Nov. 4, 1930. O. SCHUMANN 1,780,443

ROTARY INTERNAL COMBUSTION ENGINE

Filed May 25, 1928

Fig.1.

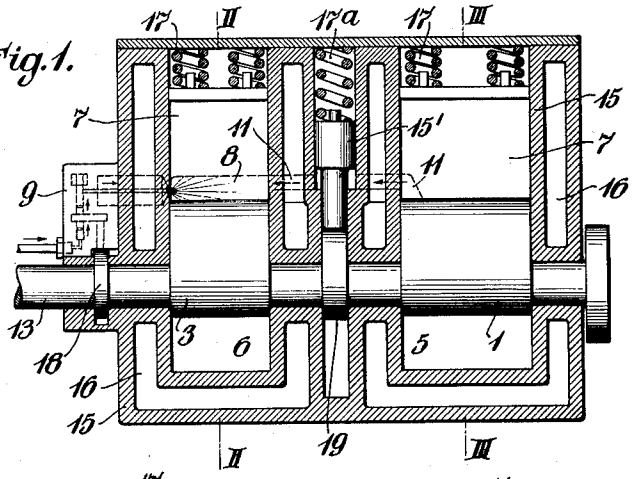


Fig.2.

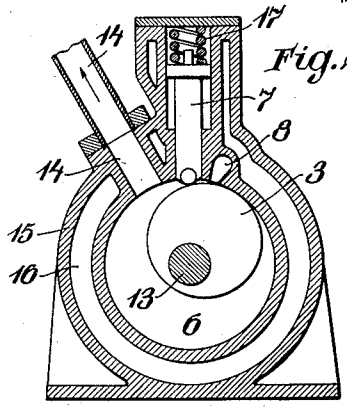


Fig.3.

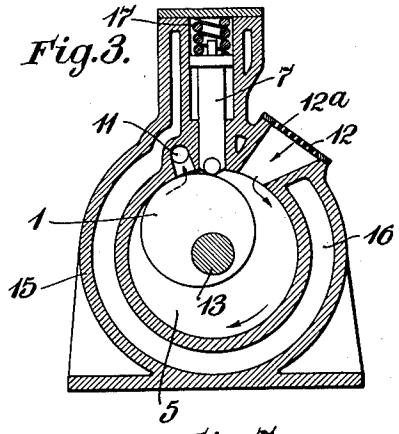


Fig.4.

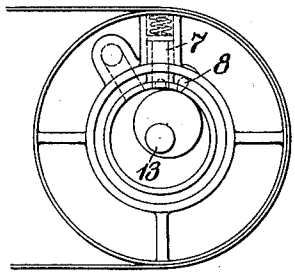


Fig.5.

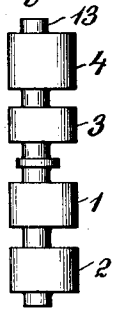


Fig.6.

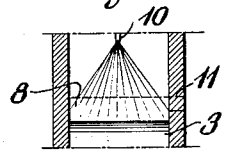
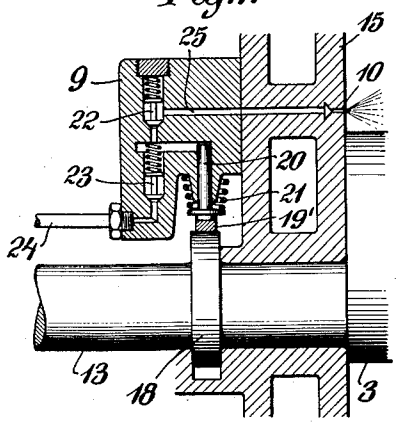


Fig.7.



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UNITED STATES PATENT OFFICE

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ROTARY INTERNAL-COMBUSTION ENGINE

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This invention relates to rotary internal combustion engines, in which either an eccentrically arranged circular rotary piston rotates in a stationary cylinder or casing, or in which the cylinder or casing rotates around an appropriately arranged stationary circular piston. There are provided, of course, the necessary means for supplying fuel, as well as air, also for permitting compression of this latter in the proper intervals of time and for injecting the fuel into the compressed air, all as fully described hereinafter.

