Oct. 20, 1931 C. H. ERICSON 1,827,938

INTERNAL COMBUSTION MOTOR

Filed March 6, 1929 4 Sheets-Sheet 1

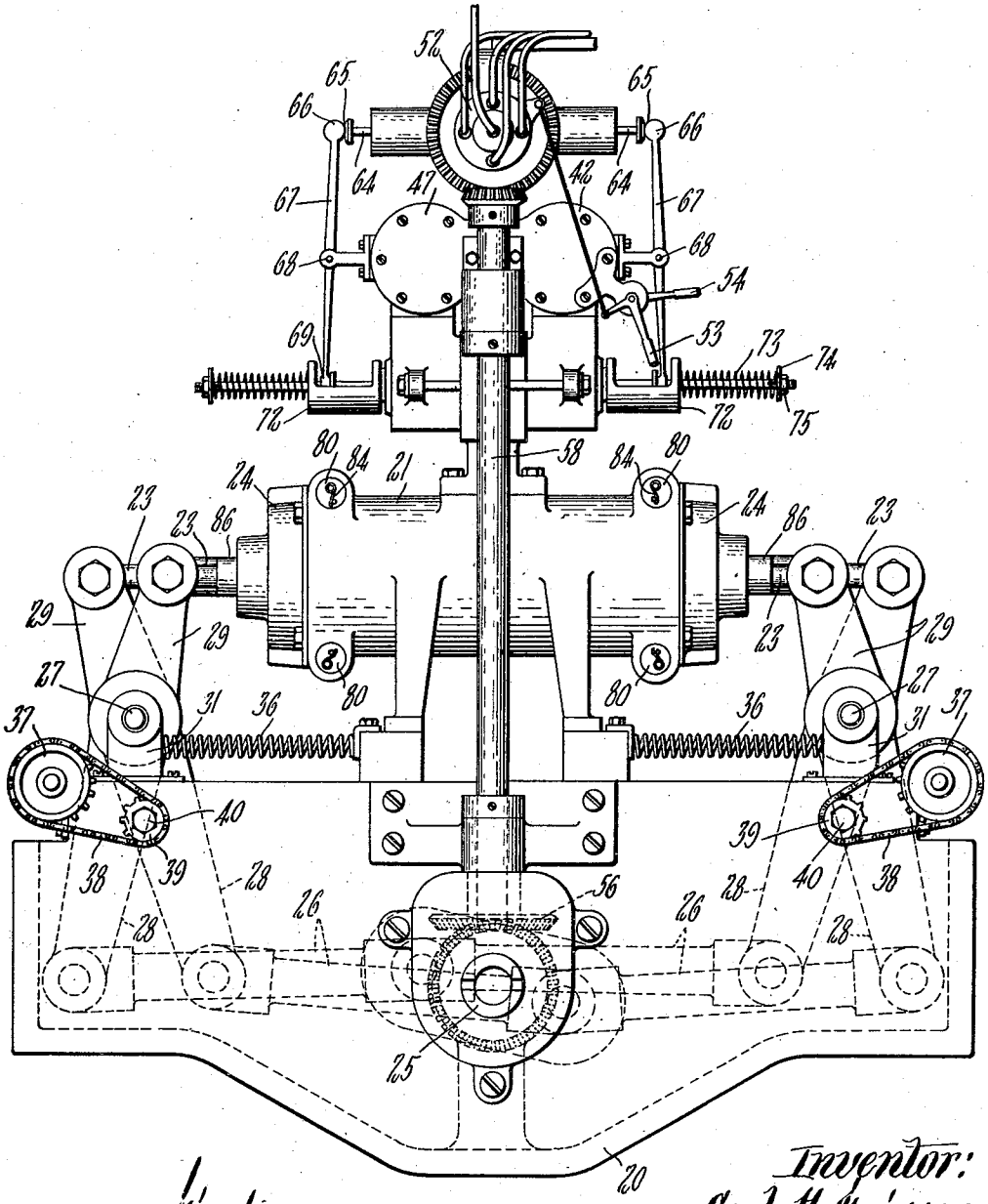


Fig. 1.

