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BY A. P. C.

V. BRESLAV

INTERNAL COMBUSTION ENGINE

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FIG. 1.

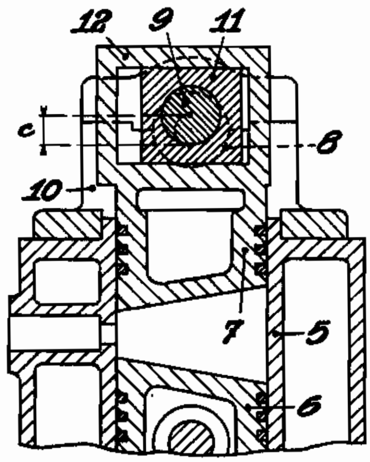


FIG. 2.

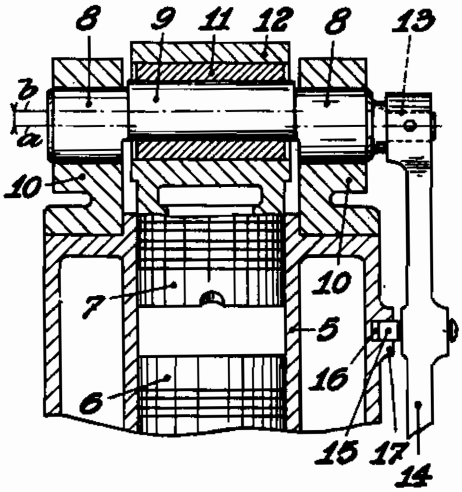


FIG. 3.

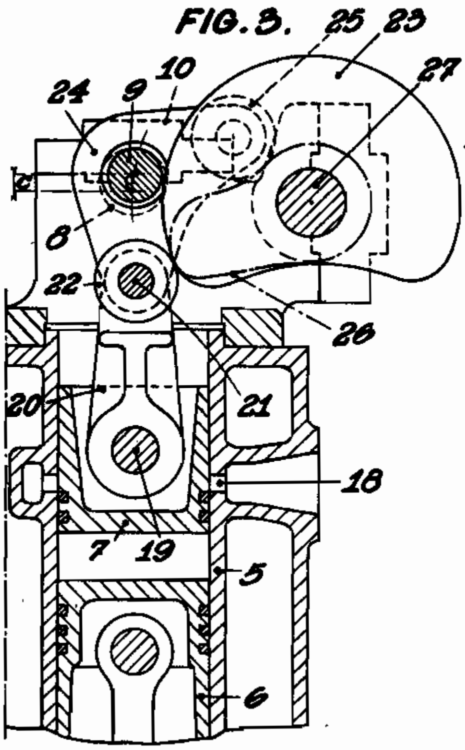
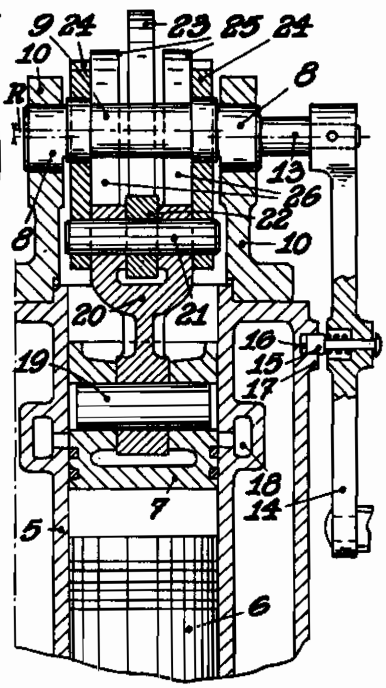


FIG. 4.



INVENTOR.
Victor Breslav

BY Singer, Ehlert, Stern & Carlberg
ATTORNEYS

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ALIEN PROPERTY CUSTODIAN

INTERNAL COMBUSTION ENGINE

Victor Breslav, Brussels, Belgium; vested in the Alien Property Custodian

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My invention relates to a device for varying the compression ratio in an internal combustion engine.

