April 1, 1930. G. PIELSTICK 1,753,020

REVERSIBLE INTERNAL COMBUSTION ENGINE OF THE FUEL INJECTION TYPE

Filed Oct. 8, 1925 2 Sheets-Sheet 1

Fig. 1.

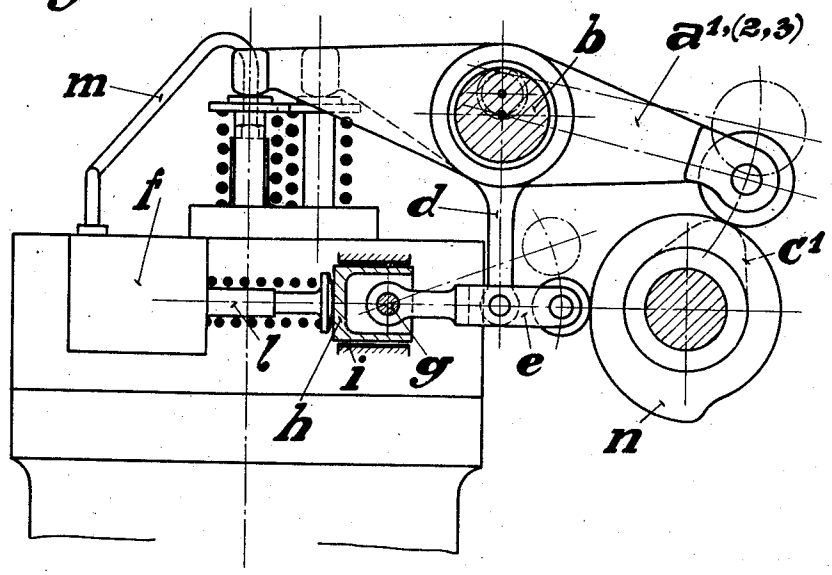
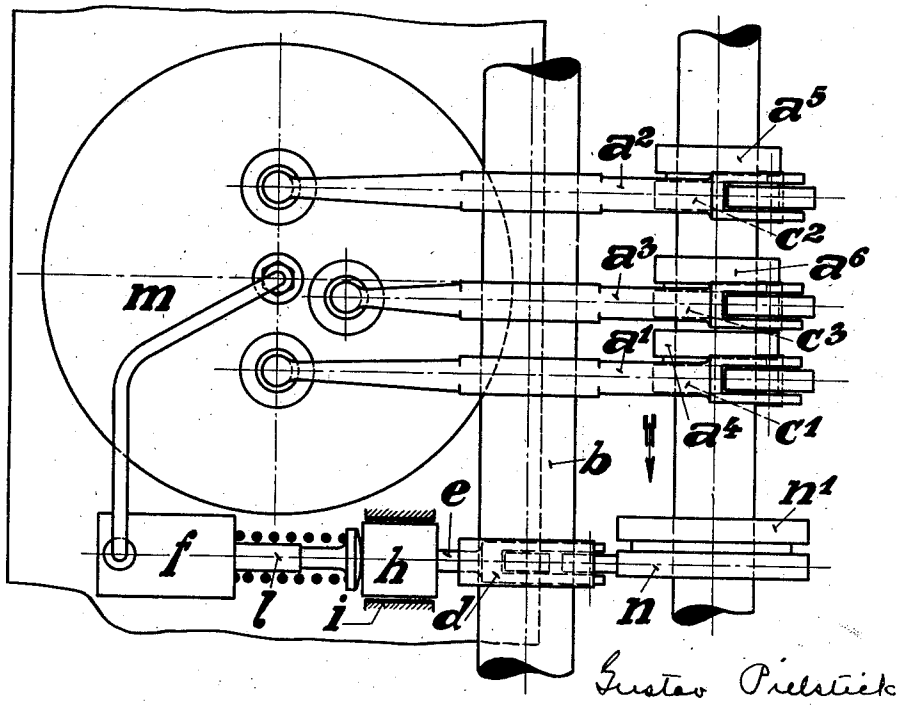


Fig. 2.



Gustav Pielstick

By Moeckel and Fehr

attorneys

April 1, 1930. G. PIELSTICK 1,753,020

REVERSIBLE INTERNAL COMBUSTION ENGINE OF THE FUEL INJECTION TYPE

Filed Oct. 8, 1925 2 Sheets-Sheet 2

Fig. 3.