Inventor:
Carl H. Ericson,
by Wright, Brown, Quinby & May
Attys.

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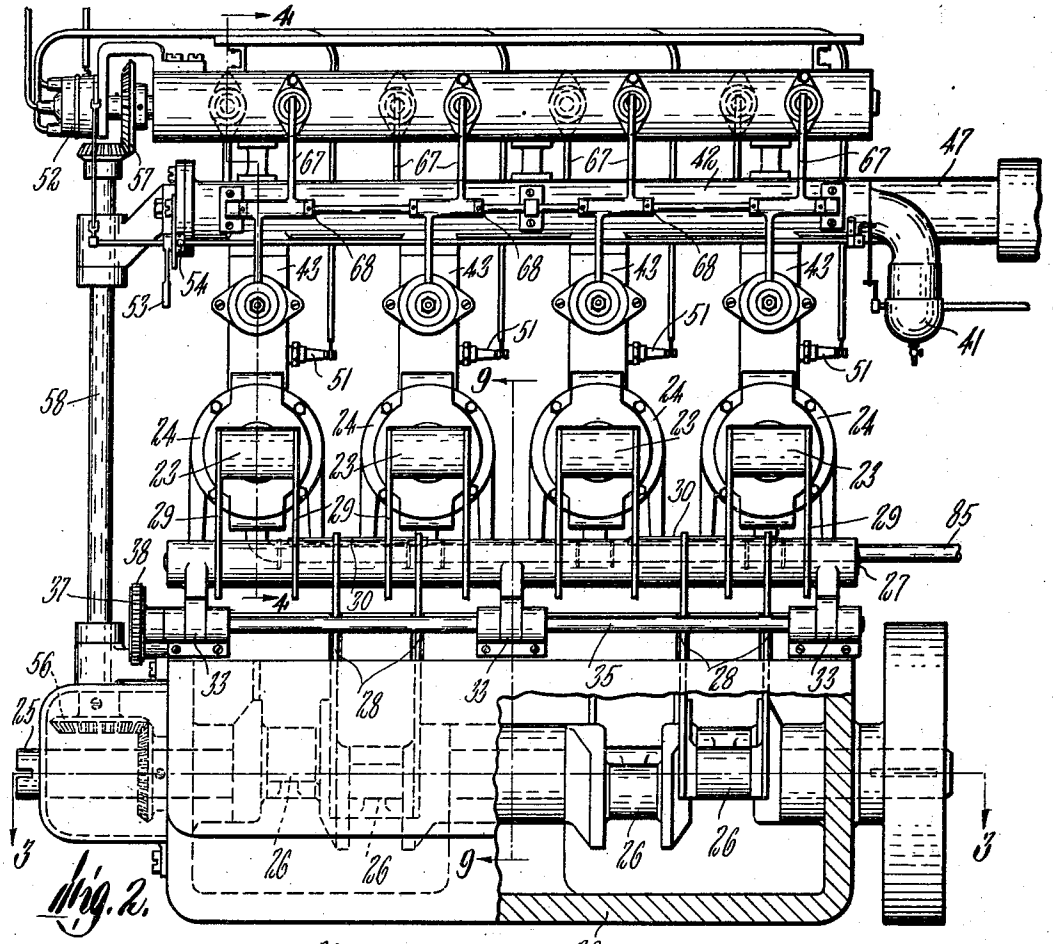


Fig. 2.

