Oct. 10, 1933. F. GOSSLAU 1,929,885

INTERNAL COMBUSTION ENGINE

Filed Sept. 11, 1930 2 Sheets-Sheet 1

Fig. 3.

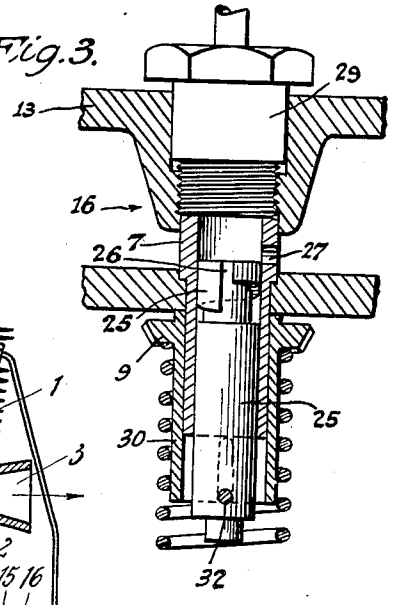
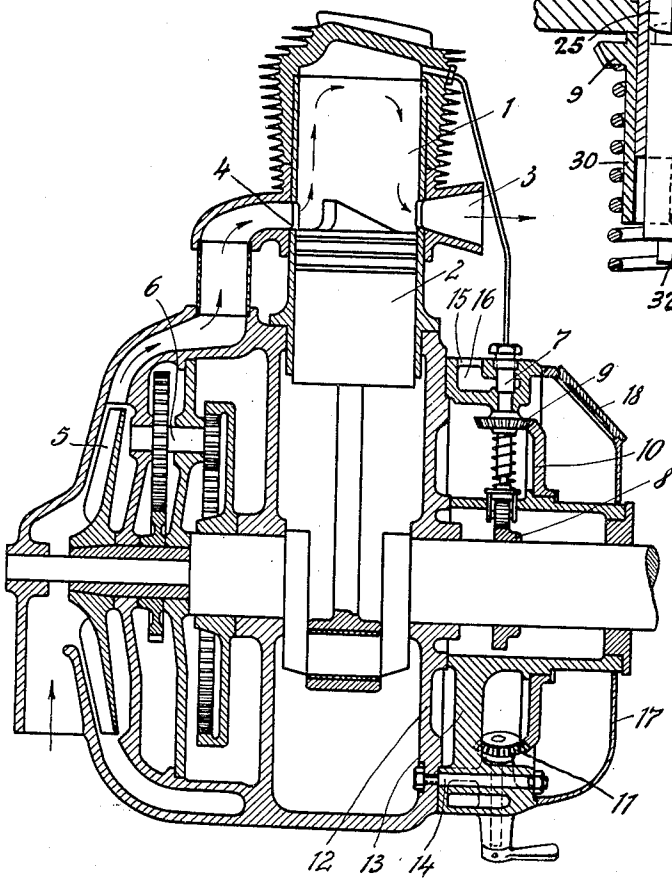


Fig. 1



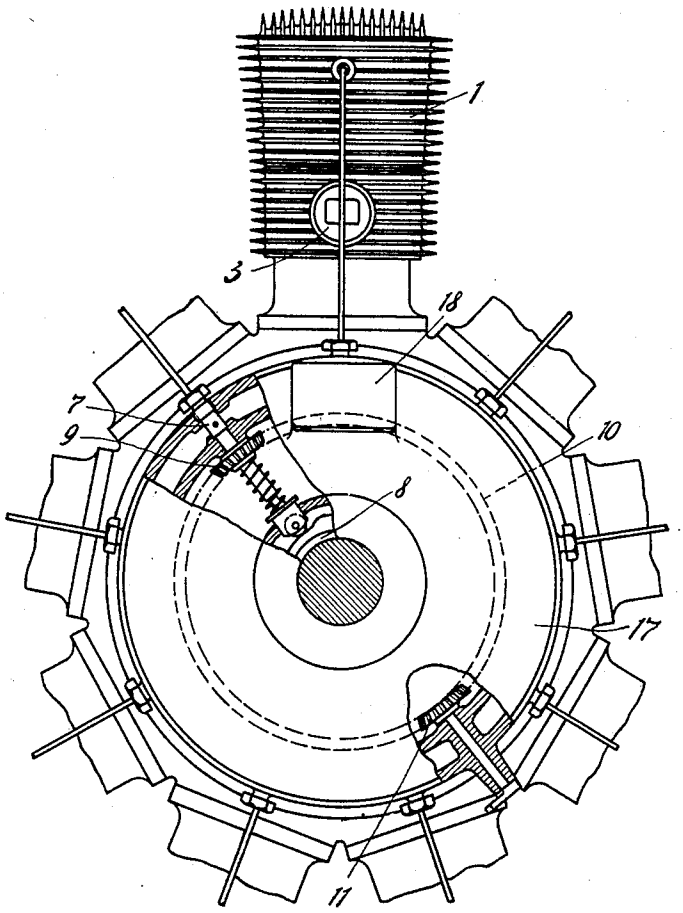
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Fig. 2



