O. A STRANAHAN.

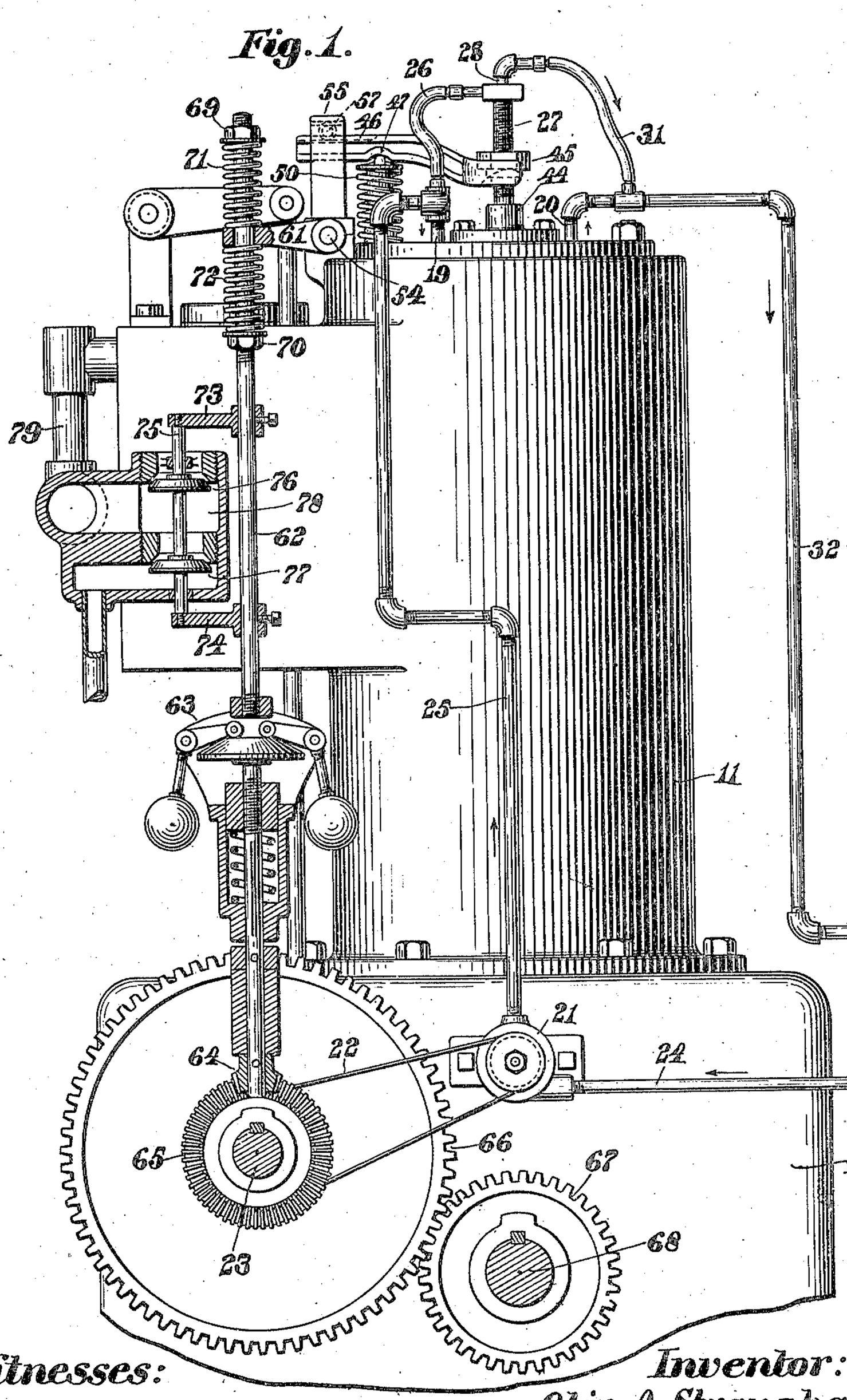
INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAR. 9, 1908. RENEWED JULY 12, 1909.

950,683. Patented Mar. 1, 1910.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

Howard Hanscom

Nathan B. Lombard

Inventor:

Olin A. Stranahan,

by Hatter & Lombard,

Atty.

