J. A. CHARTER.

VARIABLE COMPRESSION GAS ENGINE.

APPLICATION FILED JULY 13, 1918.

1,360,366. **Patented Nov. 30, 1920.**

3 SHEETS—SHEET 1.

Fig. 1.

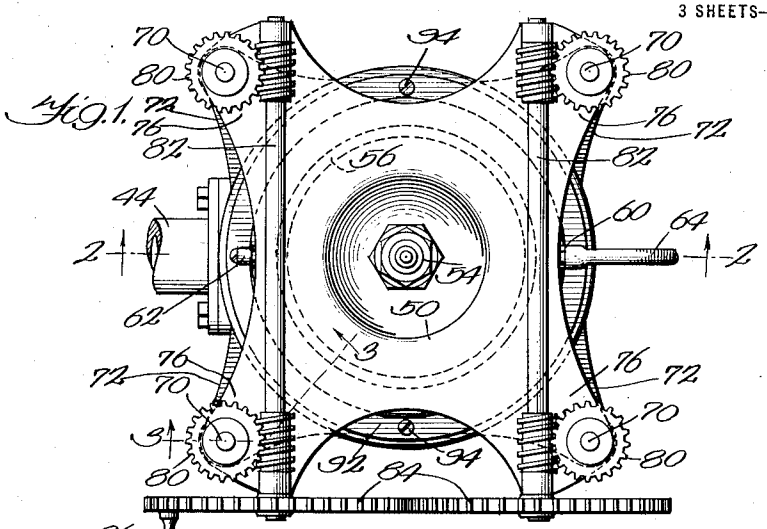
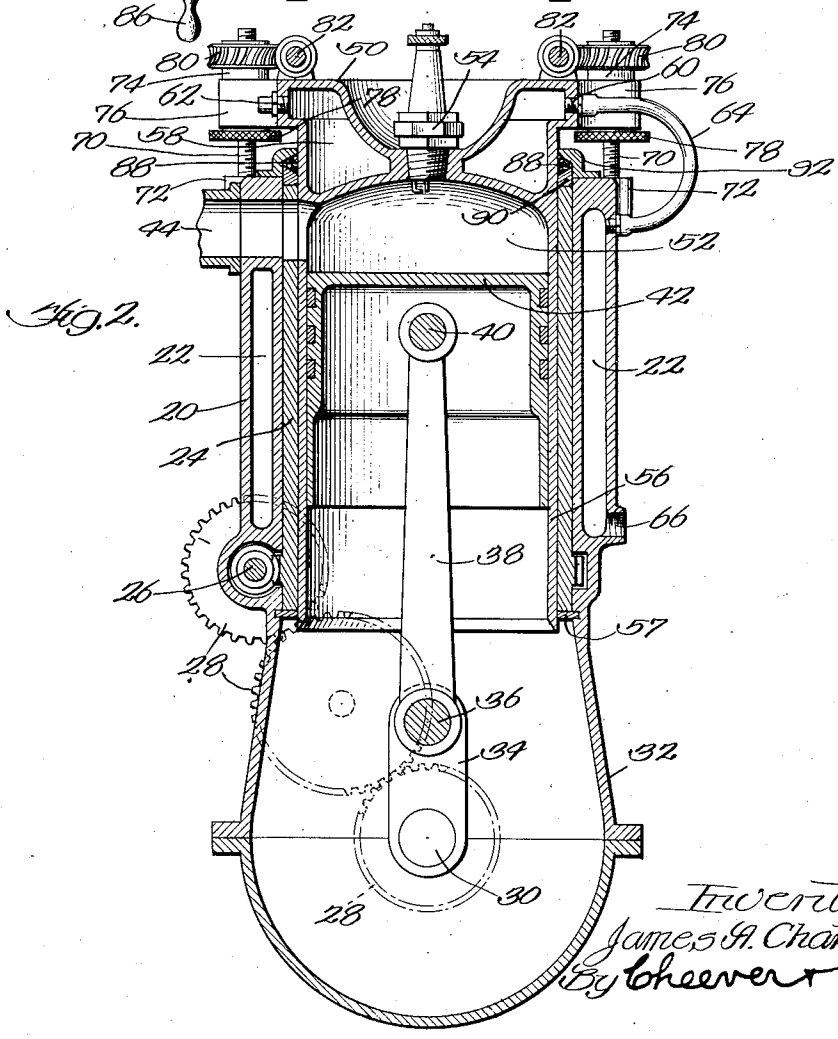


Fig. 2.



