

G. R. ELLIOTT.
INTERNAL COMBUSTION ENGINE.
APPLICATION FILED JULY 28, 1919.

1,361,236.

Patented Dec. 7, 1920.

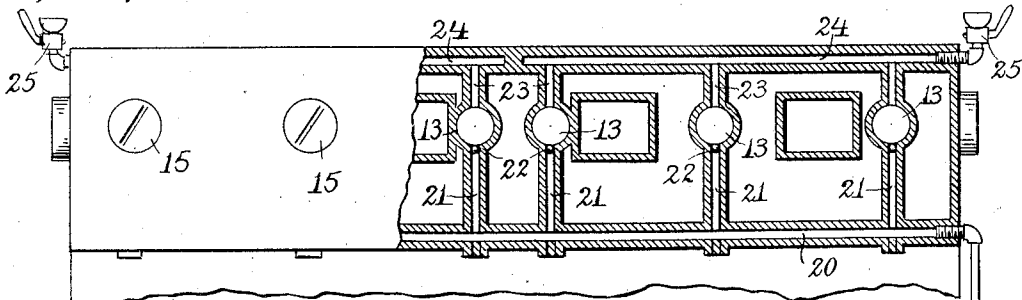


Fig. 1

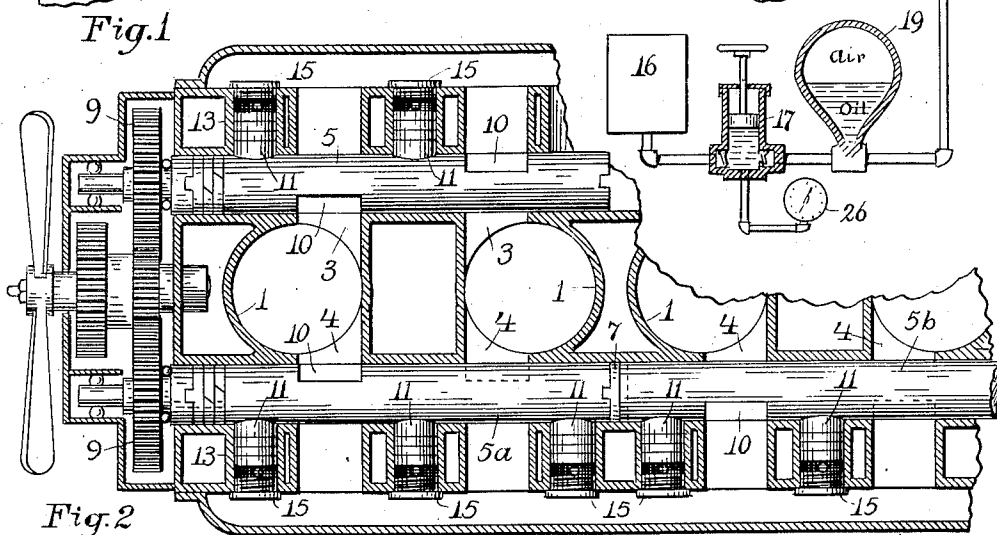


Fig. 2

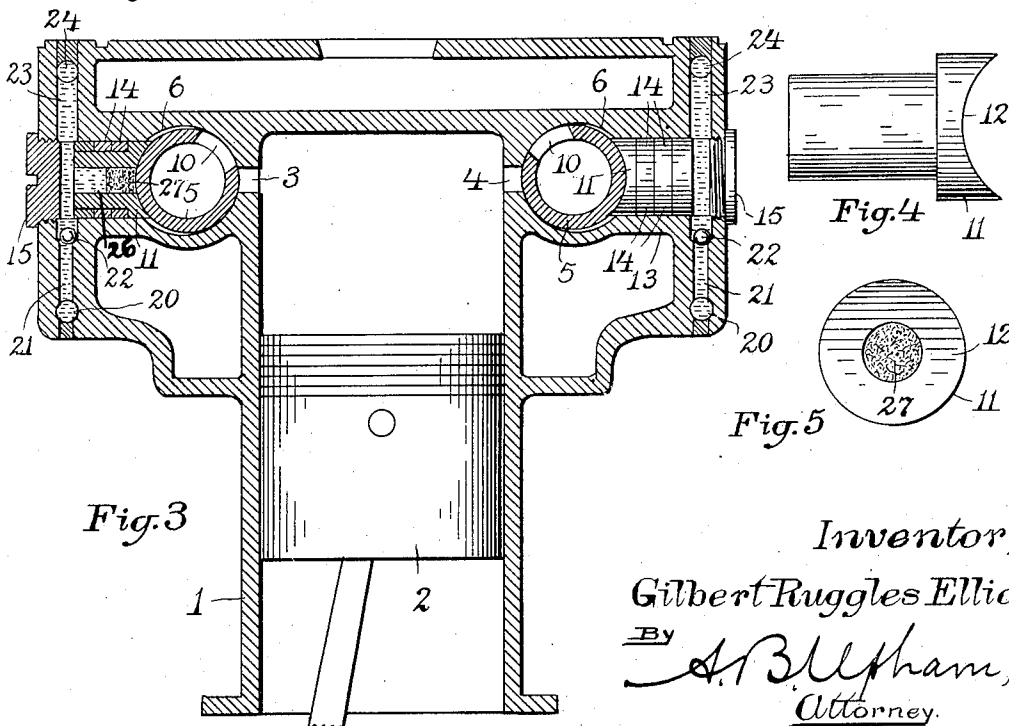


Fig. 3

Fig. 4

Fig. 5

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INTERNAL-COMBUSTION ENGINE.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, GILBERT R. ELLIOTT, a subject of the King of Great Britain, and a resident of Boston, in the county of Suffolk and Commonwealth of Massachusetts, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

In attempting to provide internal combustion engines with rotary or oscillating cylindrical valves, it is necessary to have the valve fit its chamber very snugly in order to prevent the escape of its charge during compression and also during explosion; but when the parts are thus snugly fitted, there is almost certain to be such a larger expansion of the valve than its chamber, owing to the more direct access to the interior of the valve of the exhaust, as will cause the valve to unduly expand and stick fast therein, rendering further motion of the engine impossible.

The purpose of this invention is the effecting of means whereby the valve chamber may be sufficiently large to permit any possible unequal expansion of the valve, and still the valve can be kept in so unyieldingly perfect contact with the surface of the chamber surrounding the port opening from the cylinder that there can be no leakage of charge or exploding gases between the surfaces of the valve and chamber.

In order to accomplish this I have provided means by which a body of liquid is adapted to support the valve in operative pressure against the exhaust and intake ports, the liquid acting through its incompressibility against the sudden blows of the explosions and compressions, but allowed a sufficiently slight and sluggish leakage and replenishment to accommodate the slow variations in volume due to expansion and contraction of the parts, and of the liquid itself.

To this end I arrange members to bear against the cylindrical valves at points opposite the ports leading to and from the engine cylinders, and immovably held by confined bodies of non-compressible liquid, preferably lubricating oil, such members being preferably bearing plungers or plugs movable in suitable liquid-tight casings toward and from the valves. One method of accomplishing these results is disclosed in a companion application filed May 30, 1917,

Serial No. 159,005, renewed May 15, 1919, under Serial No. 297,438; but in this present application I set forth a more simple and practical construction.

In the drawings forming part of this specification, Figure 1 is an elevation of an engine embodying my invention, parts thereof being broken away and in section. Fig. 2 is a sectional plan view thereof, but with parts broken away. Fig. 3 is a longitudinal section on a larger scale showing a cylinder having the new valves applied thereto. Fig. 4 is a side view of one of the bearing plugs upon an enlarged scale. Fig. 5 is an end view thereof.