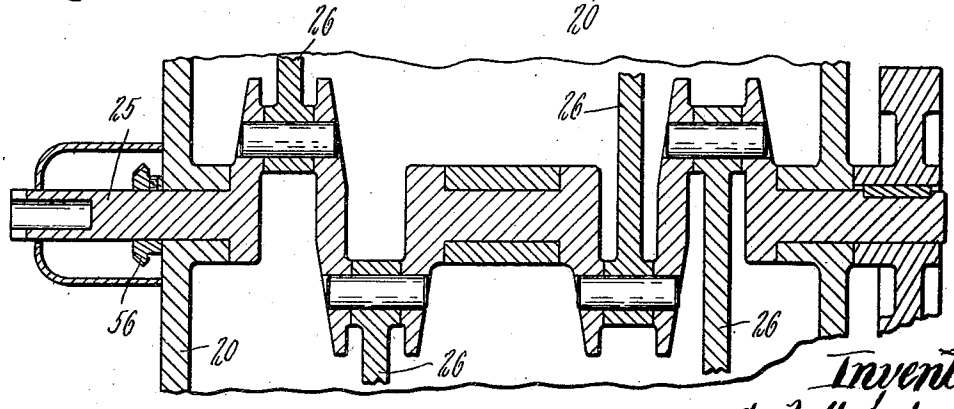


Fig. 3.

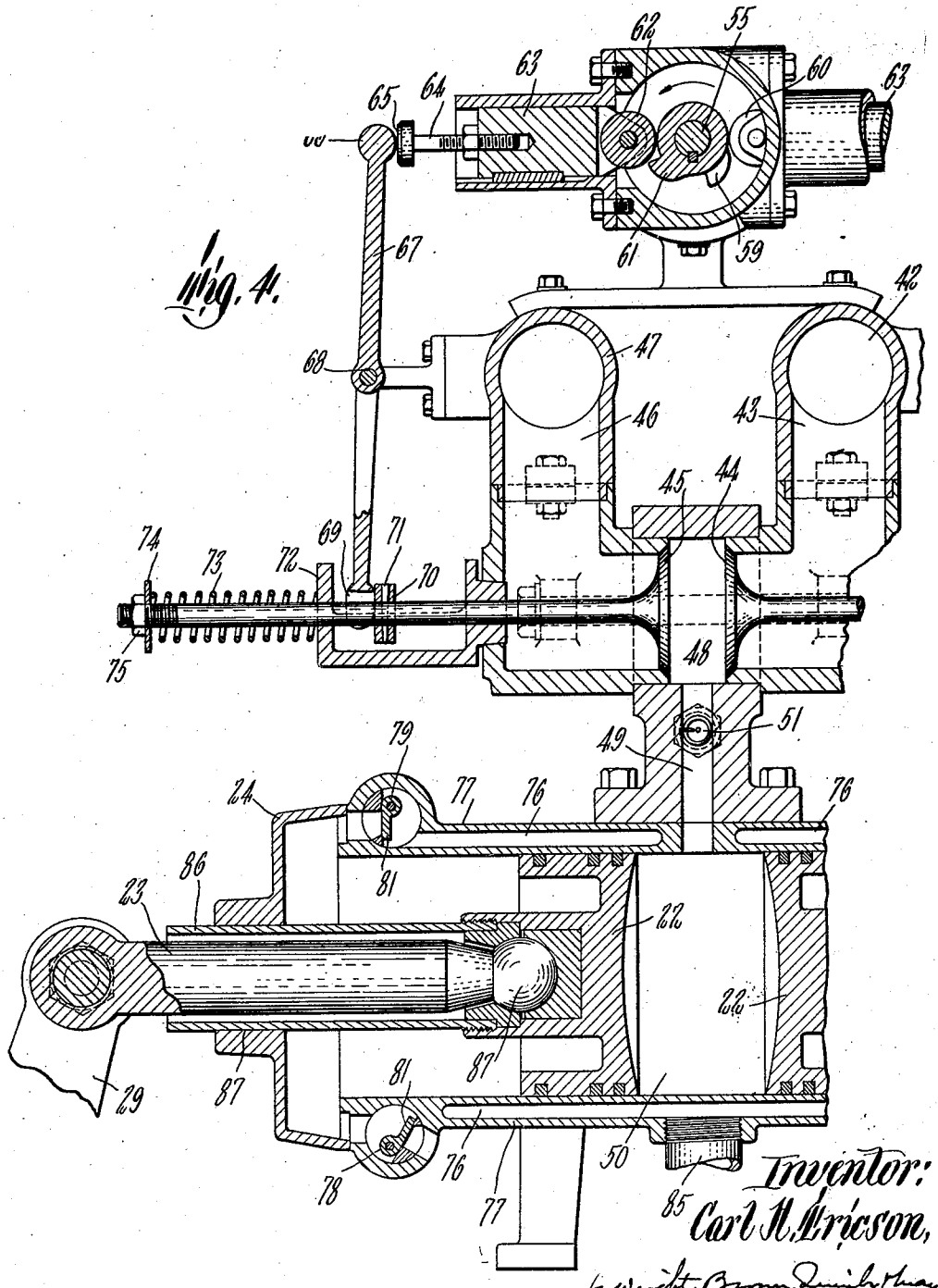
Inventor:
Carl H. Ericson,
by Wright, Brown, Quinby & May
Attys.

