V. G. OTTEWELL.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED FEB. 1, 1917.

1,313,414. Patented Aug. 19, 1919.

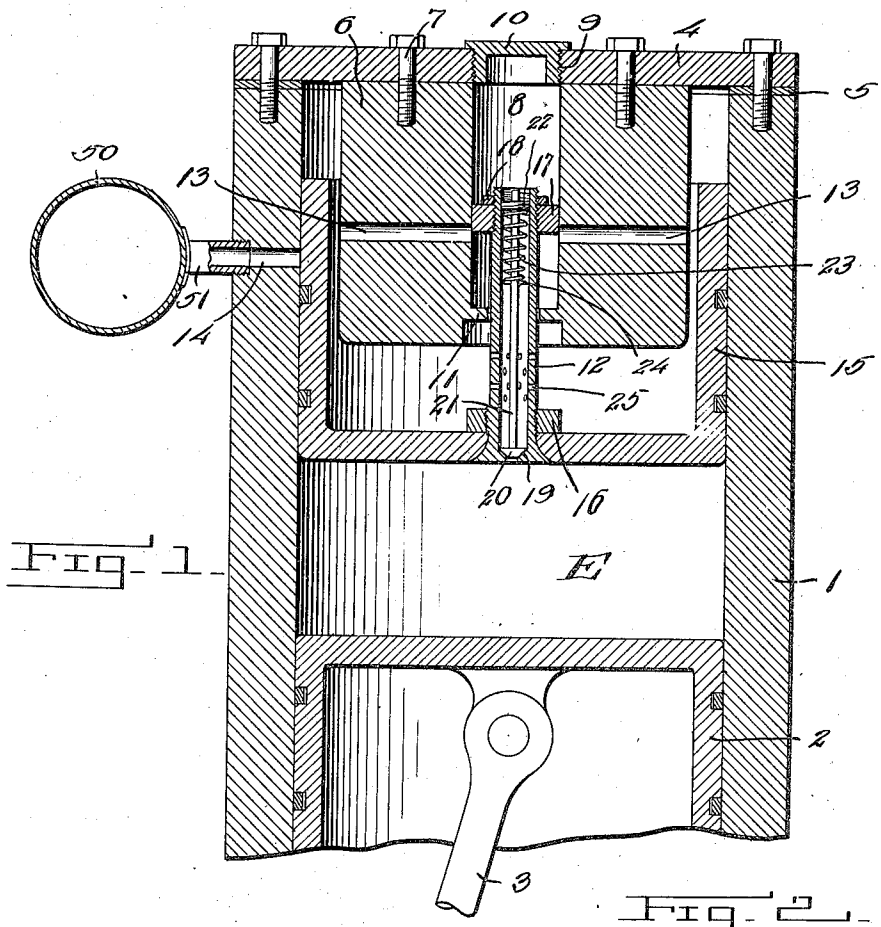
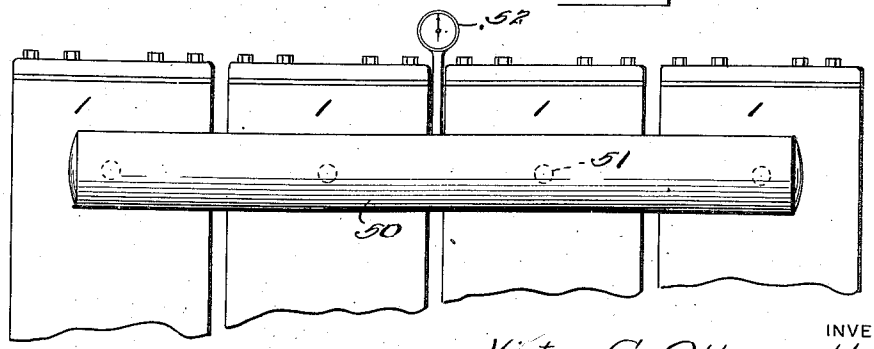


Fig. 1.

Fig. 2.



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INTERNAL-COMBUSTION ENGINE.

1,313,414. Specification of Letters Patent. Patented Aug. 19, 1919.

Application filed February 1, 1917. Serial No. 146,010.

To all whom it may concern:

Be it known that I, VICTOR G. OTTEWELL, a subject of the King of Great Britain, residing at Withrow, in the county of Washington and State of Minnesota, 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 more particularly to means for evenly distributing the pressure in the cylinders during the power stroke of the piston.

The main object of the invention is to provide an engine of this character with means whereby the shock produced by the violent explosion at the beginning of the power stroke of the engine is absorbed to relieve the working parts of the engine of excessive strains and the absorbed force imparted later on in the stroke thus producing a steady working pressure.

