper casing pivotally mounted on the base and containing a cylinder, a piston fitting in the cylinder and connected with the crank shaft, a segmental apron frame slidably fitting around the opening of the base and detachably connected with the upper casing, and a bellows-like sheet metal packing connecting the segmental apron frame with the base around the opening of the base.

6. In an internal combustion engine, a base having an opening forming a crank chamber, a crank shaft journaled therein, an upper casing pivotally mounted on the base and carrying a cylinder, a piston fitting in the cylinder and connected with the crank shaft, means for swinging the upper casing on its pivotal connection, and a flexible packing of sheet metal of a bellows-like construction connecting the upper casing with the base around the opening of the base.

7. In an internal combustion engine, a base, a crank shaft journaled therein, an upper casing pivotally mounted on the base and carrying a cylinder, a piston fitting in the cylinder and connected with the crank shaft, a shaft journaled in the base, a worm segment thereon, a suitably operated worm mounted in the base engaging the worm segment for turning said shaft, crank arms on said shaft, and links having connection with the crank arms and with the upper casing for swinging the upper casing on its pivotal connections.

8. In an internal combustion engine, a base, a crank shaft journaled therein, a cylinder pivotally mounted on the base, a piston fitting in the cylinder and connected with the crank shaft, and pipe connections for the cylinder having pivotal joints in the axis of the pivotal connection of the cylinder.

9. In an internal combustion engine, a base, a crank shaft journaled therein, a cylinder pivotally mounted on the base, a shaft journaled through the axis of one of the
5 pivotal connections of the cylinder with the base, a magneto and a water pump connected with said shaft, a driving connection between the crank shaft and the said shaft, a valve mechanism carried by the cylinder, a
10 driving connection between the said shaft and the valve mechanism, and means for swinging the cylinder on its pivotal connections.

10. In an internal combustion engine, a
15 base, a crank shaft journaled therein, an upper casing containing a cylinder pivotally mounted on the base, one of the pivotal connections being hollow, a piston fitting in the cylinder and connected with the crankshaft,
20 a shaft journaled through said pivotal connection on the pivotal axis of the upper casing, a double sprocket on the shaft within the hollow of the pivotal connection, a driving chain connecting the double sprocket
25 with the crank shaft, a valve mechanism on the upper casing, and a chain connecting the double sprocket with the valve mechanism.

11. In an internal combustion engine, a
30 base, a crank shaft journaled therein, an upper casing pivotally mounted on the base and carrying a cylinder, a piston fitting in the cylinder and connected with the crank shaft, one of the pivotal connections for
35 the upper casing being hollow and communicating with the interior of the crank case, a shaft journaled through said pivotal connection on the pivotal axis of the upper casing, a double sprocket on the shaft within
40 the hollow pivotal connection, a drive chain connecting the double sprocket with the crank shaft, a cam shaft carried by the upper casing for controlling the valves of
45 the cylinder, a sprocket wheel journaled within the upper casing, a drive chain connection between the double sprocket and said sprocket wheel, and a drive chain connection between said sprocket wheel and the cam shaft.

12. In an internal combustion engine, a
50 base having an opening forming a crank case, a crank shaft journaled therein, an upper casing pivotally mounted on the base and carrying a cylinder, a piston fitting in the cylinder and connected with the crank
55 shaft, one of the pivotal connections for the upper casing being hollow and opening into the crank case, a shaft journaled through such pivotal connection on a pivotal axis
60 of the crank case, a double sprocket thereon within the hollow, pivotal connection, a chain connection between the double sprocket and the crank shaft, a valve mechanism on the upper casing, a chain connection between the double sprocket and the
65 valve mechanism, a segmental apron frame

detachably connected with the upper casing and slidably fitting against the edges of the opening of the base, and means for swinging the upper casing on the base.

13. In an internal combustion engine, a
70 base having an opening forming a crank case, a crank shaft journaled therein, an upper casing pivotally mounted on the base, a cylinder carried thereby, a piston fitting in the cylinder and connected with the
75 crank case, one of the pivotal connections of the upper casing being formed by interfitting pairs of ears on the upper casing and the base respectively, conical plugs threaded
80 in the outer ears with their conical ends forming trunnions on which the inner ears are mounted, bushings fitting within the conical plugs and forming spherical bearings
85 therein, sleeves having spherical enlargements fitting within the spherical bearings of the conical plugs, a shaft journaled through the sleeves, a double sprocket on the shaft within the pivotal connection, a chain connecting the double sprocket with
90 the crank shaft, a valve mechanism carried by the upper casing, and a chain connecting the double sprocket with the valve mechanism.