Inventor:
James A. Charter:
By Cheever & Cox
Attys

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3 SHEETS—SHEET 2.

FIG. 3.

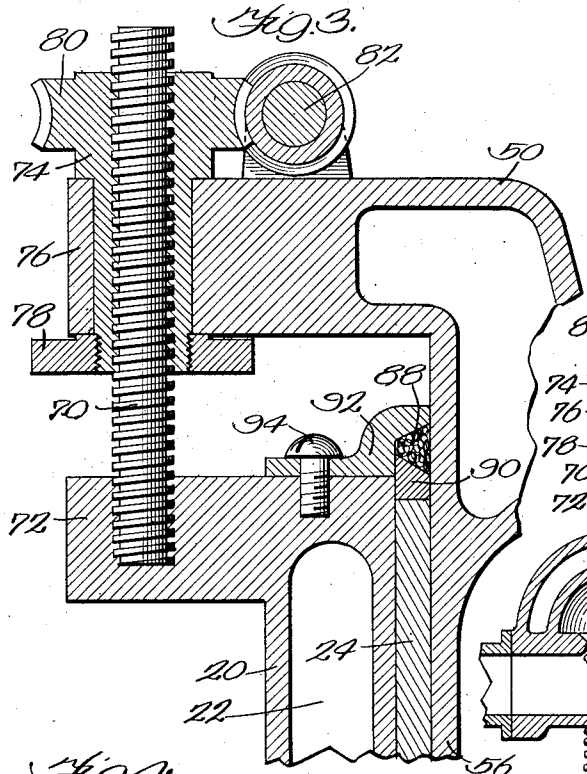


FIG. 5.

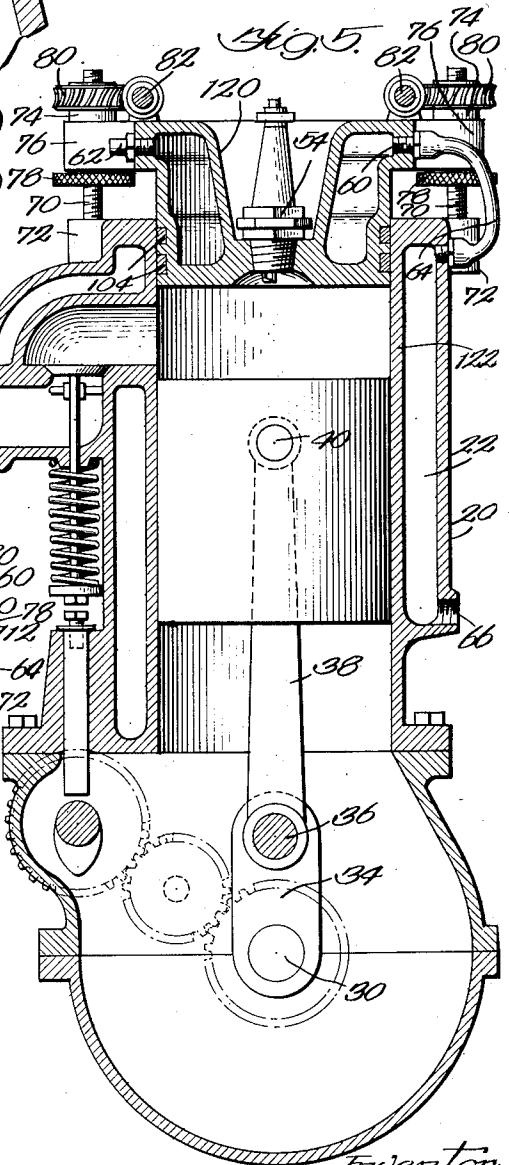
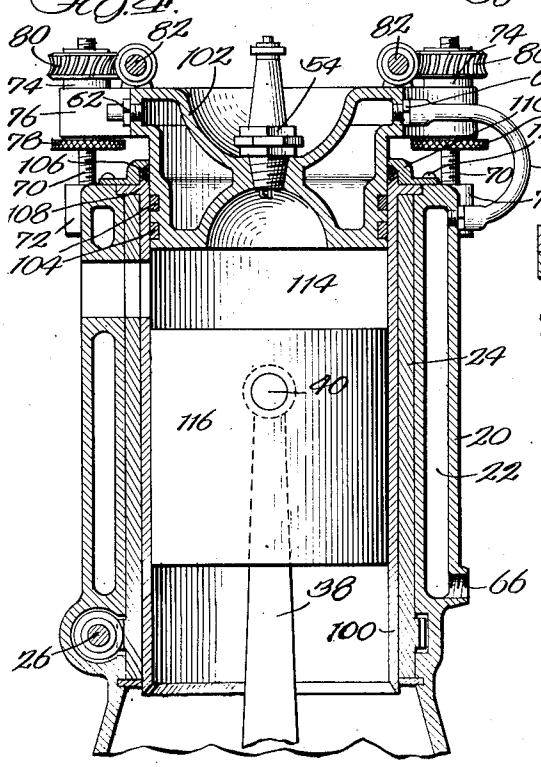