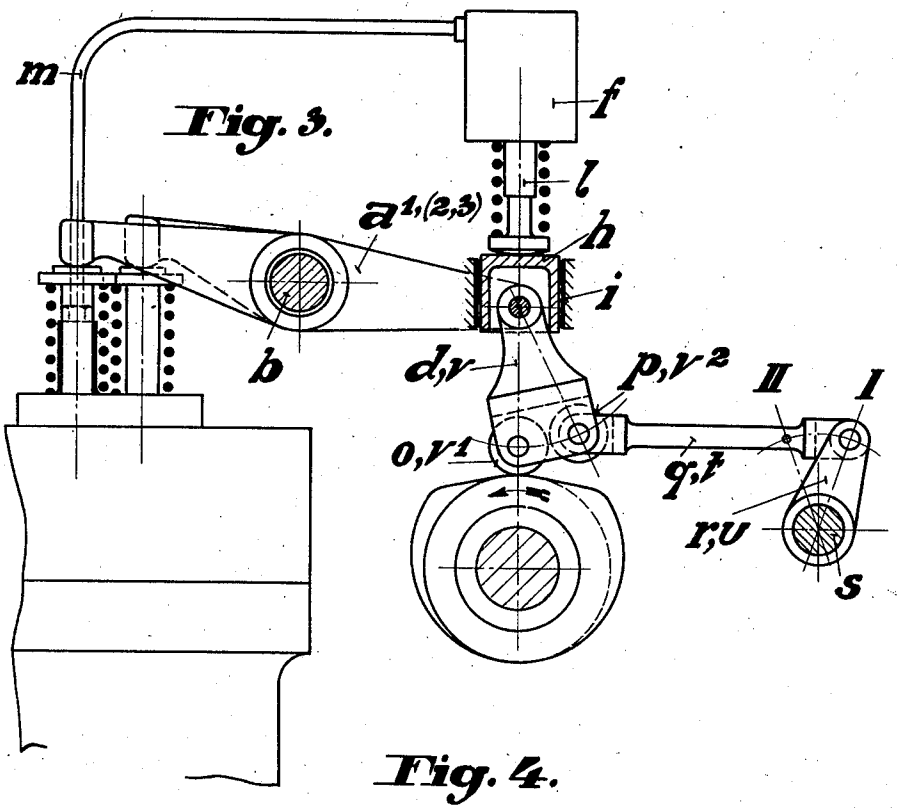
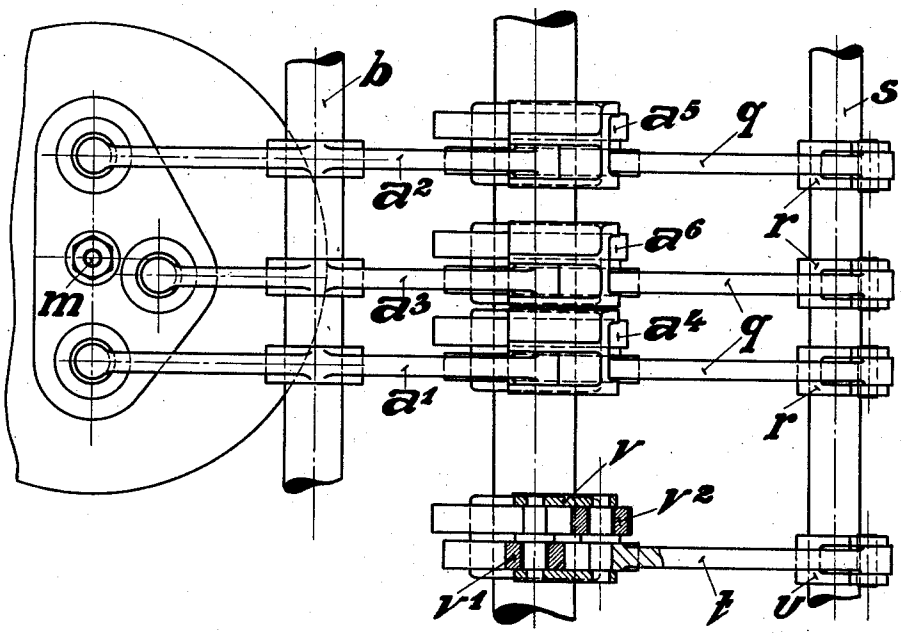


Fig. 4.