14. In an internal combustion engine, a
95 base, a crank shaft mounted therein, a cylinder pivotally mounted on the base, a piston fitting in the cylinder and connected with the crank shaft, a water jacket carried by the cylinder, a water supply pipe having a pivotal joint on the axis of the pivotal
100 connection of the cylinder, a radiator, and a telescopic tube connection having ball and socket joints with the upper end of the cylinder and with the radiator respectively.

15. In an internal combustion engine, a
105 base, a crank shaft journaled therein, an upper casing pivotally mounted on the base, a cylinder carried thereby, a shaft journaled on the pivotal axis of the upper casing, a driving connection between the shaft and
110 the crank shaft, a valve mechanism and a fan carried by the upper casing, and a chain connection between said shaft and the valve mechanism and the fan.

16. In an internal combustion engine, a
115 base, a crank shaft mounted in the base, a cylinder pivotally mounted on the base, a piston fitting within the cylinder and connected with the crank shaft, and cylinder adjusting and clamping means for adjusting
120 the capacity of the combustion chamber by swinging the cylinder on the base, said means serving to maintain the capacity as adjusted against the force of explosions within the combustion chamber.

17. In an internal combustion engine, a
125 base, a crank shaft journaled therein, a cylinder adjustably mounted with relation to the crank shaft, a piston fitting in the cylinder and connected with the crank shaft, 130

- valve mechanism for the cylinder, means for adjusting the cylinder to vary the size of the explosion chamber thereof without affecting the degree of opening of the valves, and driving means connecting the crank shaft with the valve mechanism and adapted to vary the timing of the operation of the valve mechanism incident to the adjustment of the cylinder.
18. In an internal combustion engine, a base, a crankshaft journaled therein, a cylinder adjustably mounted on the base to move toward or away from the crank shaft, a piston fitting in the cylinder and connected with the crank shaft, means for adjusting the cylinder to vary the size of the explosion chamber thereof without affecting the degree of opening of the valves, a valve mechanism for the cylinder, and driving means connecting the crank shaft with the valve mechanism and subject to adjustment with the adjustment of the cylinder whereby the timing of the operation of the valve mechanism is varied with the variation in the size of the explosion chamber.
19. In an internal combustion engine, a base forming a crank case, a crank shaft rotatably mounted therein, a cylinder having a hinge connection with the crank case at one side thereof, a piston in the cylinder connected with the crank shaft, and means for adjusting and securing said cylinder to said crank case to vary volume of combustion chamber during operation of the engine.
20. In an internal combustion engine, a base forming a crank case, a crank shaft rotatably mounted therein, a cylinder having a hinge connection with one side of the crank case, a piston in the cylinder connected with the crank shaft, means for adjusting and securing the cylinder to the crank case, a conduit for cooling liquid fixed relative to said crank case, a second conduit for cooling liquid fixed relative to said cylinder and a swivel coupling connecting the conduits, the axis of said swivel coupling coinciding with the axis of the hinge connection of the crank case with the cylinder.
21. In an internal combustion engine, a base forming a crank case, a crank shaft rotatably mounted therein, a cylinder having a hinge connection with one side of the crank case, a piston in the cylinder connected with the crank shaft, means for adjusting and securing the cylinder to the crank case,

a conduit for liquid fuel fixed relative to said crank case, a second conduit for liquid fuel fixed relative to said cylinder, and a swivel coupling connecting the conduits, the axis of said swivel coupling coinciding with the axis of the hinge connection of the crank case with the cylinder.

22. In an internal combustion engine, a base forming a crank case, a crank shaft rotatably mounted therein, a cylinder having a hinge connection with one side of the crank case, a piston in the cylinder connected with the crank shaft, means for adjusting and securing the cylinder to the crank case, an oil conduit fixed relative to said crank case, a second oil conduit fixed relative to said cylinder, and a swivel coupling connecting the conduits, the axis of said swivel coupling coinciding with the axis of the hinge connection of the crank case with the cylinder.

23. In an internal combustion engine, a base forming a crank case, a crank shaft rotatably mounted therein, a cylinder having a hinge connection with one side of the crank case, a piston in the cylinder connected with the crank shaft, means for adjusting and securing the cylinder to the crank case a conduit for exhaust gases fixed relative to said crank case, a second conduit for exhaust gases fixed relative to said cylinder, and a swivel coupling connecting the conduits, the axis of said swivel coupling coinciding with the axis of the hinge connection of the crank case with the cylinder.

24. In an internal combustion engine, a base, a crank shaft mounted in the base, a cylinder pivotally mounted on the base, a piston fitting within the cylinder and connected with the crank shaft, and means for swinging the cylinder on the base to vary the volume of the combustion chamber, said means serving to maintain the cylinder rigid with the base for any variation of the volume of the combustion chamber and means for performing an abnormal swinging of the cylinder on the base for withdrawing the piston from the cylinder.

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

CHARLES K. SALISBURY.

Witnesses:

R. S. C. CALDWELL,
KATHERINE HOLT.