Dec. 31, 1929. F. GOCKERELL 1,741,766

HIGH SPEED INTERNAL COMBUSTION ENGINE WITH SELF IGNITION

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FIG. 1.

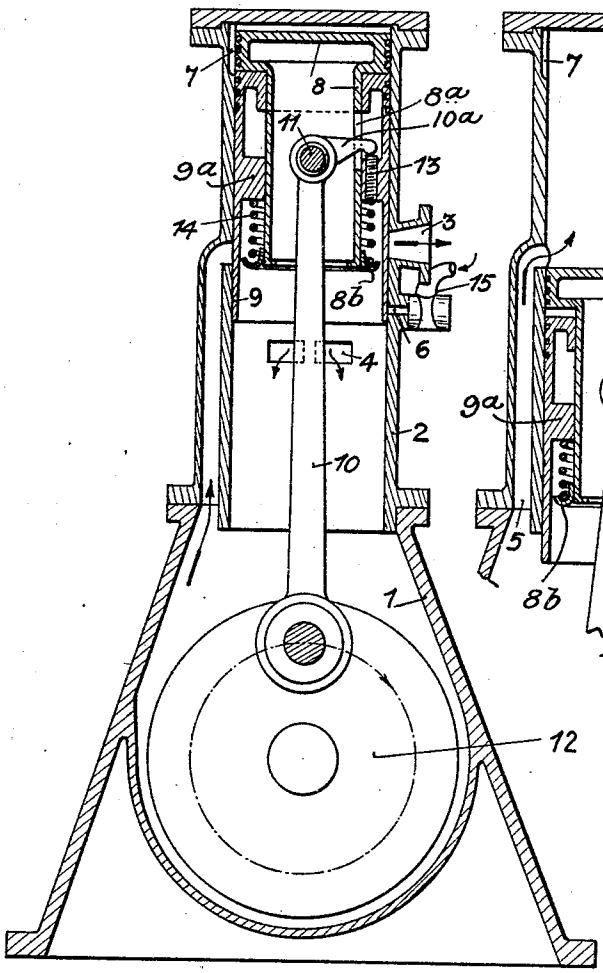
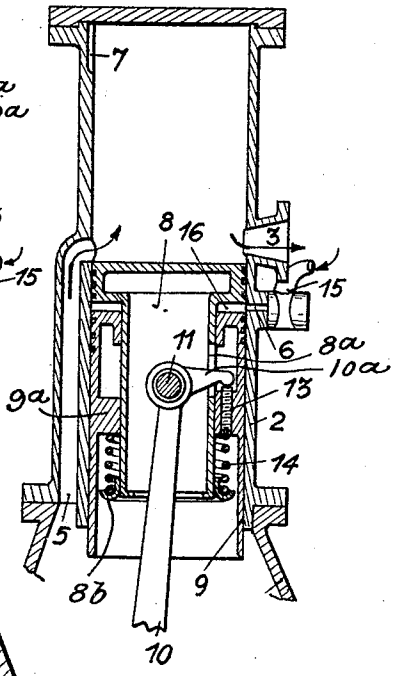



FIG. 2.




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FIG. 3.