Oct. 20, 1931. C. H. ERICSON 1,827,938

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Fig. 4.



Inventor:
Carl H. Ericson,
by Wright, Brown, Quinby & Hay
Attys.

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INTERNAL COMBUSTION MOTOR

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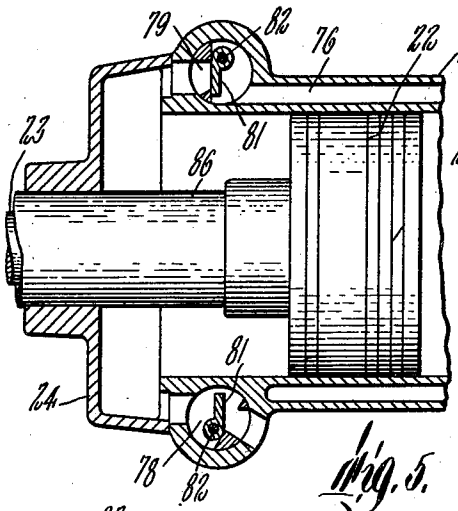


Fig. 5.

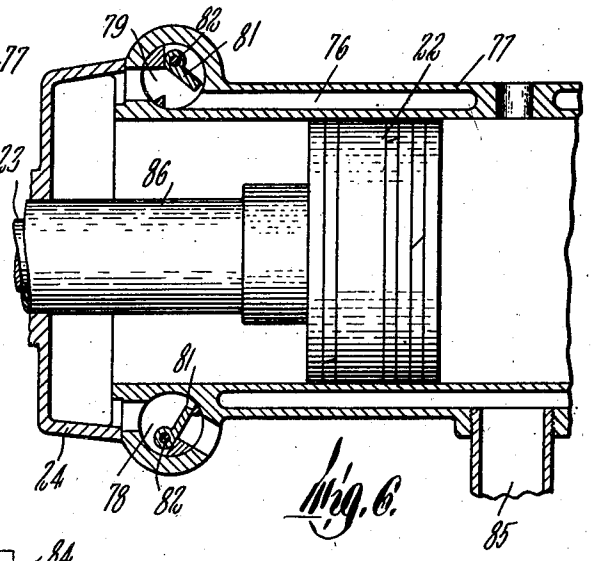


Fig. 6.

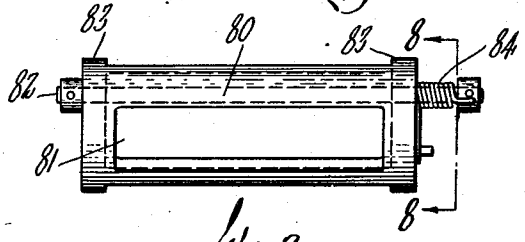


Fig. 7.

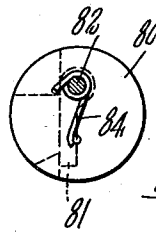


Fig. 8.

