Sept. 20, 1932. C. BROWN ET AL 1,877,803

FUEL INJECTION PUMP FOR INTERNAL COMBUSTION ENGINES

Filed Jan. 23, 1932 2 Sheets-Sheet 1

Fig. 1.

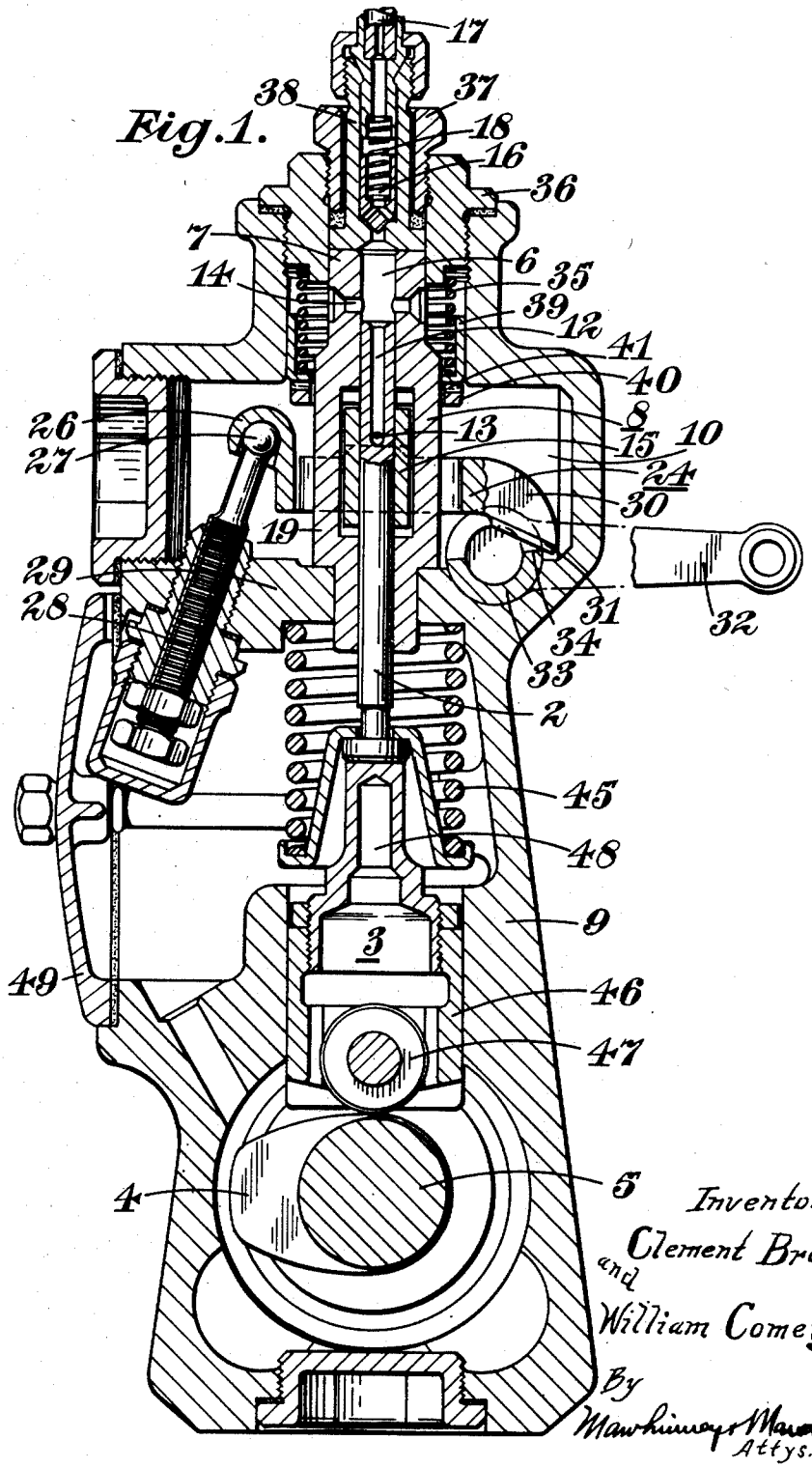

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Fig. 2.