Referring first to Fig. 3, wherein the reference numeral 1 designates one of the engine cylinders, and 2 a piston reciprocative therein, it is to be observed that at opposite sides of the closed end of the cylinder are ports 3 and 4, one being for the intake and the other for the exhaust. Rotatable in close contact with each port is a tubular cylinder 5, the chamber or casing 6 therefor being very slightly larger in interior diameter. In order to render this visible in the drawing, it is somewhat exaggerated inasmuch as a hundredth of an inch is ample for medium sized valves. By preference for the reason hereinafter set forth, each valve is designed to accommodate all four cylinders of a four-cylinder engine, but is separated into two elements 5^a and 5^b as shown in Fig. 2, terminally connected by a flexible coupling ring 7 of well known form, when the valve is rotated from one end only. If the two valve sections are separately but synchronously rotated by gearing at each end, then such coupling is not needed, but I consider it more economical to use gearing at one end of each valve 5. When I use the term "valve", I wish to be understood as designating the entire valve member, whether one or several sections, controlling the ports at one side of the engine cylinders.

Each valve 5 is formed with ports 10 co-acting with the cylinder ports 3, 4, each port 10 embracing substantially a sixth of the valve's periphery, as indicated in Fig. 3; their location along the valves being such as to give explosions in the cylinders in the customary order of 1, 2, 4, 3. That is, to have the second cylinder operate immediately after the first, the fourth after the

second, and the third after the fourth. This order is followed in the drawing of the valves shown in Fig. 2.

For immovably holding the valves in contact with the chamber walls penetrated by the ports 3, 4, under the great pressures within the cylinders during the compression and the explosion therein, I provide bearing members against each valve so disposed that one or more thereof will bear against a valve at both sides of a port, thereby giving double bearing-pressure to that part of a valve resisting the gas-pressure within a cylinder.

These bearing members are preferably cylindrical plugs 11 having a concave end fitting the periphery of a valve, each plug being slidable liquid-tight within a suitable housing 13, packing rings 14 insuring the same against leakage. The outer end of each housing chamber is closed after the introduction of the bearing plug, by a screw plug 15 proportioned to leave a space between it and the bearing plug.

This space is designed to be filled with lubricating oil, both because the most practical of the non-compressible liquids, and because of its utilization to lubricate the valves. As shown in Fig. 1, this oil is fed from a small container 16 by means of a hand pump 17 into an air chamber 19, and from thence through the main conduit 20 and the branches 21 to the chambers 13. Check valves 22 in each branch 21 prevent the return of the oil. Air escapes from the conduits and from behind the bearing plugs 11 when oil is forced therein, through branch conduits 23 and main conduits 24 to the cocks 25. When all air has escaped, as shown by the issue of oil therefrom, the cocks are closed.

By means of the hand pump 17, oil is forced into the air chamber 19 until the pressure therein is between ten and fifty pounds per square inch, the elasticity of the confined air acting against the bearing plugs 11 through the agency of the oil intermediate thereof, so that the valves 5 are at all times held snugly against the ports 3, 4.

When a charge is under compression in a cylinder, and also when the charge is fired, the heavy pressures thereof are immovably withstood by the valves 5 backed up by the bearing plugs and the confined non-compressible oil behind them. When a cylinder is exhausting, or is taking in its charge, there is no pressure against the valves from within the cylinder, and consequently no pressure of the valves against their bearing plugs. At such moment, therefore, if there has occurred any slight leakage of oil from behind the bearing plugs, the air pressure in the chamber 19 instantly forces oil from the conduits past the check valve 22, which fully replenishes such leakage.

Now, during the operation of a four-cylinder engine such as illustrated, every revolution of the crank shaft will cause both the cylinders of one pair to be under pressure, one compressing and the other firing, while the other pair will be under no pressure at all, since one cylinder of the pair will be exhausting and the other receiving its charge. Consequently during every revolution one section of each of the two sections of a valve will be under excessive pressure at the same time the other section will be free thereof, thereby diminishing wear as well as permitting the oil replenishment above recited.

Were the two main conduits 24 connected, the excessive pressure given to the oil behind the bearing plugs 11 at one end of the line of cylinders will be communicated to the bearing plugs at the other end of the line, and consequently cause unnecessary friction and wear, since such pressure is not needed during the low pressure periods.