O. A STRANAHAN.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAR. 9, 1908. RENEWED JULY 12, 1909.

950,683. Patented Mar. 1, 1910.

2 SHEETS—SHEET 2.

Fig. 3.

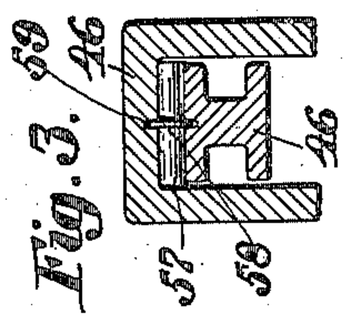


Fig. 2.

Fig. 4.

Witnesses:

Howard Hanscom

Nathan C. Lombard

Inventor:

Olin A. Stranahan,

by Watte & Lombard,

Atty.

UNITED STATES PATENT OFFICE.

OLIN A. STRANAHAN, OF NEW YORK, N. Y.

INTERNAL-COMBUSTION ENGINE.

950,683. Specification of Letters Patent. Patented Mar. 1, 1910.

Application filed March 9, 1908, Serial No. 420,505. Renewed July 12, 1909. Serial No. 507,249.

To all whom it may concern:

Be it known that I, OLIN A. STRANAHAN, a citizen of the United States of America, and a resident of New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal combustion engines and has for its object the provision of a means whereby the volume of the compression space in the cylinder may be varied either manually or automatically during the operation of the engine in order that a practically constant compression may be maintained in the cylinder under varying loads.

The invention consists in a movable device adapted to be moved to a greater or less degree into the compression space of the cylinder, the movement being controlled by a suitable governor and the extent of movement being proportionate to the load and to the amount of combustible being admitted to the cylinder.

The invention consists further in a means of maintaining said movable member in adjusted position during the compression and the explosion of the combustible.

The invention further consists in operating said movable member by means of a circulating fluid admitted to an inclosed space in the rear of said movable member and retained therein until said member has performed its function.

The invention further consists in a balanced mechanism interposed between the engine governor and said devices for changing the volume of the compression space whereby the operation of the latter will be regulated by the action of said governor.

The invention further consists in certain novel features of construction and arrangement of parts which will be readily understood by reference to the description of the drawings and to the claims hereinafter given.

Of the drawings: Figure 1 represents an elevation of an engine cylinder showing this improved invention applied thereto, the mixing chamber and the governor mechanism being shown in section. Fig. 2 represents a vertical section of the upper end of the engine cylinder with the improvements thereon, said figure being drawn to an enlarged scale. Fig. 3 represents a sectional detail, the cutting plane being on line 3—3 on Fig. 2, and Fig. 4 represents an elevation of the connection between the fulcrumed governor controlled lever and the stem of the member adapted to be moved into the compression space of the engine for the purpose of changing the volume of said space.

Similar characters designate like parts throughout the several figures of the drawings.

In the drawings, 10 represents the usual crank chamber casing of an internal combustion engine having mounted thereon the cylinder 11, the upper end of which is provided with an opening 12 to which is fitted the movable member 13. This movable member is cup-shaped, as shown in Fig. 2, and the bowl thereof is partially filled by means of a chambered extension 14 formed on a closure 15 secured to the cylinder 11 in any well-known manner. This extension 14 is provided with an inclosed chamber 16 communicating by means of the passage or opening 17 with the space 18 between the outer surface of said extension 14 and the interior of the cup-shaped movable member 13.

A suitable fluid is admitted through the pipe 19 to the chamber 16 and an outlet pipe 20 extends from said chamber 16 to any suitable point. The fluid entering the chamber 16 through the pipe 19 is caused to constantly circulate in said chamber under suitable pressure by means of the pump 21, which may be driven by means of the belt 22 from the shaft 23 or said pump may be driven in any other well-known manner. The fluid is admitted to the pump 21 through the pipe 24 and is forced through the pipe 25 to the pipe 19 and also to a flexible pipe 26 which communicates with the interior of the stem 27 of the movable member 13. Within the stem 27 is a pipe 28, the lower end of which communicates with an annular chamber 29 in the interior of said movable member 13, said chamber also communicating by means of the passage 30 with the space between said pipe 28 and the interior wall of the cylindrical stem 27 of the member 13. This construction permits a cooling fluid to be forced by means of the pump 21

through the pipe 25 and 26 into the interior of the chamber 29 and therefrom through the pipe 28, the outer end of which is connected to a flexible pipe 31 which communicates with the exhaust pipe 32 with which the pipe 20 from the chamber 16 also communicates.