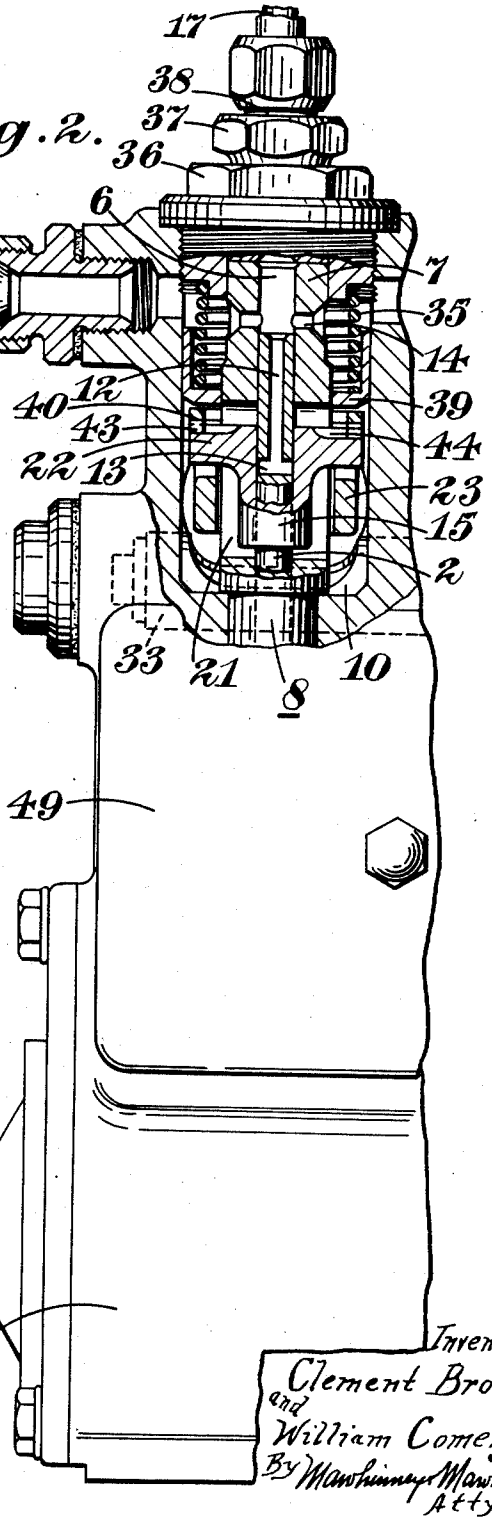
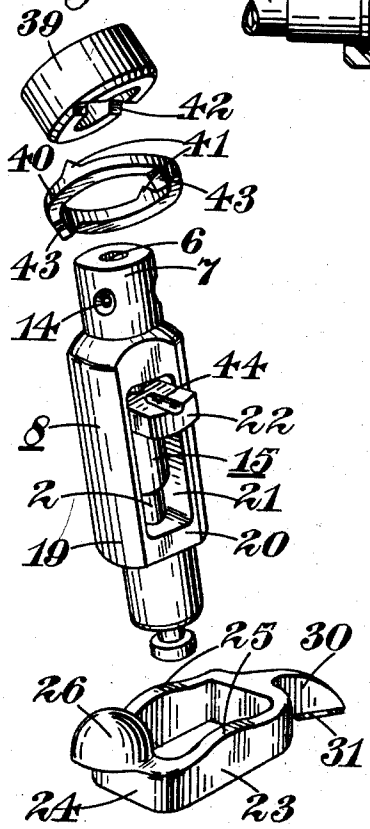


Fig. 3.



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UNITED STATES PATENT OFFICE

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FUEL INJECTION PUMP FOR INTERNAL COMBUSTION ENGINES

Application filed January 23, 1932, Serial No. 588,422, and in Great Britain February 26, 1931.

This invention relates to fuel-injection plunger pumps for internal-combustion engines, of the kind having a sleeve which co-operates with the plunger and is axially adjustable to control the functioning of the pump. It relates particularly to pumps of the kind having a hollow plunger the end of which controls an inlet port whilst an axially-adjustable sleeve around the plunger co-operates with a spill port in the plunger wall so that the duration of delivery can be varied.

Its chief objects are to provide a simple means of control for the sleeve which will not impart side thrust to it nor cause it to tilt and which will ensure a high degree of accuracy in operation, and an improved means of adjustment.