To lubricate the surfaces of the valves 5, I prefer to form an axial hole 26 through each bearing plug, and fill a part of it with felt 27 or other porous material through which the oil under the pressure behind it will very slowly but sufficiently exude against the valve surface in contact therewith, and thence spread throughout the entire surface.

By having the valve chambers 6 slightly larger in diameter as stated above, sufficient space is allowed for the expansion of the valves when the same are heated to a higher degree than are the chamber walls, which always occurs during the beginning of the engine's operation, and often occurs at other times due to changes in the temperature of the water jacket, and otherwise.

I make each valve 5 in sections flexibly connected as already recited, in order to enable one section to be removed and replaced if it happens to be worn more than the other, and also to prevent the excessive pressure against one valve section to throw the other away from its seat should the parts become unevenly worn. Further, it is easier to manufacture short valve sections than one long one and to get the latter absolutely true in diameter throughout its length, owing to the greater spring in the long one.

As shown in Fig. 2, the ports 3 and 4 are preferably made substantially tangential with respect to the cylinders 1 for the better scavenging of the latter. When the exhaust ports 4 are opened, the exhaust gases quickly acquire a rotary motion from the tangentially directed initiatory discharge and thereby are more quickly and thoroughly caused to escape from the cylinder.

Although but one side of each port 3 and 4 is tangential to the surface of an engine cylinder, yet this one side is sufficient to ini-

tiate the gyratory motion of the gases exhausting therefrom, as also to aid in the quicker intake of the charge.

By thus allowing ample space for the expansion of the valves, and at the same time solidly holding them against ports 3 and 4 to prevent leakage, especially of the charge under compression, the engine is rendered highly efficient.

10 The resilient pressure given to the oil by the compressed air in the air chamber 19 serves to retain the bearing plugs in steady contact with the valves, and also to replenish any leakage past the check valves 22 or
15 through the felt packings 27 or around the packing rings of the bearing plugs 11. This replenishment occurs automatically when the engine cylinders associated with certain bearing plugs are exhausting or taking
20 in their charge. The leakage mainly occurs when the engine is first put into operation and when the valves 5 receive their expansion before the chamber walls about them, and also as the oil behind the bearing
25 plugs 11 expands, but such expansion is so small that the leakages above referred to are ample to accommodate the expansion of the same.

Then, as the chamber walls 6 heat up and
30 the chamber increases in diameter, all possible vacant space behind the bearing plugs is instantly supplied by the air pressure acting on the oil in the conduits during the cylinder intakes and exhausts, the check
35 valves 22 immediately cutting off any return toward the pressure chamber 19. The amount of oil thus required for replenishment is so slight that a few strokes of the hand pump 17 once in a day or two will
40 suffice.

What I claim is:

1. An internal combustion engine having a cylinder and a rotary valve therefor, and means for inclosing a liquid to resist movement of the valve away from the cylinder,
45 such liquid being non-compressible, and the inclosing means being unyielding to sudden pressure, whereby such liquid is made an unyielding wall to hold said valve against sudden shocks tending to throw it away from the cylinder.

2. An internal combustion engine having a cylinder and a rotary valve therefor, and means for inclosing a liquid to resist movement of the valve away from the cylinder,
55 such liquid being non-compressible, and the inclosing means being unyielding to sudden pressures but adapted to permit a very slow variation of the liquid content.

3. An internal combustion engine having a cylinder and a rotary valve therefor, means for inclosing a quantity of non-compressible liquid to resist sudden movements of the valve away from the cylinder but to
65 permit a slow leakage of the liquid, and

means for replenishing the supply of the liquid.

4. An internal combustion engine having a cylinder and a rotary valve therefor, means for inclosing a quantity of non-compressible liquid to resist sudden movements of the valve away from the cylinder but to permit a slow leakage of the liquid, and means acting under continuous pressure for replenishing the supply of liquid.

5. An internal combustion engine having a cylinder and a rotary cylindrical valve for the cylinder, a member radially movable against the periphery of the valve, means for inclosing a quantity of non-compressible liquid to resist sudden movements of said member away from the valve, and means acting continuously to supply said liquid under pressure to said inclosing means and to check its return.