Within the cylinder 11 is the usual reciprocating piston 33 which is shown in Fig. 2 at the upper end of its stroke, leaving a compression space 34 between the end thereof and the inner end of the movable member 13. The inlet valve 35 is adapted to admit an explosive mixture to said compression chamber in any well-known manner while the valve 36 of any well-known construction and operable in any well-known manner, regulates the exhaust therefrom.

The spark plug 37 is of any well-known construction and operates in the usual manner.

Within the chamber 16 extends a boss 38 formed upon the inner face of the closure 15, this boss forming a bearing for the reciprocating valve 39 which extends through the passage 17 and is adapted to close said passage under certain conditions which will be hereinafter stated. The upper end of the valve 39 is provided with an outwardly extending flange 40 which co-acts with the shoulder 41 formed in the boss 38 to limit the downward movement of said valve 39, a spring 42 within the interior chamber of said valve 39 and surrounding the stem 27 normally retaining said valve in open position. The tension of this spring 42 may be regulated by means of the threaded plug 43 of a suitable stuffing box in an obvious manner.

The opening through the closure 15 and boss or hub 38 is closed by means of the member 44 which forms a bearing for the stem 27 in which said stem is adapted to be reciprocated. The stem 27 has threaded thereto the nut 45 which may be adjusted longitudinally of said stem 27 to limit the movement of the member 13 in one direction in case of accident by coming in contact with the end of the bearing 44 while the movement of the member 13 in the other direction is limited by means of the upper end thereof coming in contact with the inner face of the closure 15.

Co-acting with the nut 45 is a forked lever 46 having intermediate its ends a detent 47 into which extends a fulcrum 48 formed upon a sleeve 49 mounted upon a support 50 secured to the upper end of said cylinder 11. The sleeve 49 is provided with a suitable flange 51 between which and the closure 15 is interposed a spring 52. In suitable bearings 53 formed upon the cylinder 11 is a rocker shaft 54 to which is rigidly secured a slotted member 55 through the slot 56 of which extends the outer end of said lever 46. Interposed between the upper end of said slot 46 and the upper face of the lever 45 is an anti-friction roller 57 provided with a central flange 58 extending into grooves 59 and 60 in said rocker member 55 and lever 46, said flange 58 serving to maintain said roller at all times transverse to the length of said lever 46. Secured to the rocker shaft 54 is an arm 61 the outer end of which is provided with an opening therethrough through which extends a vertical rod 62 forming a part of a governor 63 of any well-known construction driven by means of a bevel pinion meshing with a bevel gear 65 on the shaft 23. This shaft 23 has mounted thereon a gear 66 meshing with a gear 67 keyed to the usual crank shaft 68. The rod 62 has threaded thereto on either side of said arm 61 the nuts 69—70 interposed between which and said arm are the balancing springs 71—72. By properly adjusting the nuts 69—70 upon the rod 62, the balancing springs 71—72 will perform the function of regulating the effect of the movement of the governor rod 62 upon the arm 61 and in turn the slotted member 55.

The rod 62 has secured thereon arms 73—74 between which is interposed a valve stem 75 having formed thereon the valve 76 and valve 77 adapted respectively to control the admission of air and gas to the mixing chamber 78 from which the explosive mixture passes through the pipe 79 to the inlet passage 80 in the cylinder 11. From this passage 80 the explosive mixture is adapted to be admitted to the compression space whenever the valve 35 is opened in the usual operation of the engine.

When the rocker arm 55 is in its normal position, as indicated in Fig. 2, the tension of the spring 52 is sufficient to substantially balance the movable member 13, the pressure of the circulating water against said movable member and the suction in the compression space 34 when the valve 39 is opened. It is obvious that if any part of the load is suddenly thrown off, the governor 63 will act to move the rod 62 upwardly thereby admitting a smaller amount of explosive mixture to the cylinder 11. When a less amount of explosive mixture is thus admitted to the cylinder, it is quite obvious that in order to secure a constant compression it is essential that the volume of the compression space in said cylinder should be reduced simultaneously with the reduction in the amount of mixture being admitted to the cylinder. This is accomplished through the medium of the arm 61 which is raised by the rod 62 moving the rocker member 55 toward the fulcrum 47. This change in leverage of the lever 46 causes the pressure in the space 18 to exceed the tension of the spring 52 and thereby permits this spring 52 to be compressed

and more of the circulating fluid to be admitted from the chamber 16 into the space 18 and move the member 13 downwardly into the compression space 34 and thereby reduce the volume therein.