FIG. 4.



Inventor:
James A. Charter.
By Cheever & Cox
Attys.

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3 SHEETS—SHEET 3.

Fig. 6.

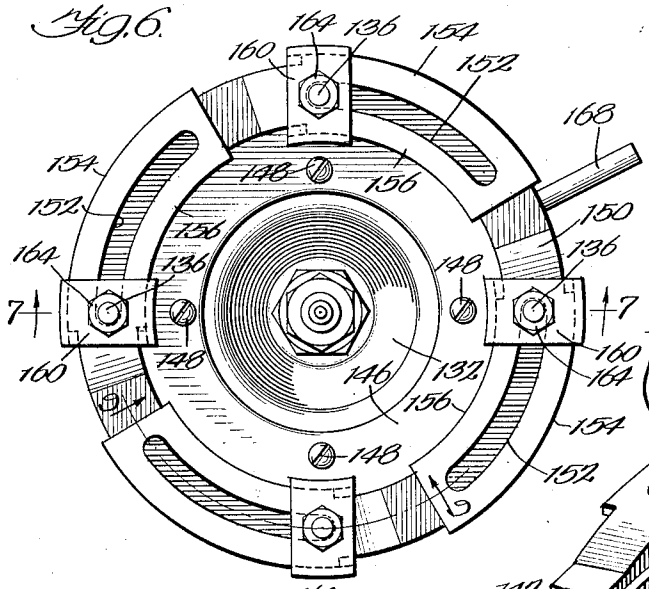


Fig. 8.

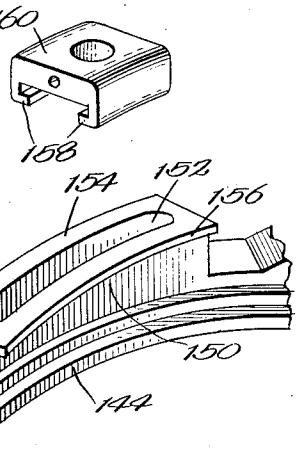


Fig. 7.