Another object is to provide an engine of this character with means for evenly distributing the pressure during the power stroke of the engine which also operates to almost completely exhaust the burned gases and produce an even compression of the fresh charge thereby raising its temperature and permitting the use of a lower grade of fuel.

Another object is to provide means for equalizing the pressure in the pressure controlled means of all of the cylinders.

With the foregoing and other objects in view, which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed may be made within the scope of what is claimed without departing from the spirit of the invention.

In the accompanying drawings:

Figure 1 represents a central vertical section through the upper portion of the engine cylinder equipped with this improvement.

Fig. 2 is a side elevation of the upper portion of four engine cylinders shown provided with a means for equalizing the pressure in the pressure controlled means constituting the essential feature of this invention.

In the embodiment illustrated, an engine cylinder 1 is shown having the usual working piston 2 connected with the crank shaft (not shown) by the usual rod 3.

This cylinder 1 has a rigid head 4 secured to the cylinder walls by bolts in the ordinary manner and having a gasket 5 arranged between it and said walls.

A solid core in the form of a casting 6 is secured to the inner face of the head 4 and extends into the cylinder, being of less diameter than said cylinder to provide a space between its outer side faces and the adjacent side walls of the cylinder in which the pressure controlled member 15, hereinafter described is designed to operate. This casting 6 may be fixed to the engine head 4 by any suitable means, bolts 7 being here shown for this purpose. This casting has a bore 8 extending longitudinally from end to end thereof which registers with an opening 9 formed in the head 4 of the cylinder and which latter is closed by a screw-threaded cap 10. An annular shoulder 11 is formed near the lower end of bore 8 of the casting 6 and is designed to form a guide for hollow piston rod 12 which carries the pressure controlled member 15. The casting 6 is also provided with transversely extending passages 13 here shown arranged intermediately of the ends thereof, preferably nearer its lower end and which afford communication between the bore 8 and the space in the cylinder which surrounds said casting.

The cylinder 1 has a passage 14 opening through one side wall near its upper end and which is designed to be connected with a pressure tank 50 for a purpose to be described.

The hollow piston rod 12 which carries the cup-shaped pressure controlled member 15, extends through the bottom of said member and has a flared head engaging a corresponding shaped seat in said bottom and which is held in engagement therewith by a lock nut 16. This rod 12 is adapted to slide in the bore 8 carrying a piston 17 at its upper or inner end, said piston being shown threaded on said rod and clamped thereto by a lock nut 18. The inward movement of the piston rod 12 is limited by the engagement of the piston 17 with the shoulder 11 at the lower end of bore 8, an air cushion being formed in said bore between the piston 17 and said shoulder 11 when the mem-

ber 15 moves inwardly thereby cushioning the movement of said member. The hollow rod 12 is provided in its outer end with a valve seat 19 with which is engaged a valve 20. This valve 20 has a stem 21 extending upwardly into the rod 12 and which is guided in an adjustable nut 22, threaded in the upper end of said rod 12. A coiled spring 23 is mounted on the stem 21 and forms a seat for said spring, the tension of the spring being controlled by the adjustment of the nut 22 on the rod 12, or a pin 24 may be made adjustable if desired and the same be accomplished. This spring 23 operates to normally hold the valve 20 closed, but will yield sufficiently to permit said valve to open when the pressure in the explosion chamber E exceeds the resisting force of said spring.

This hollow piston rod 12 is also provided with a plurality of apertures 25 opening through the side walls thereof and affording communication between the interior of said rod and the interior of the cup-shaped member 15. The side walls of the cup-shaped member 15 are spaced from the outer side faces of the casting 6 a suitable distance to permit the passage of gases contained in said member up between said casting and member into the space which surrounds the casting adjacent the head of the cylinder. It will thus be seen that communication is afforded between the bore 8 and the space surrounding the casting, and with the interior of the cup-shaped member 15 by means of the transverse passages 13, the apertures 25 in the hollow piston rod 12 operating to bring the interior of member 15 into communication with the explosion chamber E when the valve 20 is lifted, which will occur under conditions presently to be described.