6. An internal combustion engine having a cylinder and a rotary cylindrical valve therefor, a member contacting with the periphery of said valve, means inclosing a quantity of non-compressible liquid against said member to confine it against said valve, and means for continuously supplying the liquid to said inclosing means under resilient pressure and for checking its return.

7. An internal combustion engine having a cylinder and a rotary cylindrical valve therefor, a cylindrical chamber inclosing the valve the diameter of which is very slightly larger than that of the valve, the chamber having a port communicating with the cylinder and the valve having a port coacting with the former port during a certain period of the valve's rotation, a member contacting with the periphery of the valve to hold it in contact with the portion of said chamber having the port communicating with the cylinder, means for inclosing a quantity of non-compressible liquid to confine said member against said valve, and means for continuously supplying the liquid to said inclosing means and for checking its return.

8. An internal combustion engine having a cylinder and a rotary cylindrical valve therefor, a cylindrical chamber for said valve having a port communicating with the cylinder, the valve having a port periodically coacting with the former port, a bearing plug slidably supported liquid-tight fitting against the periphery of said valve, means for inclosing a quantity of non-compressible liquid against the opposite end of said plug, and means for supplying the liquid to said inclosing means and for checking its return.

9. An internal combustion engine having a cylinder and a rotary cylindrical valve therefor having a port, a cylindrical chamber for said valve having a port communicating with the cylinder, two bearing plugs

- supported slidably liquid-tight each bearing against the periphery of said valve opposite said cylinder port, the plugs being located to have the valve port between them, means
5 for inclosing a quantity of non-compressible liquid against the ends of said plugs away from the valve, and means for supplying the liquid to said inclosing means and for checking its return.
- 10 10. An internal combustion engine having a cylinder and a rotary cylindrical valve therefor, a slidable liquid-tight plug bearing against the periphery of the valve, and means for inclosing and maintaining constantly supplied a quantity of lubricating
15 oil against the end of said plug opposite its concave face, said plug having an axially disposed hole through it containing a porous plug.
- 20 11. An internal combustion engine having a cylinder and a rotary valve therefor, and means for inclosing a quantity of non-compressible liquid to resist sudden movements of the valve away from the cylinder but
25 permitting slow movement thereof, said means comprising a source of liquid supply, an air chamber, means for forcing the liquid from said source into said air chamber, a conducting means for the liquid between said air chamber and said inclosing
30 means, and a check valve in said conducting means.
12. An internal combustion engine having a cylinder and a rotary valve therefor, and
35 means for inclosing a quantity of non-compressible liquid to resist sudden movements of the valve away from the cylinder, said means comprising a tank for the liquid, an air chamber, a pump for forcing liquid
40 from the tank into the air chamber, a con-

ducting means from said air chamber to said inclosing means, and a ball valve in said conducting means to prevent return.

13. An internal combustion engine having a cylinder and a rotary valve therefor, 45 means for inclosing a quantity of non-compressible liquid to resist sudden movements of the valve away from the cylinder, and a closable conduit leading up from said inclosing means for permitting the escape 50 therefrom of any air or vapor.

14. A multi-cylinder internal combustion engine having an elongated cylindrical valve rotatively timed controlling all the cylinders, each cylinder having a port and 55 the valve having ports coacting therewith, means for inclosing a quantity of non-compressible liquid to resist sudden movements of the valve away from the cylinder ports, means for replenishing the supply of liquid, 60 and a closable conduit for each inclosing means to communicate at will with the atmosphere, the conduits for certain of the inclosing means having a section in common but not in communication with the conduits 65 for the other section.

15. A multi-cylinder internal combustion engine having an elongated cylindrical valve rotatively timed for controlling all the cylinders, means for retaining the valve in 70 constant touch with the side adjacent the cylinders, and means for resisting the sudden pressures against the same arising from the compression and explosion in the cylinders, the valve being made in a plurality of 75 sections rotative in unison.

In testimony that I claim the foregoing invention, I have hereunto set my hand this 14th day of July, 1919.

GILBERT R. ELLIOTT.