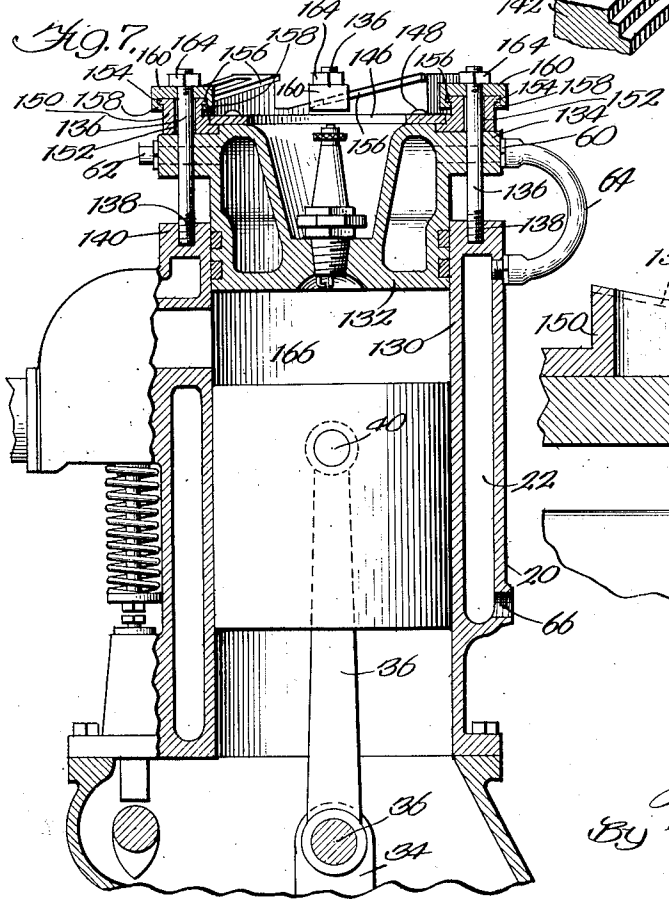
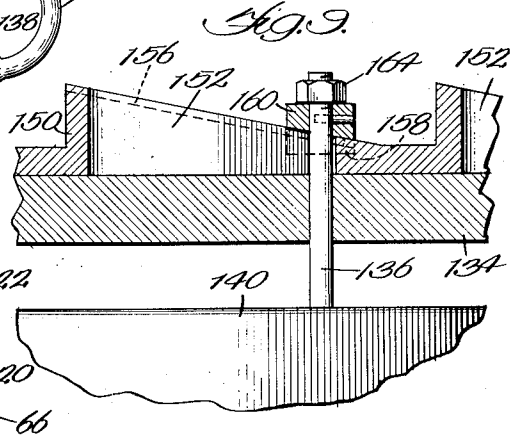


Fig. 9.



Inventor:
James A. Charter
By Cheever & Cox
Atty's.

UNITED STATES PATENT OFFICE.

JAMES A. CHARTER, OF CHICAGO, ILLINOIS.

VARIABLE-COMPRESSION GAS-ENGINE.

1,360,366. Specification of Letters Patent. Patented Nov. 30, 1920.

Application filed July 13, 1918. Serial No. 244,716.

To all whom it may concern:

Be it known that I, JAMES A. CHARTER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Variable-Compression Gas-Engines, of which the following is a specification.

This invention relates to gas engines. Its object is to increase the efficiency of these engines when, as heretofore constructed, they deteriorate in efficiency due to variation in the density of the air or other gas in which they are working, however caused. The invention consists in mechanism for varying the volume of the compression chamber of the gas engine to take care of such changed conditions in atmosphere or the like, and also correspondingly changed conditions caused by variations in the load upon the engine. More particularly, the invention consists in means for varying the distance of the interior of the cylinder head with reference to the piston or with reference to the axis of the crank shaft or both, thus varying the size of the effective space within which compression of gases to be exploded takes place. The invention further consists in the features and details of construction which will be hereafter more fully set forth in the specification and claims.

Referring to the drawings, in which similar numerals indicate the same parts throughout the several views.

Figure 1 is a plan view of an engine cylinder, whose head is equipped with operating mechanism of the preferred form for the device of this invention.

Fig. 2 is a vertical central sectional detail view taken on the line 2—2 of Fig. 1, showing somewhat diagrammatically, without going into great detail as to parts not involved in this invention, an engine of the type shown in my prior Patent Number 1,106,782, the same equipped with the mechanism of this invention in its preferred form.

Fig. 3 is an enlarged sectional detail view through the operating mechanism, appearing at the upper left hand corner of Fig. 2, taken on the irregular line 3—3 of Fig. 1.

Fig. 4 is a sectional view corresponding to that of Fig. 2, showing the device of this invention applied to the exact type of engine illustrated in my said prior patent.

Fig. 5 is a sectional view corresponding to Fig. 2, showing the device of this invention applied to a puppet valve gas engine of well known construction.

Fig. 6 is a plan, and

Fig. 7 is a central sectional detail view on the line 7—7 of Fig. 6, showing an alternative method of carrying out the device of this invention, the same, in the particular case shown, being applied to the puppet valve type of engine of Fig. 5.

Fig. 8 is a perspective view of a wedge mechanism and a sliding block therefor, used in operating the engine of Figs. 6 and 7.