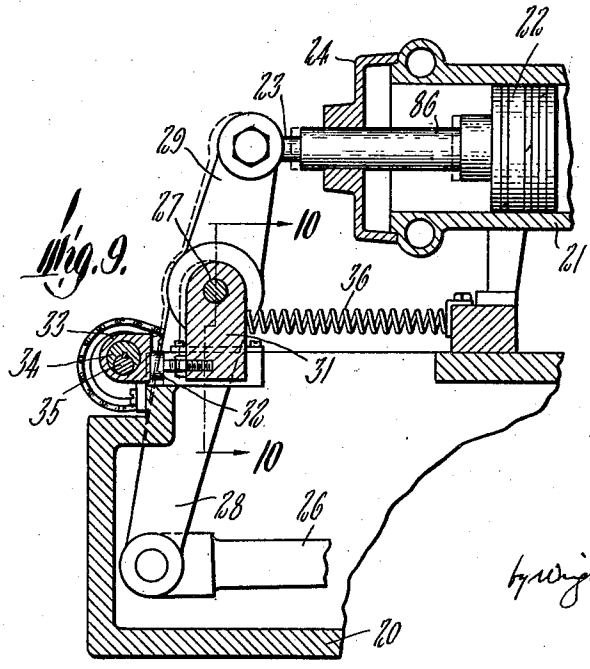


Fig. 9.

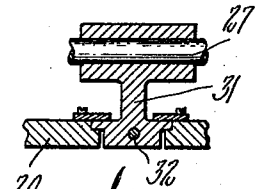


Fig. 10.

Inventor:
Carl H. Ericson,
by Wright, Brown, Quinby & May
Attys.

Patented Oct. 20, 1931 1,827,938

UNITED STATES PATENT OFFICE

CARL H. ERICSON, OF BOSTON, MASSACHUSETTS

INTERNAL COMBUSTION MOTOR

Application filed March 6, 1929. Serial No. 344,679.

This invention relates to improvements in internal combustion motors wherein an explosive mixture of air and fuel is compressed in a chamber and ignited to drive a piston which is connected by suitable mechanism to a rotatable shaft. Motors of this type which are used to drive aeroplanes are frequently carried thereby to high altitudes where the atmosphere is considerably rarefied. Thus a lesser amount of air is drawn into the explosion chamber so that the compression of the charge at the moment of ignition is less than when the motor is operating in denser atmosphere. By my invention, this may be offset to some extent by changing the stroke of the piston while the motor is running, thus diminishing the minimum volume of the explosion chamber. Ordinarily the ends of an explosion chamber in an internal combustion motor are formed by the cylinder head and the piston. According to my invention a second piston is used instead of the cylinder head so that the minimum volume of the chamber may be further regulated by altering the stroke of one or both of the pistons.

Another object of the invention is to utilize the pistons as pumps for circulating a cooling liquid, such as air, through the engine jacket. For this purpose I preferably make the pistons shorter than usual and provide means for keeping the pistons alined in the cylinders so as to prevent binding against the cylinder walls and undue wear resulting therefrom.

Other advantageous features of construction will be apparent to one skilled in the art from the disclosure of the invention which follows, and from the drawings, of which,—

Figure 1 is an end elevation of a motor embodying the invention.

Figure 2 is a side elevation of the same.

Figure 3 is a section on the line 3—3 of Figure 2.

Figure 4 is a fragmentary section on the line 4—4 of Figure 2.

Figure 5 is a fragmentary section of one of the cylinders.

Figure 6 is a similar section showing the working parts in a different position of operation.

Figure 7 is a side elevation of a one-way valve used in the cooling system for the motor.

Figure 8 is an end elevation of the same.

Figure 9 is a fragmentary section on the line 9—9 of Figure 2.

Figure 10 is a fragmentary section on the line 10—10 of Figure 9.