Two opposed tendencies can actually be observed in the construction of internal combustion engines of the "Diesel" type.

The first of these tendencies, which results from the necessity of obtaining the starting from cold of the engine at any outer atmospheric temperature, tends to admit high compression ratios for the engine.

On the contrary, the second of these tendencies, which has in view to diminish the fatigue of the mechanical parts of the engine, as well as the development of heat in the joints, tends to admit the lowest possible compression ratio which is consistent with a good combustion of the fuel, at the normal working speed of the engine under full load.

Moreover, a great number of modern engines are supercharged, that means that at the beginning of the compression stroke the cylinders are filled with air supplied by a ventilator or a compressor under a pressure above atmospheric. As the starting of the engine is always operated at a number of revolutions which is much lower than that of the normal working speed, the supercharging does not produce any noticeable effect at that moment, and the compression ratio for starting the engine must be determined so as to ensure the starting from cold without taking into account the supercharging. That gives rise to absolutely excessive compression ratios at the normal working speed.

Searches have been made in view of establishing devices for reducing the compression ratio of an engine after starting and the well known proposal has been made to subdivide the total volume of the combustion chamber into two compartments communicating with each other through a narrow channel which is obturated by means of a needle for starting. This structure has the disadvantage that the communication between the air contained in the second compartment and the compartment in which the fuel is injected is formed by the abovementioned narrow channel only, so that said air cannot aid the combustion with the desired efficiency. Now, it is just at the normal working speed and under full load that the total amount of air available must be effective.

In order to eliminate these disadvantages, my invention provides a very simple device in which the same general form of the combustion chamber is maintained for the two extreme compression ratios.

My invention is particularly intended to be applied to internal combustion engines in which the cylinder head is replaced by an element which is, or not, movable during the working of the engine and forms the inner end wall of the cylinder in which it is slidably mounted, said element being connected by the aid of a link mechanism to a fixed shaft to which the pressure developed by the explosion is transmitted.

According to my invention, the shaft on which the element slidable in the cylinder is rotatably mounted, has an intermediate cranked portion and can be given, at will, an angular displacement of about 180° for causing the movement of the sliding element between two distinct positions and modifying the volume of the combustion chamber, the centre of eccentricity of said shaft in its two extreme positions and the centre of rotation of this shaft being approximately located in alignment with the direction of transmission of the strain developed by the compression and the combustion, the arrangement being such that the displacements imparted to the sliding element by the cranked shaft may take place without depending on the displacements which this element might effect at each revolution of the engine for controlling the distribution thereof.

Two embodiments of my invention will be hereinafter described with reference to the accompanying drawings, in which:

Fig. 1 is an axial sectional view of a first embodiment of my invention;

Fig. 2 is an axial sectional view taken at right angles to Fig. 1;

Fig. 3 is an axial sectional view of another embodiment of my invention, and

Fig. 4 is an axial sectional view taken at right angles to Fig. 3.

As shown in the drawings, the inner end wall of the cylinder 5 having a piston 6 slidably mounted therein, is formed by a sliding element 7. A shaft 8, having a crank pin 9, is arranged diametrically relative to the cylinder and is pivotally mounted in bearings 10 which are rigidly supported by the end of the cylinder 5.

In the embodiment of my invention illustrated in Fig. 1, the connection between the shaft 8 and the sliding element 7 is formed by a block 11 which is rotatably mounted on the crank pin 9 and is slidably arranged in a slide 12 formed in an outer extension of the element 7.

On an extension 13 of the shaft 8, there is fixed a control lever 14 provided with an elastical locking bolt 15 which cooperates with notches 16 formed in a sector 17 integral with the engine, for alternately locking said control lever in two extreme positions spaced apart about 180° from one another.

An angular displacement of the lever 14 causes a corresponding rotation of the shaft 8, the crank pin of which carries the block 11 with it during its eccentric movement, thus producing a sliding movement of said block in the slide 12 and an axial displacement of the sliding element 7. According to the direction of the angular displacement of the lever 14, the sliding element 7 is brought from its lowermost position into its uppermost position, or inversely.