Fig. 9 is a vertical sectional detail view of the adjusting wedge device of the mechanism of Figs. 6 and 7, the same taken on the curved line 9—9 of Fig. 6.

Fig. 2 shows diagrammatically an engine outer cylinder 20, provided with a water-jacket 22, an inner rotating sleeve valve 24, driven by a worm wheel 26 which is in turn driven through gearing 28 by the crank shaft 30 located in the engine base 32, all as shown in particular detail in my said prior patent. This crank shaft 30 carries the usual crank arm 34 on whose crank pin 36 is a connecting rod 38 pivotally attached at 40 to the usual piston 42, all as well understood in the art and shown, for example, in said prior patent. As in the engine of the prior patent, this engine is provided with intake and exhaust ports, one of which, 44, is shown in the drawing, and both ports are controlled by said sleeve valve 24. The parts thus far described, except as they constitute in general terms an engine, in and of themselves form no part of this invention, they being shown here merely diagrammatically and not in detail for the purpose of showing the application of this invention to an engine of this general type.

Like all engines, this one is provided with a cylinder head 50 arranged to provide between it and the upper face of the piston 42 a combustion chamber 52 entered by the intake and exhaust ports, heretofore refererd to. In the particular case here illustrated, the spark plug 54 of the engine is located in the center of this cylinder head. In the device of this particular form of the invention, the cylinder head 50 is integral with an internal cylinder or barrel 56 arranged, as shown, inside of the sleeve 24 and is bored out on its inner surface so that the piston 42 reciprocates therein. The outer surface

of this integral cylinder 56 is carefully finished so that the sleeve valve 24 can revolve around it and can be reciprocatable vertically as shown in the drawings inside the sleeve valve 24, and while the same is in operation.

The internal cylinder 56 is centered and guided at its bottom by a suitable ring 57, placed between it and the outer main cylinder 20. This ring also serves the function of preventing downward movement of the sleeve valve 24. All surfaces of this ring 57 where movement takes place are properly finished to allow for such movement and to accurately center the internal cylinder 56 in all positions. In Fig. 2 cylinder 56 is shown in its upper extreme position, so that when head 50 and this cylinder 56 are moved downward to adjust compression space 52, cylinder 56 is still centered on ring 57.

The cylinder head 50, heretofore described, is provided with a water-jacket space 58 supplied with two ports 60 and 62 through which a constant source of cooling water or other liquid may be passed in all positions of the head with reference to the other parts of the device. In the particular form of the device here illustrated, the water-jacket space 22 of the cylinder is connected with port 60, above referred to, by a flexible hose 64, so that water entering intake port 66 of the water-jacket 22 can ultimately pass out of port 62 of the cylinder head after having cooled both the cylinder proper and the head.

In the form of the invention shown in Figs. 1–4, inclusive, the cylinder head 50 is adjustable with reference to the cylinder proper through the agency of a plurality, in the particular case here illustrated four, vertical screws 70. In the particular form shown in the drawings, the lower ends of these screws 70 enter and are suitably held rigid in lugs 72 (Fig. 3), extending from the upper portion of the outer cylinder, while threaded upon screws 70 are suitable blocks 74 journaled in suitable projecting portions 76 of cylinder head 50, and secured against endwise movement therein by nuts 78. On the upper ends of blocks 74 are worm wheels 80 driven in pairs, in the case illustrated, by wormshafts 82 which are again in turn driven in unison by a suitable train of gearing 84 operated, in the case here illustrated, by a handle 86 to be manipulated by the person operating the engine.

Suitable packing 88 is provided around the internal cylinder 56, as clearly appears in Fig. 2, the same being held in place, as shown in Fig. 3, between a guide ring 90 and a clamping or locking ring 92 attached to the upper end of the main cylinder 20 by any suitable means, such for instance as screw 94. This ring 90 is of importance in that it accurately centers the internal cylinder 56, while affording a sufficient clearance so that the sleeve valve 24 is free to rotate. It also serves the function of limiting the end travel of the sleeve 24 however caused.

The packing 88 is located outside the water-jacket and, therefore, is not damaged by the water as in prior constructions, and yet is cooled by the water-jacket while being accessible at all times for attention.