Referring to the drawings in detail, Figures 1 and 2 illustrate an internal combustion motor having a suitable base 20 on which are supported a plurality of cylinders 21, four such cylinders being included in the embodiment illustrated. Each of the cylinders 21 is provided with a pair of opposed pistons 22, the piston rods 23 extending outwardly through the opposite cylinder heads 24 so that the explosion chamber in each cylinder is defined by two of the pistons instead of one as in usual construction. Journaled in the base 20 is a suitable crank shaft 25 to which are connected a series of pitmen 26. The pitmen 26 are connected respectively to certain of the piston rods 23 as by walking beams rockably mounted on axles 27 on either side of the motor. In the motor illustrated, four pitmen 26 are provided, two extending toward the intake side of the motor and two toward the exhaust side. Of the pair extending toward the intake side, each is connected to a pair of lever arms 28 which rock about the axles 27, the pair on the exhaust side also having similar connecting parts. The piston rods 23 are connected to pairs of lever arms 29 which also rock on the axles 27. Each of the arms 28 is keyed to the two pairs of arms 29 adjacent thereto as by a key 30 so that the connected arms 28 and 29 together constitute a walking beam connecting each pitman 26 with a pair of piston rods 23. The axles 27 are adjustably mounted for lateral movement. For this purpose each one is mounted on a suitable support 31 which may slide in a groove or slot formed in the upper portion of the base 20, this construction being illustrated in Figures 9 and 10. The support 31 may be provided with an adjustable set screw 32 which serves as an abut-

ment for a block 33 which has a bore therethrough to receive an eccentric 34 which is mounted on a shaft 35. By rotating the eccentric 34, the block 33 may be moved in or out, thus moving the support 31 with the axle 27 inwardly or permitting outward movement of the axle by pressure of a suitable spring 36. In order to rotate the eccentric shaft 35, I may use any convenient and suitable mechanism. As shown, I have provided a sprocket wheel 37 fixed to an end thereof, this sprocket wheel being connected as by a chain 38 to a smaller sprocket wheel 39. The sprocket wheel 39, as shown, is provided with a hexagonal head 40 by which the wheel may be turned with a key-wrench or other suitable tool. I may, however, use a crank handle or any other suitable mechanical equivalent for this purpose. Each of the axles 27 may be independently shifted by the rotation of the corresponding sprocket wheel 39. I may, however, connect the two sprocket wheels 39 for simultaneous rotation by any suitable mechanism, not shown. By shifting the axles 27, it is obvious that the strokes of the pistons 22 will be altered. For example, if the axles 27 are moved inwardly, that is, toward each other, the confronting faces of each pair of pistons 22 will approach closer to each other on the compression stroke, so that the compression chamber will be reduced in size and the compression of the charge will be increased.

The explosive mixture for the motor may be supplied as by a suitable carburetor 41 which, as shown in Figure 3, is connected to an intake manifold 42. Each cylinder communicates with an intake manifold as by a branch pipe 43 leading from the manifold through a valve opening which is controlled by an intake valve 44. Opposed to each valve 44 is an exhaust valve 45 which permits the escape of spent gases to a suitable pipe 46 into an exhaust manifold 47. Between each pair of valves 44, 45 is a small chamber 48 communicating as by a suitable passage 49 with the explosion chamber 50, the chamber 48 and passage 49 thus being virtually a part of the explosion chamber. In any suitable location, such as the passage 49, I insert a spark plug 51 by which the explosive mixture under compression may be fired. The spark plugs 51, as shown in Figure 2, may be connected to a suitable commutator 52 in a manner well known to the art, the commutator being controlled by a suitable lever 53. Adjacent to the commutator 52 I may also mount a suitable throttle 54 to control the carburetor 41. The valves 44 and 45 may be operated by any suitable mechanism such as that illustrated in Figure 4. As shown, a cam shaft 55 may be driven from the crank shaft 25 as by suitable miter gears 56, 57 connected by a shaft 58. The gears 57 are preferably in a ratio of 1:2, so that the cam shaft 55 rotates at one-half the speed of the crank shaft 25. Mounted on the cam shaft 55 are a number of cams 59 which engage cam followers 60 so as to open the intake valves 44 at the proper times. The cam shaft also carries cams 61 which engage cam followers 62, thus controlling the operation of the exhaust valves 45. The mechanical connecting means between the cam followers and their respective valves is illustrated in Figure 4. As shown, each cam follower comprises a roller carried by a slide 63. The slide also carries a set screw 64 which is adjustable in the slide and which includes an abutting face 65 against which is pressed the end 66 of a rock lever 67, pivotally mounted as at 68. The opposite end of the lever 67 may be fork shaped as at 69 to straddle a stem of the valve which it operates. This fork may be pressed against a collar 70 suitably secured as by a pin 71 to the valve stem. If preferred, the valve stem itself may be provided with a reduced portion having a shoulder against which the fork 69 may rest. A bracket 72 extends outwardly from the motor casing beyond the fork 69. A valve spring 73 is provided on the portion of the valve stem extending outwardly beyond the bracket 72, this spring being compressed between a face of the bracket 72 and a suitable washer 74, mounted on the end portion of the valve stem and held thereon as by a nut 75. This valve spring tends to close the valve. As the cam shaft 55 rotates, the cams thereon engage their respective cam followers at suitable times, moving the slides 63 outwardly so that the levers 67 are rocked, pushing against the collars 70, and opening the valves against the pressure of the valve springs 73.