This cup-shaped member 15, which may be termed a yieldable cylinder head or auxiliary piston, and the parts coöperating therewith, are here shown in connection with a single cylinder only, but it is to be understood that it may be used in an engine having any desired number of cylinders, four of such cylinders being shown in Fig. 2. When more than one cylinder is employed, it is found desirable to have the pressure in the member 15 and the space surrounding the casting 6 of the different cylinders equal, as some difficulty might be experienced in adjusting the individual valves 20 to produce this effect and consequently the pressure tank 50 is provided with pipes 51 leading therefrom and connecting with the passages 14 of the cylinders and the air supplied from this tank merely operates to equalize the pressure in all of the cylinders at the time the auxiliary pistons 15 are at their lowest points of travel. This pressure tank 50 is provided with a gage, indicated at 52 which will show at all times the pressure within the tank 50. It is to be understood that tank 50 obtains its supply of compressed air from the space above the pistons 15 in case the pressure above said pistons is higher than the pressure in the tank at the time the pistons uncover the passages 14. When the pressure in the tank exceeds the pressure behind the pistons, air passes therefrom through the pipes 14 to this space and thereby equalizes the pressure in all of the cylinders. It is not intended that this tank be provided with any outside source of pressure, though it might be desirable under some conditions, as for instance, in starting the engine when the pressure in tank 50 and that above the pistons 15 had been reduced to such a low point as to render the starting of the engine difficult because of the low compression in the combustion chamber E.

In the use of an engine equipped with this improvement, assuming the space within the member 15 and around the casting 6 to have a pressure of sixty pounds. This pressure will operate to hold the auxiliary piston 15 down at the extreme limit of its inward stroke which is controlled by the engagement of the piston 17 on the rod 12 with the shoulder 11. When in this position with the pressure above described, the working piston 2 will be at the beginning of its compression stroke, and as said piston advances, and the pressure of the fresh charge in the chamber E increases beyond sixty pounds, it will operate to lift the auxiliary piston 15 until the piston 2 reaches the limit of its compressing stroke and then the compression in chamber E will be about equal to that within the piston 15 and in the space above it. The spring 23 operates during this time to hold the valve 20 on its seat 19 in the hollow piston rod 12 and when the explosion occurs in the explosion chamber E, the force exerted thereby overcomes the pressure of spring 23 and the pressure in piston 15 and opens the valve 20, thereby admitting the compressed air from the explosion chamber E into the cup-shaped member 15, said air passing in through the hollow piston 12 and out through the apertures 25 therein. At the same time the auxiliary piston 15 is forced upwardly or outwardly. The admission of the compressed gases through the hollow rod 12 continues at each power stroke until the pressure within the auxiliary piston and the space above it, together with the strength of the spring 23 is sufficient to hold the valve 20 seated during the power stroke. The pressure that will be necessary to accomplish this will be determined by adjustment of the spring 23 by means of the nut 22, also by the exposure of the outer face of the valve 20, the exposed face of said valve within the hollow

piston rod being greater than that which is exposed to the explosion chamber E.

When the auxiliary piston 15 is forced upwardly by the explosion in chamber E it raises the pressure within the piston 15 and the space above it and relieves the pressure in the explosion chamber, until the two pressures become equal. The working piston 2 moving outward, relieves the pressure in the explosion chamber E and the pressure within the member 15 causes it to move inward thereby keeping the pressure within the explosion chamber even. Hence it will be seen that the force exerted on the piston 2 is relieved at the first part of the explosion stroke and added later on in the stroke, thus giving a steady working pressure instead of a shock such as usually occurs.

When the piston 2 reaches the point at which the exhaust port opens, the auxiliary piston 15 should have reached its limit of inward movement and is brought gradually to rest by the air cushion formed in the space between the shoulder 11 and the piston 17, the air forming said cushion being supplied through the transverse passages 13. The pressure within and above the piston 15 holds said piston in inward position during the exhaust stroke of piston 2, the two pistons 2 and 15 being then in close proximity with the space between them reduced to a minimum, so that all of the burned gases in said space will be almost if not completely exhausted. This is very desirable as the fresh charge which is drawn in by piston 2 on its next stroke will not be diluted with any burned gases.

When the pressure tank 50 is employed in connection with two or more cylinders of an engine as is shown in Fig. 2, the air passages or pipes 51 thereof communicate with the cylinders through their passages 14 and these passages are open only when the pistons 15 of the respective cylinders are below said openings 14, and when they are at this point, the pressure from the tank 50 is admitted to the space above said pistons 15 or vice versa. This does not cause any loss of pressure obtained by the explosion which forces the piston 15 outwardly, but merely equalizes the pressure in all of the cylinders at the time when the pistons 15 are at their lowest point of travel.

In the embodiment herein shown, no intake or exhaust valves or spark plugs are shown, as they form no part of the invention, and as they are so well known in the art, illustration thereof is not deemed necessary.