According to this invention, the sleeve is adjustable by means of an actuating rocker which makes line or point contact with diametrically-opposite parts thereof. For example, the sleeve may have diametrically-opposite lugs each of which has a radial-line rolling engagement with one side of the rocker which is bifurcated, and the latter may have a ball-and-socket (or equivalent) pivot at one end and a line or point contact with the actuating means at the other end.

By a further feature of the invention, the sleeve is spring-pressed axially against the rocker through the medium of an intermediate member having a gimbal engagement with the spring and sleeve.

In the accompanying drawings,

Figure 1 is a transverse section through a multi-cylinder fuel pump embodying the invention,

Figure 2 is a fragmentary part-sectional side elevation of the pump, and

Figure 3 is a perspective view showing the pump body and the disassembled parts of the sleeve adjusting mechanism.

Like numerals indicate like parts throughout the drawings.

In the construction of pump illustrated, there is a plurality of vertical plungers 2 each actuated through a tappet 3 from a cam 4 on a shaft 5 driven by the engine. The upper part of each plunger 2 reciprocates in an axial bore 6 of a cylindrical end portion 7 of the pump body 8, which is detachably mounted in the pump casing 9 and projects downwardly into a chamber 10 formed therein. Fuel is supplied to this chamber through the pipe 11. The upper end of the plunger is axially bored at 12. "Spill" ports 13 formed in its walls connect its interior, and thus the cylinder bore 6, with the surrounding chamber 10 in certain conditions.

During the suction stroke of the plunger, fuel enters the cylinder bore 6 through inlet ports 14 in the cylinder walls which are uncovered by the end of the plunger as it approaches the bottom of its stroke. Just below the base of the cylinder 7, the plunger 2 is surrounded by a close-fitting sleeve 15, and at the bottom of the stroke the "spill" ports 13 are closed by this sleeve. On the delivery stroke, fuel is at first forced back into the chamber 10 through the inlet ports 14 until these are closed by the end of the rising plunger, the "spill" ports 13 being assumed to be covered by the sleeve 15 during this period. The fuel is then delivered past a spring-loaded delivery valve 16 at the upper end of the pump cylinder 7, and thence by way of the pipe 17 to the injection valve (not shown).

Delivery of fuel continues until the "spill" ports 13 in the plunger rise above the edge of the control sleeve 15, after which the fuel in the cylinder bore 6 is "spilled" and escapes back to the chamber 10, the delivery valve 16 closing under the action of its spring 18. The point in the delivery stroke at which "spilling" takes place, and hence the duration of injection, depends on the height of the sleeve 15, and it will be seen that the higher the sleeve the longer the period of delivery.

The lower part 19 of the pump body 8 is also cylindrical, but of greater diameter than the upper part 7. It is formed with flat sides 20, and has a longitudinal slot 21 within which the sleeve 15 is movable with clearance. Diametrically-opposed lugs 22 on the sides of the sleeve project from the slot 21, the undersides of these lugs being engaged by the mid part 23 of a slotted rocker 24 which loosely embraces the pump body 8. The upper edges of the rocker are curved at 25 so as

approximately to make a radial-line contact with the lugs 22.

One end of the rocker is cupped at 26 and engages a ball end 27 formed on an adjusting screw 28 which projects through the lower wall 29 of the chamber 10, whilst the other end 30 is knife-edged on its lower surface 31 in a line radial to the pump body and bears upon an operating cam (or the equivalent) connected to an external control lever 32.

In a convenient arrangement, as illustrated, a tubular shaft 33, actuated by the lever 32, is mounted in the pump casing transversely of the rocker 24, the walls of the tube being cut away adjacent the end 30 of the latter to form a substantially radial surface 34 one edge of which is engaged by the rocker. Thus the engagement between the end 30 of the rocker and the cam surface 34 is such that the latter cannot cause tilting of the rocker so as to apply unequal pressure to the lugs 22 and thereby cause the sleeve 15 to bind on the plunger.

Alternatively, a normal form of cam may be used, its contour being preferably designed to give a uniform lifting effect on the sleeve 15 throughout the whole movement of the control lever 32.

