Dec. 3, 1929. J. MAHLER 1,737,602

FUEL PUMP

Filed April 1, 1925

Fig. 1.

A–B

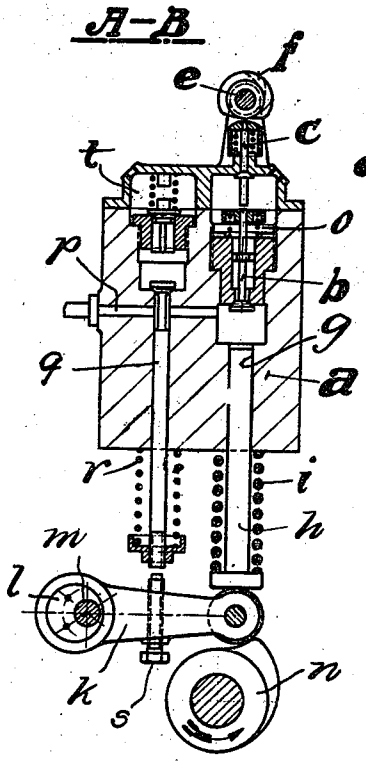
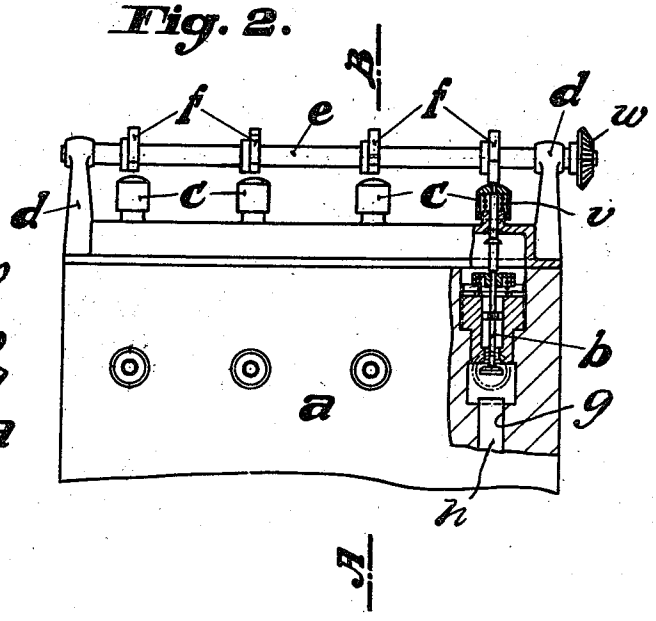


Fig. 2.



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Patented Dec. 3, 1929 1,737,602

UNITED STATES PATENT OFFICE

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FUEL PUMP

Application filed April 1, 1925, Serial No. 19,896, and in Germany May 9, 1924.

This invention relates to a novel fuel pump for combustion machines having several cylinders, especially for automobile purposes, and operating on the principle of injection of the fuel. In vehicle motors it frequently happens, for instance when travelling down hill, or in case of a small vehicle load, that temporarily not the full output but only a small part of the output of the machine is desired. Heretofore this had been done by properly reducing the degree of admission. From an economical point of view, however, this is not desirable, since a machine operating under a smaller load requires a relatively greater amount of fuel than a machine operating under full load.

This invention is designed to bring about an improvement of the economy of operation in such a case, by providing in addition to a certain range of output, which is controlled in the ordinary manner, further regulating means for entirely rendering inoperative several cylinders in case of small loads, while the remaining cylinders are retained in working condition under full load. For this purpose according to this invention there is provided a regulating device on the fuel pump, by means of which the suction valves or the overflow valves, or also special valves, which connect the pressure space of the fuel pump with the suction space, are opened in succession, thus rendering the corresponding cylinders of the machine inoperative. This regulating device may consist, for instance, of pushing rods which are operated in succession by cams or the like thus opening a part or all of these valves. By reason of this in every case only those cylinders of the combustion machine will be supplied with fuel, which are controlled by the valves of the fuel pump not under the action of the cams, while the remaining cylinders whose fuel pump valves are opened will be rendered inoperative.

In the accompanying drawing there is shown an example of carrying this invention into effect. In the drawing, Fig. 1 is a vertical section through the fuel pump according to line A—B of Fig. 2, and Fig. 2 shows the fuel pump in elevation with parts broken away to show in section through a suction valve which is in open condition.