The invention is illustrated diagrammatically and by way of example on the accompanying drawing on which Figure 1 is an axial section through a rotary internal combustion engine designed according to this invention, this figure showing a constructional form in which the pistons (an air-compressing piston and a working piston) are rotating in a stationary casing; Figure 2 is a cross-section in the plane II—II of Fig. 1, Figure 3 a cross-section in the plane III—III of Fig. 1, Figure 4 a cross-section through a constructional form in which the piston is stationary and the cylinder or casing rotates around this piston, this figure being drawn to a reduced scale relatively to Figs. 1–3, Figure 5 shows merely the shaft of another modification, in which two air-compressing pistons and two working pistons are provided, the respective engine being a two-stage one, Figure 6 shows some details of another modification in which the fuel is injected not approximately parallel to the shaft, as in Fig. 1, but approximately at right angles thereto, i. e. practically vertically, and Figure 7 is a separate view of the fuel feeding pump which is shown in vertical section, the plane of the section passing through the axis of the shaft of the engine.

If the engine is a two-stage one, as indicated by the detail Figure 5, it has two air-pistons 1 and 2, preferably of equal size, and two working pistons 3 and 4, preferably of unequal size, the smaller of them being the high-pressure piston, the larger the low-pressure one. In the constructional form shown in Figs. 1–3 there is only one air-piston 1 and one working piston 3, the former rotating in the cylinder 5, the other in the cylinder 6, which both are located in a common casing 15 provided with cooling spaces 16. The pistons 1 and 3 are affixed to, or made integral with, a shaft 13 by which the power generated is transmitted in known manner. Each piston co-operates with a slide 7 arranged above it and in the casing 15 and serving to separate the suction space from the compression space. The slides are subjected to the pressure of springs 17 which keep the lower face of each slide in contact with the circumferential surface of the respective piston.

The air enters into the cylinder 5 through a branch 12 (Fig. 3) covered with a sieve or piece of wire-netting 12^a and the compressed air passes from the cylinder 5 to the cylinder 6 through a passage 11 which terminates in a transversely located chamber 8 (Figs. 1 and 2) which serves as mixing chamber for the air and the fuel. This latter is injected into said chamber by means of a nozzle 10 supplied with the fuel by the pump 9, which is described separately in the next paragraph. The waste gases escape through the branch 14 (Fig. 2). The fuel pump may be actuated by the shaft 13 by the intermediary of an eccentric 18 (Fig. 1) or may have driving means of its own. The passage 11 for the compressed air from the cylinder 5 into the mixing chamber 8 can be controlled by a slide-valve 15′ controlled by an eccentric 19. Also this valve is subjected to the pressure of a spring 17^a.

The pump comprises a plunger 20 which is reciprocated by the eccentric 18 by the intermediary of a shiftable member 19′ operated by the control device of the pump. This device, the operation of which depends upon the speed of the engine, is known, does not form a part of the present invention, and I have from these reasons abstained from showing and describing it in detail. The plunger is subjected to the pressure of a conical compression spring 21 which is compressed in the position shown in Fig. 7; in this position the plunger is in its highest position. The pump comprises, besides the plunger, a suction valve 23 and a delivery

valve 22, each of which is subjected in known manner to the pressure of a helical spring, as shown. The liquid fuel is supplied through the pipe 24. The nozzle 10 receives the fuel through the passage 25 which in turn receives the fuel from the space above the delivery valve. It will be obvious that the fuel is supplied as long as the plunger reciprocates.

The engine may be designed as a high-pressure, medium-pressure or low-pressure engine. In the first and the second case all light and heavy liquid fuels, also solid fuels in pulverulent or other form, may be used, whereas in the third case (low-pressure engines) chiefly light liquid fuels are employed. The air is compressed, as the case may be, to from 4 to 12 atmospheres. The igniting device by which the mixture of the liquid fuel and the air is ignited already in the chamber 8 or only in the cylinder 6 may be of any desired type.

A medium-pressure engine has generally two air pistons (1 and 2, Fig. 5) and two working pistons (3 and 4, Fig. 5), and a high-pressure engine may also have two or even more than two pistons of each kind. I have abstained from showing and describing in detail also such rotary internal combustion engines, in that their construction and manner of operation, apart from the number of the pistons and the appertaining cylinders, is the same as already described on the preceding pages.

Concerning the control member 15 which is intended to control the flow of the compressed air on its way from the cylinder 5 to the chamber 8, I wish it to be understood that it may also be so designed as to serve as a means for preventing the combustible mixture from flowing back through the passage 11 into the cylinder 5.

It depends upon the number of revolutions of the engine whether the engine is so designed that the air piston is, or the air pistons are, leading with respect to the working piston or pistons, or whether the reverse takes place.