The sleeve 15 is pressed down on the rocker by a helical spring 35 retained by a screwed collar 36 in the top of the pump casing, this collar itself carrying a gland nut 37 which holds the pump body 8 and delivery valve body 38 in place. Preferably the lower end of the spring 35 fits into a cup 39 guided in the casing 9 and between the cup and the sleeve 15 is interposed an intermediate member comprising a washer 40 which is formed on each surface with two diametrically-opposite ridges or projections. These ridges are preferably knife-edged, the upper pair 41, 41 engaging V-grooves 42, 42 in the cup 39, whilst the lower pair 43, 43 engages grooves 44, 44 in the lugs 22 (see Figure 3). The two pairs of ridges are arranged on diameters which are at right-angles, so that the washer 40 has a gimbal mounting.

It will be clear that there is no possibility of any side-thrust on the sleeve 15 and pump plunger 2, and thus leakage from the cylinder 7 due to wear is obviated, as also is sticking of the sleeve. Furthermore, as the rocker 24 is enclosed in the suction chamber, its bearings are always efficiently lubricated.

The plunger is loaded by a spring 45 in the usual manner and the tappet which reciprocates it takes the form of a large-diameter piston 46 with a roller 47 and screwed stem 48 which provides a coarse adjustment for setting the plunger initially in relation to the cylinder 7. By this means a slight manufacturing error in the main cam 4, length of plunger 2 or cylinder 7, etc., (which would otherwise affect the timing of injection) may be compensated for, the actual running control of injection advance being effected through a helical-splined coupling of known type, or its equivalent, in the pump drive.

The adjusting screw 28 for the rocker pivot has a very fine thread and provides an individual adjustment whereby any slight inaccuracy in the disposition of the various cam surfaces 34 on the control shaft 33 of a multi-cylinder pump can be compensated for and the duration of injection equalized for all the engine cylinders. When the above adjustment has once been made, the duration of injection, and hence the quantity of fuel pumped, is controlled for the pump as a whole by means of the single lever 32.

In the construction of pump above described, all parts, in the manufacture of which great accuracy is essential, are of circular section. The tappet and rocker pivot adjustment are easily accessible on removal of a large cover-plate 49 at one side of the casing.

The invention thus provides a construction which is simple to manufacture and in which the accuracy of metering and control of the fuel delivered is maintainable over very long periods.

What we claim as our invention and desire to secure by Letters Patent of the United States is:—

1. A fuel-injection plunger pump having a sleeve which co-operates with the plunger and is axially adjustable to control the functioning of the pump, said sleeve having diametrically-opposite lugs which make line contact on one face with an actuating bifurcated rocker and on the other side with a washer, said washer making line contact on its other face with spring-pressed means.

2. A fuel-injection plunger pump having a sleeve which co-operates with the plunger and is axially adjustable to control the functioning of the pump, said sleeve having diametrically-opposite lugs which make line contact on one face with an actuating bifurcated rocker and on the other side with a washer, said washer making line contact on its other face with spring-pressed means, said washer having ridges formed on its opposite faces arranged on mutually-perpendicular diameters, the ridges engaging grooves in the coacting parts.

3. In a fuel-injection plunger pump having an axially-movable sleeve co-operating with the plunger for regulating the pump operation, spring means biasing said sleeve in one direction, and a bifurcated rocker for actuating said sleeve in the other direction, said rocker being universally pivoted at one end and having a knife edge at its other end which is substantially colinear with said universal pivot, said knife edge being engaged by a transverse edge on an actuating member.

4. In a fuel-injection plunger pump, the combination with an axially-movable sleeve

co-operating with the plunger to regulate the operation of the pump, of an actuating lever engaging the sleeve for moving it in one direction, and a spring-pressed washer engaging the sleeve for moving it in the other direction, said washer having ridges formed on its opposite faces arranged on mutually-perpendicular diameters, the ridges on one face engaging diametrically-opposite parts of said sleeve and the other ridges being acted upon by said spring.

5. In a fuel-injection plunger pump having an axially-movable sleeve co-operating with the plunger to control the pump operation, the combination with diametrically-opposite lugs on said sleeve, of spring means engaging the faces of one side of said lugs and actuating means engaging the opposite faces, the faces on both sides of said lugs making radial-line contacts with the adjacent members.

In testimony whereof we have signed our names to this specification.

CLEMENT BROWN.
WILLIAM COMERY.