It is obvious that the proportion of the compression space displaced by the movable member 13 will be in proportion to the distance of movement of the roller 57 toward the fulcrum 47. When an additional load is placed upon the engine it is obvious that the governor will act to cause the rod 62 to be lowered and in so doing the rocker member 55 will be moved away from the fulcrum 47. This movement will so change the leverage of the lever 46 that the tension of the spring 52 will exceed the pressure upon the member 13 and permit said spring to so act upon said lever 46 that the member 13 will be moved upwardly. It is obvious that the amount of movement of the member 13 will be in proportion to the distance that the roller 57 moves away from the fulcrum 47.

To allow the outward movement of the member 13 and thereby increase the volume of the compression space for increased loads the spring 42 has sufficient tension to hold the valve 39 in its open position against the pressure upon its face due to the pressure of fluid in the space 18 created by the tension of the spring 52. To safeguard against failure of the spring 42, there is a small opening 13* between the space 18 and chamber 16 for the gradual transfer of fluid from said space 18 to the chamber 16. This provides a nicely balanced mechanism interposed between the usual governor of an internal combustion engine and a device for changing the volume of the compression space in said engine, the movement of which is regulated by means of the governor without throwing any material additional work thereon, the decrease and increase in the volume of the compression space being always proportioned to the decreased or increased load to be cared for by the engine. By such a construction the amount of compression in the engine is made practically constant for all loads. It is obvious that when the space 18 is filled with the circulating fluid and compression takes place within the space 34, the member 13 will move toward the closure 15 creating a pressure of fluid in the space 18 upon the face of the valve 17 in excess of the tension of the spring 42, causing it to close and retain within the space 18 a compact mass of fluid which will prevent further movement of the member 13 until the compression has occurred and the explosion has taken place.

An important feature of the invention is the function of the nut 45 to limit the inward movement of the member 13 by resting against the end of the lever 46. The adjustment of this nut 45 upon the stem 27 fixes the normal position of the member 13 in the compression space 34 and thereby determines the compression of the explosive mixture at normal load. The operation of the device as explained then practically maintains this compression under varying loads. Different kinds and qualities of explosive mixtures require different degrees of compression for best results. The simple adjustment of the nut 45, which can be made while the engine is running, fixes the compression at any desired amount. When a plurality of cylinders are used in the same engine, the adjustment for degree of compression is independent for each cylinder.

The invention may be applied to any type or style of internal combustion engine, either with a single cylinder or a plurality of cylinders or either vertical or horizontal engines, single or double acting, it only being necessary to change the details of construction to comply with the various conditions which exist in the different types, one or more of these details in construction being capable of variation without affecting the principles of the invention.

While in larger sizes of engines it is found quite desirable to cool the movable member 13 by means of circulating through a chamber therein a cooling agent, it is obvious that in the smaller sizes this means of cooling the member may be entirely dispensed with, the chamber 29 being omitted, and the stem 27 being made solid. The member 44 is provided with a vent 81 communicating with the chamber in the boss 38 of the closure 15 which chamber may be partially filled with oil for lubrication. When compression takes place within the space 34 and the pressure caused thereby is transmitted through the member 13 to close the valve 39, the circulating fluid contained in the space 18 will be pocketed in such a manner that the movable member will be held in fixed position corresponding with the position of the governor for the particular load.

As the movement of the member 13 is limited in both directions, even should an accident occur to any of the balanced mechanisms by which the movement of said member is regulated from the governor, no damage could ensue.

This makes a very effective apparatus for securing a constant compression under all loads, the operation and many advantages of which it is believed will be fully apparent without further description.