The pistons 1 and 3 may extend to opposite directions relatively to the shaft 13 so as to balance one another; this is true also of engines having two or more air pistons and two or more working pistons. What I have said concerning the balancing of the pistons is true also of the balancing of rotary control members and the like, where such ones are provided. I mention also the point that it is not indispensably requisite that the air piston and the working piston are arranged co-axially; they may be arranged side by side, there being then two parallel shafts which may be coupled with each other in any desired manner. I also do not limit myself to the circular shape of the pistons as shown by way of example on the drawing. Also other shapes are possible, especially if two or more cycles are to be carried out at one revolution, as has already been mentioned.

Cooling the engine may be effected by means of water or another cooling liquid or by means of air. Also the pistons and the shaft can be cooled if they are hollow.

It has already been mentioned in the introductory part of this specification that the pistons may be stationary and the cylinder may rotate. An example for such a constructional form is shown quite diagrammatically in Fig. 4, in which similar numerals of reference denote similar parts as in the other figures, except the numeral 20 which indicates a pulley firmly connected with the rotary cylinder 15, and the numeral 21 which indicates a belt by which the power is transmitted to any machine or the like.

By way of supplement I still mention that the chamber 8 should have practically no corners and no clearance, and should communicate with the cylinder 6 through a narrow slot directed in the direction of rotation of the piston 3. The nozzle 10 is preferably shaped as a long cone having a rounded-off end provided with the injection bores. In the case of two or more nozzles arranged side by side, their bores are preferably so arranged that they all together produce a fan-like jet, as in Fig. 6. Prior to introducing the fuel into the air this latter is used for scavenging the cylinder, as ordinarily done also with ordinary piston internal combustion engines.

I claim:

1. A rotary internal combustion engine, comprising, in combination, a casing forming two chambers; a shaft traversing said chambers; two circular pistons affixed to said shaft in said chambers, one of them being larger than the other and serving to compress air, the other being adapted to be driven round in the appertaining chamber by the explosions; a passage provided in said casing and so located as to conduct the compressed air from the chamber enclosing said larger chamber to the other chamber; a valve inserted into this passage; means for actuating said valve in correspondence with the revolutions of said two pistons; and a fuel nozzle terminating opposite the end of said compressed-air passage at the chamber enclosing the smaller piston, substantially as set forth.

2. A rotary internal combustion engine, comprising, in combination, a casing forming two cylindrical chambers located side by side; a shaft traversing said chambers in the centres thereof; two circular pistons secured excentrically to said shaft and being adapted to travel round in their respective chambers, of which one serves as air compression chamber and the other as working chamber; a passage extending in said

casing from the air compression chamber to the working chamber, and a fuel nozzle also extending into the latter chamber opposite the end of said passage; a control valve in said passage between said two chambers, and means for operating said valve, said means comprising on the one hand a cam provided on the said shaft, and on the other hand a helical spring, substantially as set forth.

3. A rotary internal combustion engine, comprising, in combination, a casing forming two chambers arranged side by side and having each an upwardly directed extension; a shaft traversing said chambers in the centres thereof; two circular pistons attached to said shaft inside said chambers and adapted to travel round in them and around said shaft; slides located in said chamber extensions and contacting at one end with said pistons; means keeping said slides in contact with the said pistons at every position thereof; a passage extending in said casing from one of said chambers to the other and serving to conduct compressed air from the first chamber into the other; a control-valve in said passage, and automatic means for actuating this valve; and a fuel nozzle terminating into said other cylinder opposite the end of the said passage, substantially as set forth.

4. A rotary internal combustion engine, comprising, in combination, a casing forming two chambers adapted to form cylinders for rotating pistons; a shaft extending through the centres of said chambers or cylinders; a smaller circular piston and a larger circular piston secured to said shaft within the chambers, this piston being adapted to compress air and the other piston being adapted to be rotated by the explosions; a passage extending from the compressed-air chamber to the working chamber, and an extension of said passage, this extension extending along the smaller piston path parallel to the said shaft and having a slot opening into the chamber pertaining to this piston; a fuel nozzle terminating into said passage extension opposite the said passage itself, and means for controlling the flow of the compressed air through the said passage, substantially as set forth.

5. A rotary internal combustion engine, comprising, in combination, a casing forming two cylinders adapted to receive rotary pistons; a shaft extending through said cylinders and two pistons of different size affixed to said shaft in the said cylinders; slides arranged in extensions of the cylinders and contacting at one end with the said pistons; springs pressing said slides continually onto the circumferential surface of the pistons; a compressed-air passage extending from the one cylinder to the other and extending further along the respective cylinder parallel to the shaft; and a control piston arranged between said slides, and means for actuating said control-piston automatically, substantially as set forth.

In testimony whereof I affix my signature.

OTTO W. SCHUMANN.