Gustav Pielstick
By
Marechal and Fehr
Attorneys.

Patented Apr. 1, 1930 1,753,020

UNITED STATES PATENT OFFICE

GUSTAV PIELSTICK, OF AUGSBURG, GERMANY, ASSIGNOR TO MASCHINENFABRIK AUGSBURG-NUERNBERG, AKTIENGESELLSCHAFT, OF AUGSBURG, GERMANY, A CORPORATION OF GERMANY

REVERSIBLE INTERNAL-COMBUSTION ENGINE OF THE FUEL-INJECTION TYPE

Application filed October 8, 1925, Serial No. 61,246, and in Germany October 20, 1924.

The invention refers to reversible internal combustion engines of the fuel injection type in which the fuel pump is driven by cams. In order that the engine may be reversed the valve levers and the fuel pump lever must, as is well known, be removed from their cams and brought into contact with the reversing cams. Hitherto this has required a separate operation for the valve levers and the fuel pump lever. In order, therefore, to reverse the engine two independent movements had to be executed, whereby reversal was rendered difficult and the design of the engine complicated. Moreover, the separate actuation of the valve levers and the fuel pump lever might easily lead to mistakes on the part of the operator.

The invention overcomes the above-mentioned defects by providing a control element common to the valve levers and the fuel pump drive so that they can be raised simultaneously from their actuating cams or brought into contact therewith as required. For this purpose, the valve levers and the fuel pump mechanism are connected in such a way with a shaft common to both that, by turning this shaft, they are simultaneously brought into or out of contact with their corresponding cams. This shaft may be the lever shaft or even a specially arranged shaft.

Two embodiments of the invention are shown diagrammatically in the accompanying drawing, in which Figures 1 and 2 show in side elevation and plan a form of the invention for an engine in which reversal is effected by the displacement of the cam shaft, whilst Figures 3 and 4 show a form of the invention for an engine in which reversal is effected by displacement of the rollers co-operating with the cams.

In Figures 1 and 2 a^1, a^2 and a^3, are the levers for the inlet, outlet, and starting valves of the engine. These levers are, in the usual way, mounted eccentrically on a lever shaft b the turning of which brings them into or out of contact with their cams—c^1, c^2 and c^3. An arm d is also mounted eccentrically on the lever shaft b close to the levers a^1, a^2 and a^3 and is connected to a rod e which serves to actuate the fuel pump. This rod e is connected at g by a pin-joint to a crosshead h, moving in a guide i, against which crosshead the pump plunger l is held by a spring. The rod e is actuated by a cam n. m is the fuel pipe leading from the fuel pump f directly to the injection nozzle so that the fuel pump governs the supply of fuel to the injection nozzle and the cylinder.

If the lever shaft b is turned the various levers a^1, a^2 and a^3, and the arm d are simultaneously displaced, so that the levers as well as the rod e of the fuel pump f are brought out of contact with their cams and the cam shaft can be moved in the usual way until the cams a^4, a^5 and a^6, and n^1, designed for the reverse running of the engine, reach their operating position. Thereafter the shaft b is turned back whereby the co-operation of the cams with the corresponding levers and the rod e is effected.

In Figures 3 and 4, the levers a^1, a^2 and a^3 for the inlet, outlet, and starting valves of the engine are arranged concentrically on the lever shaft b and have their free arms pivoted to roller carriers d which carry one behind the other (but displaced laterally according to the position of the cams a^4, a^5 and a^6) the cam rollers o, p for the forward and reverse running of the engine. The roller carriers d are connected by rods q and arms r to the control shaft s. Similarly the drive of the fuel pumps f is controlled from the control shaft s. The crosshead h against which the pump plunger l is held by a spring as in Figures 1 and 2, is pivoted to a roller carrier v, corresponding to the carrier d, with rollers v^1 and v^2 for the forward and reverse running of the engine, which roller carrier v is connected by a connecting rod t and an arm u to the control shaft s. If the engine is to be altered from "forward" to "reverse," the control shaft s is turned from the position I to the position II, whereby the cam rollers o, and v^1 are brought out of contact and correspondingly the cam rollers p and v^2 are brought into contact with their appropriate cams. Bringing the control shaft back from the position II to the position I will alter the engine to its former direction of running.