Having thus described my invention, I claim:

1. In an internal combustion engine provided with a piston having an unvariable stroke, the combination of a device controlled by the speed of said piston for positively varying the volume of the com-

pression space in the cylinder during the operation of the engine said device including an adjustable member for varying the normal position thereof; and means for retaining said device in adjusted position during the compression and explosion of the combustible admitted to said compression space.

2. In an internal combustion engine provided with a piston having an unvariable stroke, the combination of an automatic device controlled by the speed of said piston for positively varying the volume of the compression space in the cylinder during the operation of the engine said device including a secondary piston, a stem therefor, and an adjustable member on said stem adapted to vary the normal position of said secondary piston; and means for retaining said device in adjusted position during the compression and explosion of the combustible admitted to said compression space.

3. In an internal combustion engine provided with a piston having an unvariable stroke, the combination of an automatic device controlled by the speed of said piston for positively varying the volume of the compression space in the cylinder during the operation of the engine; and fluid-controlled mechanism for locating said device prior to compression and retaining it in adjusted position during the compression and explosion of the combustible admitted to said compression space.

4. In an internal combustion engine provided with a piston having an unvariable stroke, the combination of a solid imperforate device adapted to be moved in the cylinder to vary the volume of the compression space in said cylinder; fluid controlled mechanism regulated by the speed of the engine for effecting said movement prior to compression; and means for retaining said device in adjusted position during the compression and explosion of the combustible admitted to said compression space.

5. In an internal combustion engine provided with a piston having an unvariable stroke, the combination of a solid imperforate device adapted to be moved in the cylinder to vary the volume of the compression space in said cylinder; mechanism controlled by the speed of the engine for effecting said movement prior to compression; and fluid-controlled mechanism for retaining said device in adjusted position during the compression and explosion of the combustible admitted to said compression space.

6. In an internal combustion engine provided with a piston having an unvariable stroke, the combination of a solid imperforate device adapted to be moved in the cylinder to vary the volume of the compression space in said cylinder; fluid-controlled mechanism regulated by the speed of the engine for effecting said movement prior to compression; means for retaining said device in adjusted position during the compression and explosion of the combustible admitted to said compression space; and a governor adapted to regulate the movement of said device according to the load and thereby maintain practically a constant compression under varying conditions.

7. In an internal combustion engine provided with a piston having an unvariable stroke, the combination of an open-ended cylinder; an imperforate member completely filling the open end thereof; and fluid-controlled means regulated by the speed of the engine for moving said member longitudinally in said opening prior to compression and retaining it in adjusted position during the compression and explosion of the combustible admitted to the compression space.

8. In an internal combustion engine provided with a piston having an unvariable stroke, the combination of an open-ended cylinder; an imperforate member completely filling the open end thereof; means including fluid-controlled mechanism regulated by the speed of the engine for moving said member longitudinally in said opening prior to compression; and means for preventing further operation of said fluid-operated mechanism during the compression and explosion of the combustible admitted to the compression space.

9. In an internal combustion engine, the combination of a reciprocating piston; a cylinder therefor; a second reciprocating member in a chamber in said cylinder; a stem therefor; an adjustable member on said stem; and automatic means coöperating with said adjustable member for moving said member within said cylinder thereby varying the compression space between said piston and member.

10. In an internal combustion engine, the combination of a reciprocating piston; a cylinder therefor; a second reciprocating member in a chamber in said cylinder; fluid-controlled mechanism for moving said member prior to compression within said cylinder thereby varying the compression space between said piston and member; and means for preventing movement of said second reciprocating member during the compression and explosion of the combustible admitted to said compression space.

11. In an internal combustion engine, the combination of a reciprocating piston; a cylinder therefor; movable means on said cylinder for varying the compression space in said cylinder prior to compression; and a fluid-controlled device for preventing movement of said movable means during the compression and explosion of the combustible admitted to said compression space.

12. In an internal combustion engine, the

combination of a cylinder member; a piston member therein; movable means on one of said members adapted to be operated by the speed of the engine for positively varying the volume of the compression space in said cylinder prior to compression; and a fluid-controlled device for preventing movement of said movable means during the compression and explosion of the combustible admitted to said compression space.

13. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating piston in said cylinder; a reciprocating member in said opening; a closure for said opening; and means for admitting a fluid between said closure and member to move said member a desired distance and retain it in its new position during the compression and explosion of the combustible admitted to the cylinder.