In the operation of the engine of Figs. 1 and 2, the operator takes hold of handle 86 and, through the gearing just described, raises or lowers, as the case may be, the cylinder head 50 and its attached internal cylinder 56 until the area of the effective compression space 52 becomes the correct size to give proper results, dependent upon the density of the atmosphere in which the engine is operated or the load, or both. When the atmosphere is rare he obviously moves the parts 50—56 downward, and when the density of the atmosphere increases, he moves it upward.

The modified form of construction shown in Fig. 4 differs from that of Figs. 1, 2 and 3 in that the engine is diagrammatically exactly that of my said prior patent with a rigidly seated internal cylinder 100 between which and the main cylinder 20 the sleeve valve 24 rotates. In this construction, the cylinder head 102 is made without the internal cylinder 56 of Fig. 2, and reciprocates directly in cylinder 100, just described, being packed with reference thereto by the rings 104, and sealed by the ring of packing 106 held in place between the flange 108 of cylinder 100, which acts as a centering ring, and the locking ring 110 secured in place by screws 112. This cylinder head 102 is water-jacketed and is provided with the same operating mechanism as is shown in Figs. 1 and 2. By properly manipulating the operating mechanism, cylinder head 102 is moved up and down to vary the volume of combustion space 114 which exists between the cylinder head and the piston 116.

In Fig. 5 an adjustable cylinder head of exactly the type shown in Fig. 4 is applied to a puppet form of gas engine, the head 120 of this engine sliding directly in the water-jacketed cylinder 122. So far as the device of this invention is concerned, the operation is identical with that of the device of Fig. 4.

The particular form of cylinder head reciprocating mechanism shown in Figs. 1 to 5 is not at all essential to the broad idea of this invention, and one alternative structure is accordingly shown in Figs. 6 to 9, inclusive. In Fig. 7, the engine of Fig. 5 is shown equipped with such alternative head adjusting mechanism.

In the particular form of device last referred to, the engine cylinder 130 is pro-

vided with a vertically reciprocatable head 132, as before. On the upper portion of head 132 is a circular flange 134, pierced by a plurality, in the particular case here illustrated four, bolts 136, whose lower ends 138 enter and are more or less rigid in the upper flange 140 of the cylinder 130. Rotatably mounted upon the upper surface of circular flange 134 is a circular ring 142, held in place by flanges 144 which pass under a suitable retaining ring 146 held in place by screws 148, or the like. Rising from the upper surface of ring 142, and in the case here illustrated integral therewith, are wedges 150, one for each bolt 136. Each wedge is provided with an elongated slot 152 within which an adjacent screw 136 is located, the same being so arranged that the ring 142 can be rotated backward and forward a distance equal to the lengths of the slots 152. The upper surfaces of the wedge blocks 150 are capped with a ledge or cam track 154 having overhanging oppositely disposed flanged edges 156, about which are clasped the inwardly turned edges 158 of an adjacent block 160 which is mounted upon the adjacent bolt 136, as shown, and held against sliding movement thereon by any suitable means, such as a pin 162. These blocks 160 are further held in place, if desired, by nuts 164 on the upper ends of bolts 136.

The result of the construction just described is that the cylinder head 132 is suspended from the tops of the bolts 136 through the agency of the ring 142 and the wedges 150, and that the cylinder head may be moved up and down a vertical distance equal to the effective thickness of the wedges 150 which is, of course, determined by the difference in height of the two ends of the wedges measured at the ends of slots 152.

In the operation of this form of device, the operator controls the volume of compression space 166 under cylinder head 132 by taking hold of any part of ring 142, as for instance a projecting handle 168, and rotating the ring in either direction, as desired, to cause the wedges 150 to elevate or lower, as the case may be, the head 132 within the cylinder 130.

It will be noticed that both types of adjusting device heretofore described, provide for very gradual and progressive adjustment of the compression space, thus enabling the operator to accurately adjust his engine to the conditions which arise and as they arise.

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

1. In device of the class described, in combination, a cylinder and a cylinder head mounted for reciprocation with reference thereto, there being formed in each a water-jacket space, means for reciprocating the cylinder head with reference to the cylinder, and a flexible pipe connection between the water-jacket spaces of the cylinder and cylinder head, whereby water in the cylinder water-jacket is passed to the interior of the cylinder head in all of its positions with reference to the cylinder.