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UNITED STATES PATENT OFFICE

1,929,885

INTERNAL COMBUSTION ENGINE

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Application September 11, 1930, Serial No. 481,141, and in Germany September 21, 1929

3 Claims. (Cl. 123—195)

My invention relates to internal combustion engines and more particularly to an engine of that kind having radially arranged cylinders.

The supply of fuel in internal combustion engines frequently takes place through a fuel pump and, besides, through a controlled injecting organ. The arrangement of the valve gear for each individual cylinder and the separate drive required for same, makes the construction of the engine complicated. It must also be remembered that it is difficult, even with the most careful manufacture of the parts, to obtain a uniform injection, owing to the many joints in the valve gear, which all have a certain play. Finally, the fuel pump also requires its separate drive.

By the present invention, the above drawbacks are eliminated. It consists in controlling a plurality of fuel pumps, also radially arranged and corresponding in number to that of the cylinders, by means of a single cam rotating at the same speed as the crank shaft, open nozzles, or nozzles opening under the pressure of the delivered fuel being employed as an injecting organ. According to the present invention I provide a particularly advantageous support for these pumps in the form of an annular frame, detachably fixed on the casing and forming a part of the latter and serving at the same time as a guide for the piston lifters of the pumps, and as a support for the outer shaft end bearing. All pumps are driven by a common cam fixed directly on the crank shaft. In order to vary the output of the pumps in common, my invention provides a means for producing a regulation for all pump cylinders without the necessity of displacing or shifting a constantly moving control element. According to the invention, this is achieved by employing fuel pumps of the type disclosed in my aforementioned patent, in which the delivery is regulated by turning the piston itself, this turning of the piston being according to my invention performed by a bevel wheel common to all the pumps.

An example for carrying out the invention is given in Figs. 1, 2 and 3 of the accompanying drawings. Fig. 1 shows a vertical section in axial direction of a multi-cylinder motor of the radial type; Fig. 2 a side elevation with portions cut away, and others shown partly in section, and Fig. 3 shows in larger scale a longitudinal vertical section through one of the pumps. The illustrated machine is of the two cycle type. The piston 2 of the cylinder 1 is just at the bottom dead center, the scavenging ports 4 and the exhaust ports 3 are open. The scavenging and the charging of the cylinder 1 is effected by means of a blower 5 driven from the crank shaft through the gear 6. Each cylinder has a separate fuel pump 7, all the fuel pumps being arranged radially. For a nine-cylinder motor of the radial type, there would, therefore, be nine fuel pumps mounted in one plane, all of which would be controlled by a single cam 8 arranged on the crank shaft. The change in the delivery of the individual fuel pumps is effected by turning a bevel gear wheel 9 on each pump, which varies the angular position of each pump piston in its cylinder. This is shown in detail in Fig. 3, though it does not form part of the present invention, being claimed particularly in the U. S. Patent No. 1,876,916, granted to me September 13, 1932. As will be noted from Fig. 3 gear wheel 9 is attached to a sleeve 30 which is rotatably disposed on the pump cylinder 7. This sleeve is provided at its free end with two oppositely disposed longitudinal slots 31, and the two ends of a transverse pin 32 fixed in the lower end of piston 25 are disposed in these slots, whereby the piston can freely reciprocate without interference by the sleeve. If now gear 9 is rotated in one or the other direction, piston 25 must follow owing to the aforedescribed coupling pin arrangement. Piston 25 is recessed at its inner end as shown at 26, and port 27 is cleared sooner or later by this recess according to the angular piston position, whereby some of the fuel previously taken in through this port is discharged when the piston has reached a certain height, at which communication is established between port 27 and the compression chamber of the pump. The displacement is controlled from the operator's post by means of the gear wheel 11 which meshes with the gear wheel 10.