14. In an internal combustion engine, the combination of a cylinder; a piston therein; a member in said cylinder beyond the stroke of said piston adapted to be moved longitudinally in said cylinder and controlled by the speed of the engine; means for admitting a fluid behind said movable member to move it partially into the compression space; and means for preventing the displacement of said fluid during the compression and explosion of the explosive mixture.

15. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening; means for admitting a fluid between said closure and member to move said member; means for limiting the movement of said member; and a spring for returning said member to its normal position.

16. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening provided with an inclosed chamber; a fluid inlet to said chamber; an outlet therefrom; and a passage from said chamber to the space between said closure and reciprocating member.

17. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening provided with an inclosed chamber; a fluid inlet to said chamber; an outlet therefrom; a passage from said chamber to the space between said closure and reciprocating member; and a valve for closing said passage.

18. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening provided with an inclosed chamber; a fluid inlet to said chamber; an outlet therefrom; a passage from said chamber to the space between said closure and reciprocating member; and an automatically operated valve for closing said passage.

19. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening provided with an inclosed chamber; a fluid inlet to said chamber; an outlet therefrom; a passage from said chamber to the space between said closure and reciprocating member; and a spring-controlled valve for closing said passage.

20. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening provided with an inclosed chamber; a fluid inlet to said chamber; an outlet therefrom; a passage from said chamber to the space between said closure and reciprocating member; a valve for closing said passage; and means for normally retaining said valve in open position.

21. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening provided with an inclosed chamber; a fluid inlet to said chamber; an outlet therefrom; a passage from said chamber to the space between said closure and reciprocating member; a spring-controlled valve for closing said passage; and means for regulating the tension of said spring.

22. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening; means for admitting a fluid between said closure and member to move said member; means for limiting the movement of said member; a spring for returning said member to its normal position; and means for regulating the tension of said spring.

23. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening; means for admitting a fluid in the space between said closure and member; a member secured to said reciprocating member and extending through said closure; a nut thereon; a spring-controlled lever coacting with said nut; and a governor for controlling the movement of said lever.

24. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure

for said opening; means for admitting a fluid in the space between said closure and member; a member secured to said reciprocating member and extending through said closure; a nut thereon; a lever co-acting with said nut; a yielding fulcrum for said lever; and a governor for controlling the movement of said lever.

25. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening; means for admitting a fluid in the space between said closure and member; a member secured to said reciprocating member and extending through said closure; a nut thereon; a lever co-acting with said nut; a spring-controlled fulcrum member for said lever; a support therefor; and a governor for controlling the movement of said lever.

26. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening; means for admitting a fluid in the space between said closure and member; a member secured to said reciprocating member and extending through said closure; a nut thereon; a lever coacting with said nut; a spring-controlled fulcrum member for said lever; a support therefor; means for adjusting said support; and a governor for controlling the movement of said lever.

27. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening; means for admitting a fluid in the space between said closure and member; a member secured to said reciprocating member and extending through said closure; a fulcrumed lever adapted to move said member; a rocker member for actuating said lever; and governor-controlled mechanism for regulating the movement of said rocker member.

28. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening; means for admitting a fluid in the space between said closure and member; a member secured to said reciprocating member and extending through said closure; a fulcrumed lever adapted to move said member; a rocker member for actuating said lever; an anti-friction member between said rocker member and lever; and governor-controlled mechanism for regulating the movement of said rocker member.

29. In an internal combustion engine, the combination of a cylinder provided with an opening through one end thereof; a reciprocating member in said opening; a closure for said opening; means for admitting a fluid in the space between said closure and member; a member secured to said reciprocating member and extending through said closure; a lever adapted to move said member; a yielding fulcrum therefor; a rocker member for actuating said lever; and governor-controlled mechanism for regulating the movement of said rocker member.

30. In an internal combustion engine, the combination of a cylinder member; a piston member therein; a device on one of said members for varying the volume of the compression space in said cylinder; a governor; and balanced mechanism interposed between said governor and device whereby said governor may regulate the operation of said device.

Signed by me at 7 Water st., Boston, Mass., this 6th day of March, 1908.

OLIN A. STRANAHAN.

Witnesses:
EDNA C. CLEVELAND,
WALTER E. LOMBARD.