2. In combination, an engine cylinder having ports therein, an internal sleeve valve provided with means for moving it, controlling said ports, a cylinder head and an internal cylinder connected therewith, located inside said main cylinder and sleeve valve for reciprocation lengthwise of the axis of the main cylinder, a piston reciprocatable inside of said internal cylinder, rings guiding opposite ends of said internal cylinder so that it may reciprocate without interfering with the reciprocation of the piston or the movement of the sleeve valve, and means for reciprocating the piston head and attached internal cylinder, for the purposes set forth.

3. In mechanism of the class described, an engine including an external cylinder, a sleeve valve mounted for rotation inside of said external cylinder, a reciprocatable internal cylinder mounted inside the sleeve valve, means supporting and guiding the internal cylinder so that it may reciprocate with reference to the main cylinder without interference with the operation of the sleeve valve, a cylinder head closing the internal cylinder, a piston inside the internal cylinder adapted for reciprocation therein, and means operatable from outside the device and located at the top of the cylinder head for moving the cylinder head and attached internal cylinder longitudinally of the sleeve valve and engine piston, while both are in operation, for the purposes set forth.

4. In mechanism of the class described, an engine, including an external cylinder, a sleeve valve mounted for rotation inside of said external cylinder, a reciprocatable internal cylinder mounted inside the sleeve valve, means supporting and guiding the internal cylinder so that it may reciprocate with reference to the main cylinder without interference with the operation of the sleeve valve, a cylinder head closing the internal cylinder, a piston inside the internal cylinder adapted for reciprocation therein, a water-jacket in and carried by said cylinder head adapted to cool the cylinder head and adjacent end of the internal cylinder, and means operatable from outside the device for moving the cylinder head and attached internal cylinder longitudinally of the sleeve valve and engine piston, while both are in operation, for the purposes set forth.

5. In mechanism of the class described, an engine, including an external cylinder, a

sleeve valve mounted for rotation inside of said external cylinder, a reciprocatable internal cylinder mounted inside the sleeve valve, means supporting and guiding the internal cylinder so that it may reciprocate with reference to the main cylinder without interference with the operation of the sleeve valve, a cylinder head closing the internal cylinder, a piston inside the internal cylinder adapted for reciprocation therein, a water-jacket in and carried by said cylinder head adapted to cool the cylinder head and adjacent end of the internal cylinder, packing between the upper end of the outer cylinder and the inner cylinder and outside the water-jacket and means operatable from outside the device for moving the cylinder head and attached internal cylinder longitudinally of the sleeve valve and engine piston while both are in operation, for the purposes set forth.

6. In a device of the class described, an external engine cylinder, an internal engine cylinder spaced apart therefrom to form an annular space between the two, a cylindrical sleeve valve rotatable in said annular space, a spacing ring located near one end of the internal cylinder, a spacing ring 90, a packing ring 88 and a locking ring 92 at the outer end of the external cylinder, said two rings serving to guide and space the internal cylinder so that it may move longitudinally of the outer cylinder and the sleeve valve, for the purposes set forth.

7. In combination, an engine cylinder, a cylinder head reciprocatable with reference to said cylinder to vary the volume of the interior of the cylinder, a plurality of screw-threaded posts extending non-rotatably from the end of the cylinder and projecting through openings in portions of the cylinder head, and mechanism operated from outside the engine cylinder adapted to, in connection with said posts, gradually and progressively move the cylinder head with reference to the cylinder.

8. In combination, an engine cylinder, a cylinder head reciprocatable with reference to said cylinder to vary the volume of the interior of the cylinder, a plurality of screw-threaded posts extending non-rotatably from the end of the cylinder and projecting through openings in portions of the cylinder head, rotatable nuts threaded on said posts and so mounted on the cylinder head that they can be rotated but cannot be moved longitudinally with reference thereto, and means for simultaneously rotating said nuts to gradually and progressively move the cylinder head with refernce to the cylinder.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

JAMES A. CHARTER.

Witnesses:
DWIGHT B. CHEEVER,
M. S. ROSENZWEIG.