In the two extreme positions of the element 7, each of which corresponds to a different volume of the combustion chamber, the geometrical axis *a* of the shaft 8, as well as the axis *b* of eccentricity of the crank pin 9, must be located substantially in an axial plane of said sliding element, in order that the strains applied to the latter during the compression and the combustion might not give rise to a torsional moment which would tend to make automatically rotate the shaft 8. The locking bolt 15, which maintains the control mechanism in the desired positions, also prevents any unsetting which might result from the vibrations of the engine while working.

To start the engine, the lever 14 is put into its locked position corresponding to the lowermost position of the sliding element in the cylinder, in order to obtain the highest compression-ratio. Already after a few revolutions and before the engine attains its normal working speed, the locking bolt 15 is removed and the lever 14 is turned over and is then locked in its position corresponding to the uppermost position of the element 7, which corresponds to the normal working speed of the engine.

The stroke of the element 7 is indicated in Fig. 1 and corresponds to the distance *c* between the two extreme angular positions of the axis of eccentricity of the crank pin 9.

The connection between the shaft 8 and the sliding element 7, as shown in Figs. 1 and 2, could also be formed by a rod pivotally connected to said shaft and said element, or by any other mechanism capable of transforming the angular movement of the cranked shaft into a rectilinear movement of the sliding element. The embodiment shown in Figs. 1 and 2 is given by way of example only.

The embodiment shown in Figs. 3 and 4 concerns the application of my invention in the particular case of an engine in which the movable element forming the inner end wall of the cylinder operates as a distributor piston actuated by means of a knee joint which is positively controlled by cams.

In this case, there is a supplemental condition in view of which it is necessary that the axis of eccentricity of the crank pin 9 be located in its two extreme positions at the same distance from the centre of the cams, as otherwise the mechanism would not be positively controlled.

The exhaust ports 18 of the engine according to this embodiment, are controlled by the movable element 7 which here operates as a distributor piston. The latter is provided with an axle 19 having a rod 20 rotatably mounted thereon, the other end of which is rotatably mounted on a pivot 21 carrying a roller 22 which is guided by a cam 23. At the ends of the pivot 21, there are fixed two webs 24 rotatably mounted on the shaft 8 to which the pressure resulting from the compression and the combustion are applied.

Rollers 25 are rotatably mounted on extensions of the webs 24 and are guided by two cams 26.

The cams 23 and 26 are positively operating, i. e. that their outlines are combined so as to impart to the webs 24 the same law of movement about the shaft 8 and to exactly determine at every moment the position of the distributor piston 7.

In this known distributor mechanism, the shaft 8 according to my invention is provided with a crank pin 9 which is eccentric relative to the bearings 10 and upon which the webs 24 are rotatably mounted. Every angular movement of the shaft 8 causes a displacement of the axis of rotation of said webs, determined by the radius of eccentricity R (Fig. 4) of said crank pin. This displacement causes a stroke C (Fig. 3) of the movable element 7, which modifies the volume of the combustion chamber without varying its general form.

The radius of eccentricity R is determined so as to obtain the desired position of the element 7 for the starting of the engine.

Moreover, the amplitude of the required angular movement of the shaft 8 is determined in such a manner that the centre of rotation of the webs 24 be located, both in the starting position and in the position for the normal working speed of the engine, on a concentric circle relative to the cam shaft 27, in order to ensure a positive operation of the cams.

In the embodiment shown in Figs. 3 and 4, as well as in that illustrated in Figs. 1 and 2, the shaft 8 is controlled by a lever 14 which is fixed in its extreme positions by the locking system 15, 16, 17.

The little unsetting of the distribution resulting from the increase of the overlapping of the exhaust port 18 by the movable element 7, does not have practically any influence upon the free running of the engine while starting. The stroke of the element 7 acting as a distributor piston which is influenced by the positively acting cams, is effected as well under the action of the highest compression as when the engine is running at its normal speed.

VICTOR BRESLAV.