In the first form of the invention (Figures

1 and 2) the lever shaft *b* and in the second form of execution (Figures 3 and 4) the control shaft *s*, constitute the common element the turning of which brings the valve levers on the one hand and the rod for actuating the fuel pump on the other hand simultaneously into or out of contact with their cams.

What is claimed is:

1. In an internal combustion engine of the character described, a cylinder, valve mechanism including inlet and exhaust valves therefor, means for operating said valve mechanism, pumping means having a pump plunger for supplying fuel to the said cylinder and controlling the time of fuel injection, operating means for said fuel-pumping means including forward and reverse cams for driving said pump plunger, and means for simultaneously varying the operative functioning of the valve mechanism and the fuel-pumping means to effect forward or reverse operation of the said engine.

2. A reversible internal combustion engine of the character described comprising, in combination, a cylinder, a pump having a pump plunger controlling the supply of fuel to said cylinder, cam means having forward and reverse cams for actuating said pump plunger, inlet and exhaust valve mechanism associated with said cylinder, operating levers therefor, cam means having forward and reverse cams for actuating said operating levers, and means for simultaneously varying the relative positioning of the fuel pump and the valve operating levers with respect to their respective actuating cam means to effect simultaneous operative engagement or disengagement thereof.

3. A reversible internal combustion engine of the character described comprising, in combination, a cylinder, a pump having a pump plunger controlling the supply of fuel to said cylinder, an operating connection for said pump plunger, valve mechanism for said cylinder, a shaft constructed for variable operative positioning, control mechanism for said pump carried by said shaft, operating means for said valve mechanism carried by said shaft, actuating cams associated respectively with said pump plunger operating connection and said valve operating means, and means for rotatably varying the positioning of said shaft to simultaneously engage or disengage the said pump plunger operating connection and the valve operating means with the respective actuating cams.

4. An internal combustion engine of the character described comprising, in combination, a cylinder, a fuel pump having a pump plunger controlling the supply of fuel to said cylinder, an operating arm connected with said pump plunger, a cam drive normally in engagement with said operating arm for driving said pump, valves associated with said cylinder, operating levers operatively connected with said valves, a cam drive normally in engagement with said operating levers, a control shaft, and connections between said pump plunger arm and said valve levers and the control shaft, whereby movement of the control shaft is adapted to simultaneously move the pump plunger arm and the valve levers into or out of operative engagement with their respective cam drives to permit reversal of the engine.

5. A reversible internal combustion engine of the character described comprising, in combination, a cylinder, a pump having a pump plunger for feeding fuel to said cylinder and controlling the time of fuel injection, inlet and exhaust valve mechanism for the cylinder, operating means for the pump plunger and valve mechanism, a cam-shaft for actuating said operating means, said cam-shaft having two sets of cams thereon, one set being adapted for forward running and the other set for reverse running, and a single means for moving the operating means for the pump plunger and valve mechanism out of operative engagement with one set of cams and into operative engagement with the other set of cams in order to reverse the engine.

6. A reversible internal combustion engine of the character described comprising, in combination, a cylinder, a pump having a pump plunger controlling the supply of fuel to said cylinder, valve mechanism for the cylinder, an operating connection for the pump plunger including a roller carrier, an operating connection for the valve mechanism including a lever and roller carrier, a cam-shaft adapted to drive the operating connections of the pump plunger and the valve mechanism, said cam-shaft having two sets of cams thereon, one set being adapted for forward running and the other set being adapted for reverse running, a common member, and operative connections between the roller carriers of the pump plunger and the valve mechanism and said common member, the construction being such that movement of said common member simultaneously moves the roller carriers of the pump plunger and the valve mechanism out of operative engagement with one set of cams and into operative engagement with the other set of cams to reverse the engine.

7. A reversible internal combustion engine of the character described comprising, in combination, a cylinder, inlet and exhaust valve mechanism for said cylinder, a fuel pump having a pump plunger for feeding fuel to said cylinder, a cam-shaft having cam mechanism thereon for forward and reverse running of the engine, operative connections between said cylinder valve mechanism and said cam mechanism for controlling the time of opening and closing of the valve, an oper-

ative connection between said pump plunger and said cam mechanism for controlling the time of fuel injection, and a single control means for simultaneously varying the relative positioning of the operative connections of said cylinder valve mechanism and said pump plunger with respect to the cam mechanism for reversal of said engine.

In testimony whereof I have affixed my signature.

GUSTAV PIELSTICK.