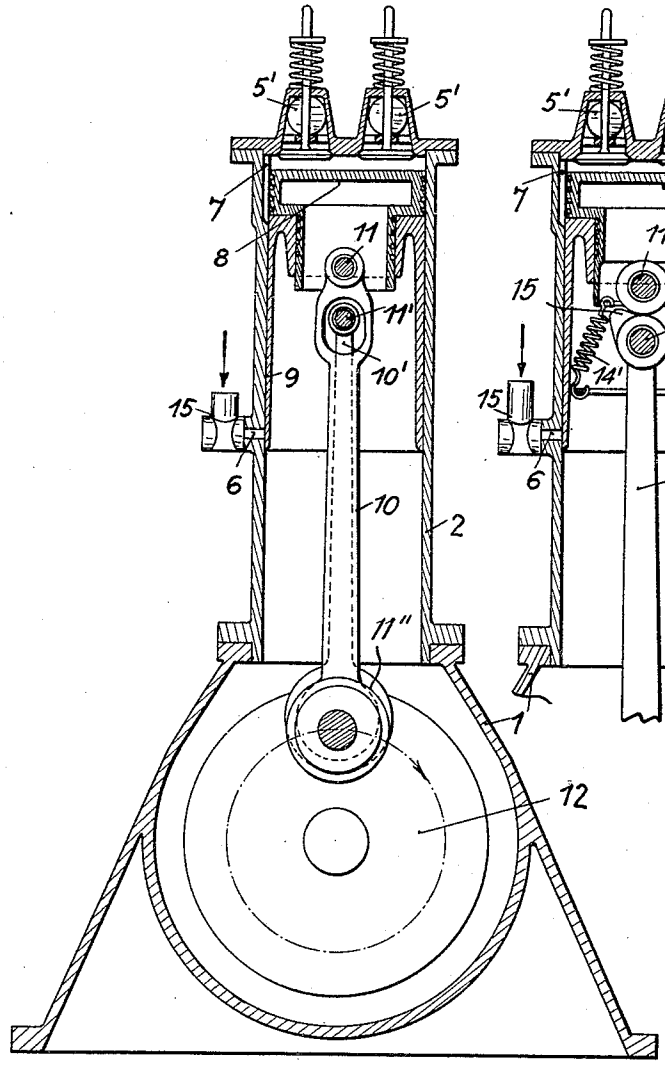



FIG. 4.




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# UNITED STATES PATENT OFFICE

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## HIGH-SPEED INTERNAL-COMBUSTION ENGINE WITH SELF IGNITION

Application filed December 9, 1926, Serial No. 153,608, and in Germany October 24, 1925.

My invention relates to a two-stroke or four-stroke cycle combustion engine with self-ignition, and is characterized by certain particular arrangements and combinations of parts by which the construction of the engine, as well as the assembling and mounting of its parts, is simplified and the operation of the engine rendered still more reliable.

In the accompanying drawing I have illustrated an engine constructed according to my invention, Fig. 1 being an axial section through the engine, Fig. 2 a similar section showing only the upper half of Fig. 1 with the piston of the engine in a position different from that shown in Fig. 1, Fig. 3 a section similar to Fig. 1 showing a modified form of engine according to my invention and Fig. 4 a section similar to Fig. 2 showing another modified form of engine according to my invention.

Referring to Figs. 1 and 2, the cylinder 2 is mounted on the crank casing 1 and provided in known manner with an exhaust opening 3, an air inlet slot 4, and an overflow channel 5, through which the air entered through the slots 4 into the spaces below the piston, i. e. the lower half of the cylinder and the crank casing (the piston being then in its uppermost position, as in Fig. 1), and compressed by the downward stroke of the piston, may pass into the cylinder space above the piston when this has arrived in its lowermost position, as in Fig. 2.

The fuel is introduced through a cylinder wall port 6 which communicates with a carburetter 15. The port 16 is arranged near the top of the piston 9 when this is in its lowermost position, as in Fig. 2, and at and near the top of the cylinder is provided a small by-pass groove 7 more fully dealt with hereinafter.

The working piston in the cylinder 2 is provided, as may be seen especially from Fig. 2, with an annular groove 16 extending over the periphery of said piston. This groove is produced by the temporarily opposite motion of the two parts of the piston and in this manner a fuel chamber will be formed which is supplied at the under dead point position of the piston with fuel through the slots 6. The fuel during upward stroke of the piston will be conveyed into the upper part of the cylinder 2 which forms the combustion space and will come in contact with the highly compressed and heated charging air which is present above the piston by means of the by-pass groove 7. This is accomplished by causing the charging air to expand for a moment and thus enter into the fuel chamber of the piston, whereby the explosion will be initiated which now will drive the piston towards below. The piston is formed by two sleeve-like parts 8 and 9 which are displaceable one within and relatively to the other and as a whole form the body of the piston.