From the foregoing description, taken in connection with the accompanying drawing, the advantages of the construction and of the method of operation will be readily apparent to those skilled in the art to which the invention appertains and while I have described the principle of operation of the invention together with the device which I now consider to be the best embodiment thereof, I desire to have it understood that the device shown is merely illustrative and that such changes may be made as are within the scope of the claimed invention.

I claim:

1. In an internal combustion engine, a cylinder provided with a head and having a working and an auxiliary piston and with a combustion chamber between them, said auxiliary piston having an opening communicating with the combustion chamber of the cylinder, a valve normally closing said opening, and pressure means for holding said valve closed, the pressure of said holding means being overcome by the pressure produced by the explosion in the combustion chamber of the cylinder whereby said valve is opened and the pressure medium in the combustion chamber admitted to said auxiliary piston thereby relieving the pressure on the working piston, the pressure medium in said auxiliary piston operating to advance the piston while the working piston is moving outward.

2. In an internal combustion engine, a cylinder having two pistons movable toward and away from each other, one of said pistons being pressure controlled and having means for retaining the pressure behind it whereby it is held in advanced position, said retaining means being opened on the reaching of a predetermined pressure in the space between said pistons, whereby said pressure controlled piston is moved backward and additional pressure fluid admitted into and behind said piston until the pressures behind and in advance thereof become equal, the pressure behind said pressure controlled piston operating to move it forward on the forward movement of the other piston.

3. In an internal combustion engine, a cylinder having two pistons movable toward and away from each other, one of said pistons being pressure controlled and having a pressure fluid within and behind it for normally holding the piston at the limit of its inward stroke, said piston having an opening in its inner end, a spring pressed valve controlling said opening, said valve being opened against the tension of its spring and the pressure behind it when the pressure in advance of the piston reaches a predetermined point.

4. In an internal combustion engine, a cylinder having two pistons movable toward and away from each other, one of said pistons being pressure controlled and cup-shaped, with its closed end extending inwardly, a hollow rod extending rearwardly from the closed end of said piston and opening through said closed end, a valve closing the opening in the piston, a guide

for said rod, said rod having apertures to afford communication with the interior thereof and with the interior of said piston, and means for guiding said piston.

5. In an internal combustion engine, a cylinder provided with a head and having a working and an auxiliary piston, said auxiliary piston being pressure controlled and cup-shaped with its closed end extending inward, and its open end positioned toward the head of the cylinder, a core carried by the said engine head and extending into said auxiliary piston with its sides spaced from the side walls of the piston, and coöperating means carried by said piston and core for limiting the inward movement of the piston.

6. In an internal combustion engine, a cylinder provided with a head and having a working and an auxiliary piston, said auxiliary piston being pressure controlled and cup-shaped with its closed end extending inward, and its open end positioned toward the head of the cylinder, a core carried by said engine head and extending into said auxiliary piston with its sides spaced from the side walls of the piston, said core having a bore extending longitudinally therethrough, a piston operating in said bore, means in said bore for limiting the movement of said piston, and a connection between said bore piston and said auxiliary piston whereby the latter is limited in its inward movement by the limiting means for said bore piston.

7. In an internal combustion engine, a cylinder provided with a head and having a working and an auxiliary piston, said auxiliary piston being pressure controlled and cup-shaped with its closed end extending inward, and its open end positioned toward the head of the cylinder, a core carried by the said engine head and extending into said auxiliary piston with its sides spaced from the side walls of the piston, said core having a bore extending longitudinally therethrough, a piston operating in said bore, means in said bore for limiting the movement of said piston, and a connection between said bore piston and said auxiliary piston whereby the latter is limited in its inward movement by the limiting means for said bore piston, said core having air passages communicating with said bore to admit air for cushioning the inward movement of the piston.

8. In an internal combustion engine, a cylinder provided with a head and having a working and an auxiliary piston, said auxiliary piston having a means whereby it is retracted at the beginning of the power stroke of the working piston and advanced during the outward movement of said working piston thereby evenly distributing throughout the power stroke the pressure of the gases produced by the explosion before the beginning of said stroke, and means for cushioning the inward movement of said auxiliary piston.

9. In an internal combustion engine, a cylinder provided with a head and having a working and an auxiliary piston, said auxiliary piston having a means whereby it is retracted at the beginning of the power stroke of the working piston and advanced during the outward movement of said working piston thereby evenly distributing throughout the power stroke the pressure of the gases produced by the explosion before the beginning of said stroke, and means for providing an air cushion to limit the inward movement of said auxiliary piston.

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

VICTOR G. OTTEWELL.

Witnesses:
E. W. REDMAN,
ROBERT A. BATES.