As showing a preferred embodiment the invention is illustrated in the drawing as adapted for use with a four cylinder engine the cylinders and associated parts of which are not illustrated, since they are not needed for a clear understanding of the invention. The fuel pumping and associated control mechanism comprises a casing or block *a*, having a plurality of passages or fuel pump cylinders *g*, within which are reciprocably mounted the plungers or pistons *h*. Each of these pistons is surrounded by a spring *i* which tends to urge it downward on the suction stroke, into contact with a roller mounted in the end of the rocker arm *k*, which is pivotally mounted upon an eccentric *l*, carried by the shaft *m*. Cooperating with each of the rocker arms *k* is a cam *n*, which upon rotation, causes the rocker arm to swing to effect operation of the corresponding piston *h*. As each piston moves downwardly on the suction stroke under the action of the spring *i*, the corresponding suction valve *b* opens against the action of the spring *o*, permitting a charge of oil to flow into the cylinder *g*. On the upward stroke of the plunger *h*, under the action of the cam *n* this charge of fuel is forced outwardly through the passage *p* to the corresponding cylinder. Cooperating with each individual pump is a by-pass valve *q*, which is normally held against its seat by spring *r*, surrounding the lower end of the valve stem. Mounted within the rocker arm *k* is an adjustable abutment *s*, which during operation contacts with the lower end of the valve stem *q*, as the rocker arm is moved upwardly during the pressure stroke of the plunger *h*, to raise the by-pass valve from its seat allowing a portion of the oil being forced through the passage *p* to pass off through this valve and a suitable overflow passage *t*. The shaft *m* is suitably connected to the engine governor, or other mechanism, for varying the setting of the eccentric *l* to thus vary the time of opening of the by-pass valve, and so control the quantity of fuel fed to each cylinder by its respective fuel pump during the pressure stroke of that pump.

Extending downwardly through the top of the casing *a* is a plurality of push rods *c*, there being one rod for each suction valve *b*. Surrounding each push rod is a spring *v* which urges it away from its cooperating valve *b*. These push rods *c* are arranged in substantial alignment with the stems of the suction valves *b*, and are so arranged that when forced downwardly against the action of the springs *v*, they will contact with the stems of the suction valves *b* to force those suction valves from their seats. Mounted above the casing, in uprights *d*, is a rotatable cam shaft *e*, this cam shaft being arranged above the enlarged upper ends of the several push rods *c*. Carried upon the cam shaft *e* is a plurality of cams *f*, there being a cam arranged upon this cam shaft for cooperative relation with the enlarged end of each of the push rods *c*. These cams *f* are preferably mounted upon the cam shaft *e* in such respective angular relationship that upon rotation of the shaft they will come into contact in succession with the several rods *c* to press the latter downward, whereby the respective suction valves of the fuel pump will be opened and kept in open condition during further rotation of the shaft. And when any suction valve is thus held open, the fuel pump associated therewith is rendered inoperative with respect to the forcing of fuel to the cooperating cylinder. The cams are so arranged that by rotating the shaft *e* one or more cylinders of the engine may be rendered inoperative, depending on the desired work output of the engine, while those cylinders which are not so rendered inoperative will continue to operate, and will work under conditions of full load with an efficient consumption of fuel within the cylinders which thus remain working at full load. If desired, as for instance in case of no-load travel of the vehicle, the cam shaft may be turned so that all of the fuel pumps are rendered inoperative to thus cut out of operation all of the engine cylinders. Mounted upon one end of the cam shaft is a gear *w*, for driving connection with any suitable operating mechanism. Such mechanism may be operable from the driver's compartment of the automobile or other vehicle, so that control of the engine may be readily effected while the vehicle is in motion.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

I claim:

1. In a fuel pump of the character described, the combination of suction valves with an output regulating device for successively opening said valves to render one or more cylinders of the engine inoperative comprising pushing rods arranged above said valves and successively controlled by cams for opening said valves and retaining the same in open condition.

2. In a fuel pump, the combination of valves, with an output regulating device for successively opening said valves to render one or more cylinders of the engine inoperative comprising pushing rods arranged above said valves, said pushing rods being in operative connection with cams for opening said valves, and a shaft for said cams for rotating the latter.

3. In a fuel pump, the combination of valves with an output regulating device for successively opening said valves to render one or more cylinders of the engine inoperative comprising pushing rods arranged above said valves, and an adjusting rod having wedge-shaped cams for controlling said pushing rods.

4. In a multi-cylinder internal combustion engine of the character described, the combination of a fuel pumping mechanism having a pump for each cylinder, each of said pumps including a pump plunger, a suction valve for controlling connection between the pressure space and the suction space of each said pump, a relief valve associated with each pump for controlling the degree of admission of fuel to each respective cylinder, and a regulating device, comprising a push rod cooperating with the valve stem of each suction valve, a cam adapted to contact with each push rod, and a single cam shaft carrying the cams in such relation that as the shaft is moved the cams successively contact with their respective push rods to successively open the suction valves and to hold the same open, in order to cut off the supply of fuel to one or more of the cylinders to vary the output of the engine and keep the remaining cylinders operating under substantially full load conditions.

5. In a multi-cylinder internal combustion engine of the character described using fuel injection, the combination with fuel pumping means for supplying fuel to the respective cylinders, and regulating means for controlling the quantity of fuel admitted to the respective cylinders; of an additional controlling mechanism for cutting off the supply of fuel to one or more respective cylinders without affecting the operation of any remaining cylinders, comprising a single control member for the fuel supply to said respective cylinders, and means independent of engine conditions for actuating said single control member to cut off the supply of fuel to one or more or all of said cylinders.

In testimony whereof I have affixed my signature.

JOHANN MAHLER.