In itself, it is possible, for example, to provide each fuel pump with a separate casing and to build the individual pump casings into the crank case, similar to the manner in which this is done with the valve guides of radial engines of the four cycle type.

An arrangement of that kind would, however, cause some difficulty not only as to the accurate adjustment of the individual pumps with respect to the cam, but also as to the provision of a common fuel supply for all the pumps. The same difficulty would arise, if each individual pump were to be fastened to the crank case, for instance, by means of a flange. If with the latter arrangement it became necessary to replace even a single pump the readjustment would be very troublesome and could hardly be done on the spot, where, for instance, an airplane may have to land in a case of emergency. Finally, this arrangement

has also the disadvantage that in the workshop the engine case cannot be manufactured at the same time as the pump plant, but that on the contrary the engine case must already be finished before the pumps can be adjusted.

These drawbacks are avoided through the present invention by housing all pumps in a separate part of the casing fastened to the crank case in an easily detachable manner. With an arrangement of that kind, not only are advantages obtained in the making and assembling of the engine, but it is, if desirable, thus also possible to employ different materials for the two parts 12 and 13. In such a case, for instance the crank case 12, in which the crank of the crank shaft is situated, and which transmits the forces developed in the engine cylinders to the main shaft, may be made of very strong material, whilst the part of the case 13 containing all the pumps may consist of weaker and perhaps lighter material. If part 13 is thus made separately, it can easily be made so as to contain a fuel chamber from which all pumps can be directly supplied. This chamber assumes in this case a convenient annular duct adjacent to the points where the pumps are located. A further development of the invention consists in the provision of an annular dished cover 17, rotatable on its seat in housing 13, for enclosing the part of the housing containing the fuel pumps, and in providing in said rotatable cover an opening through which a hand may be passed. As the opening can be brought in front of each pump by turning the cover, all the pumps are easily accessible for examination and repairs. This presents a special advantage for airplane engines, as it is thereby not necessary to remove the propeller. During normal operation, the cover 17 is held in position by screws. The part of the case 13, in which all the pumps are housed, is fastened to the crank case 12 by means of bolts 14. 15 is the supply opening for the fuel, which connects with annular fuel duct 16, serving for the distribution of fuel to all fuel pumps. 18 is a cover for closing the opening in the cover 17.

I claim as my invention:

1. In a two-cycle internal combusion engine, having a crank shaft, a casing having a crank case, cylinders radiating from said casing and a fuel pump for each cylinder radially arranged with respect to the crank shaft, and a common cam on said shaft for driving all of said pumps, an annular frame detachably fixed to said casing concentrically with the shaft and forming a part of the casing, for radially supporting said pumps, and a piston lifter for each pump also supported by said frame in cooperative relation to said cam, whereby the piston of each pump is operated by its appertaining lifter.

2. In a two-cycle internal combustion engine, having a crank shaft, a casing having a crank case, cylinders radiating from said case and a fuel pump for each cylinder radially arranged with respect to the crank shaft, and having a rotatable piston for varying the amount of fuel delivered, and a common cam on said shaft for driving all of said pumps, an annular frame detachably fixed to said casing concentrically with the shaft and forming a part of the casing, for radially supporting said pumps, and a piston lifter for each pump also supported by said frame in cooperative relation to said cam, whereby the piston of each pump is operated by its appertaining lifter, and a common adjustable control gear wheel mounted on, and concentrically with said annular frame and geared to the pistons of said pumps for rotatingly adjusting all of said pistons simultaneously.

3. In a two-cycle internal combustion engine, having a crank shaft, a casing having a crank case, cylinders radiating from said case and a fuel pump for each cylinder radially arranged with respect to the crank shaft, and having a rotatable piston for varying the amount of fuel delivered, and a common cam on said shaft for driving all of said pumps, an annular frame detachably fixed to said casing concentrically with the shaft and forming a part of the casing, for radially supporting said pumps, and a piston lifter for each pump also supported by said frame in cooperative relation to said cam, whereby the piston of each pump is operated by its appertaining lifter, and a common adjustable control gear wheel mounted on, and concentrically with said annular frame and geared to the pistons of said pumps for rotatingly adjusting all of said pistons simultaneously, the inner portion of said frame extending laterally beyond the frame face in the direction of the crank shaft and having a bearing in said extension for supporting the driving end of said shaft.

FRITZ GOSSLAU.