In order to ensure efficient cooling of the motor, I provide means for circulating a cooling fluid through the passages 76 which are formed by suitable jackets 77 surrounding the cylinders. The cooling fluid which may be atmospheric air, may be circulated through the passages 76 by the pumping action of the pistons 22. As shown in Figure 4, the explosion chamber in each cylinder is located between the confronting faces of each pair of pistons 22. The opposite faces of the pistons are utilized to pump air or other cooling fluid into the chamber formed by the piston and the corresponding cylinder head 24, one-way valves 78 and 79 being provided to ensure the circulation movement of the cooling fluid through the passages 76. The valves 78 admit atmospheric air or other cooling fluid to the pumping chamber within the cylinder. The valve 79 admits air from the pumping chamber directly into the passage 76. The valves 78 and 79 may be of similar construction as illustrated in Figures 7 and 8. As therein shown, each valve may comprise

a cylinder 80 having relatively large portions of the side walls cut away to provide suitable ports. The valve member itself may comprise a flat plate 81 hinged on a shaft 82 which may be journaled in the end portions 83 of the cylinder 80. A suitable spring 84 may be provided to hold the valve resiliently closed, this spring being preferably light so that the valve may be easily opened by a small increase of pressure on the inlet side thereof. The operation of the valves in connection with the reciprocation of the piston 22 is illustrated in Figures 5 and 6. In the former figure, the piston is shown as moving toward the right and thus sucking in the cooling fluid through the valve 78, the valve 79 being closed at this time to prevent suction of fluid from the passage 76. In Figure 6 the piston is moving as shown toward the left, this resulting in forcing of the air in the pump chamber through the valve 79 into the passage 76, the valve 78 being closed at this time to prevent the escape of air from the chamber therethrough. Thus each piston is used as a pump to circulate cooling fluid through the passages surrounding its cylinder. The cooling medium, after taking up heat from the wall of the cylinders, may be exhausted through any convenient vent as the exhaust pipe 85.

In order to provide a tight pumping chamber for the circulation of cooling fluid, I may attach to the piston 22 a tubular guide member 86 which is in closely fitted sliding engagement with an aperture 87 through the cylinder 24. The piston rod 23 extends loosely through the tube 86 and may be pivotally connected to the piston 22 as by a ball and socket joint 87 or by any mechanical equivalent thereof. The tube 86 not only provides a convenient method of keeping the pumping chamber tight, but also serves to maintain the piston 22 properly alined within the cylinder. As I preferably make the piston relatively short in order to afford the maximum pumping chamber, this guiding tube 86 is of especial value in resisting torsional stresses which might otherwise tend to cause the piston to bind in the cylinder and wear the walls of the cylinder unduly.

Having thus described an embodiment of this invention, it should be evident to those skilled in the art that various changes and modifications might be made therein without departing from its spirit or scope as defined by the appended claim.

I claim:

In an internal combustion motor, a piston, a piston rod reciprocable therewith, a crank shaft, a pitman connected to said crank shaft, a walking beam having its ends pivotally attached respectively to said piston rod and pitman and having a fulcrum at fixed distances from said ends, and means for shifting the fulcrum transversely of said walking beam, during the operation of the motor whereby the stroke of the piston is altered.

In testimony whereof I have affixed my signature.

CARL H. ERICSON.