The piston or connecting rod 10 which transmits the power in known manner to the crank disk 12 is formed in the manner of a bell-crank lever in that its upper end which is connected with the piston member 8 by the cross bolt 11 has a short arm $10^a$ extending at right angles to the rod 10 through a slot $8^a$ of the piston member 8; the end of said arm contacts with a pin 13 screwed into an inner annular projection $9^a$ of the piston member 9, and a helical spring 14 is inserted between this projection $9^a$ and a flange-like member $8^b$ secured to the lower end of the piston member 8. The piston member 9 is moved downwardly by the arm $10^a$ and upwardly by the spring 14. If the piston composed of the members 8, 9 is in its upper position, as in Fig. 1, the piston member 9 has been moved upwardly by the spring 14, the annular space or groove 16 intermediate the two piston members being now completely closed and the fuel having been delivered through the groove 7 into the cylinder space above the piston, or its member 8. If the piston has moved into its lowermost position, as in Fig. 2, the space or groove 16 will have been re-established and again filled with fuel. The pin 13 is threaded and may be adjusted in the annular projection $9^a$ in order to vary the width of the space 16 and therewith the amount of the liquid fuel which is supplied at every stroke.

In the modification shown in Fig. 3 valves 3′ and 5′, of which one is the inlet valve and the other the outlet valve, are provided in-

stead of slots or ports or the like. According to Fig. 3 the piston is likewise composed of an outer member 9 and an inner member 8, but the means for moving said two members relatively to each other, however, being different from in Figs. 1 and 2. According to Fig. 3 the piston member 8 and the crank disk 12 are connected with each other by means of a cross bolt 11 and a piston or connecting rod 10, the same as in Figs. 1 and 2. According to Fig. 3 furthermore the piston member 9 is connected with the crank disk by a connecting rod 10′ and a cross bolt 11″, as well as by an eccentric 11‴ provided at the lower end of the rod 10′. In this manner the piston members 8 and 9 will be reciprocated, and simultaneously therewith shifted relatively to each other, the co-operation with the fuel inlet 6 and the fuel groove 7 being the same as in Figs. 1 and 2.

In the modification illustrated in Fig. 4 there is only one rod 10, as in Figs. 1 and 2, at the upper end of this rod, however, there is provided a cam-like member 15 which co-operates with a roller 16 carried by a cross bolt 11 of the piston member 8. The member 15 and the roller 16 are constantly held in contact with each other by a helical spring 14′. In this case also the two piston members will be shifted relatively to each other during rotation of the crank disk 12, the piston member 8 being lifted relatively to the piston member 9 when the lower end of the rod 10 has just moved past its lowermost position, that is to say, when its position corresponds to that of the connecting rod 10 in Fig. 2.

By using the two-part working piston as conveying means for the fuel the Diesel principle is, as it were, reversed, in that the air is supplied to the fuel. This is accomplished in a very simple manner and with the greatest possible efficiency because the free sectional area available between the two members of the piston is about 400 times larger than that of a fuel nozzle designed in accordance with the ordinary Diesel motor in which the fuel is injected into the compressed air.

If an engine designed according to this invention is intended to be used in connection with airships or aeroplanes, a compression reducing device as well as an artificial ignition will be required for the starting of the motor which otherwise would commence to instantly ignite which is dangerous for the plant. A particular advantage is obtained if it is desired to use the improved engine or motor combined with a compressor. By providing a compressor the simplicity of the plant will not be impaired, because the compressor needs to deliver solely pure air, in contradistinction to explosion motors in which the compressor is in operative connection with the carburetter.

Owing to the small and always constant volume of the fuel chamber the combustion mixture may be made rich in fuel which is connected with the advantages that the fuel will be consumed economically and may be supplied in accurately dosed quantities, and that the amount of fuel may be regulated very finely by means of a throttle, the same as in carburetter engines.

I claim:

A high-speed self-igniting combustion engine comprising a cylinder, a two-part piston consisting of an outer and an inner member both shiftable relatively to each other and forming between them in certain positions of the engine a circumferential groove intermediate said members adapted to receive and convey liquid fuel; a connecting rod hinged to said inner piston member, and a projection extending forth from the upper end of said rod towards said outer piston member and controlling the relative shifting of said two members; a fuel supply channel provided on said cylinder for establishing communication with said groove when said piston is practically in its lowermost position, and means for conveying the fuel carried upwards by said piston into the cylinder space above the piston when this has arrived practically in its uppermost position.

In testimony whereof I affix my signature.

FRITZ GOCKERELL.