

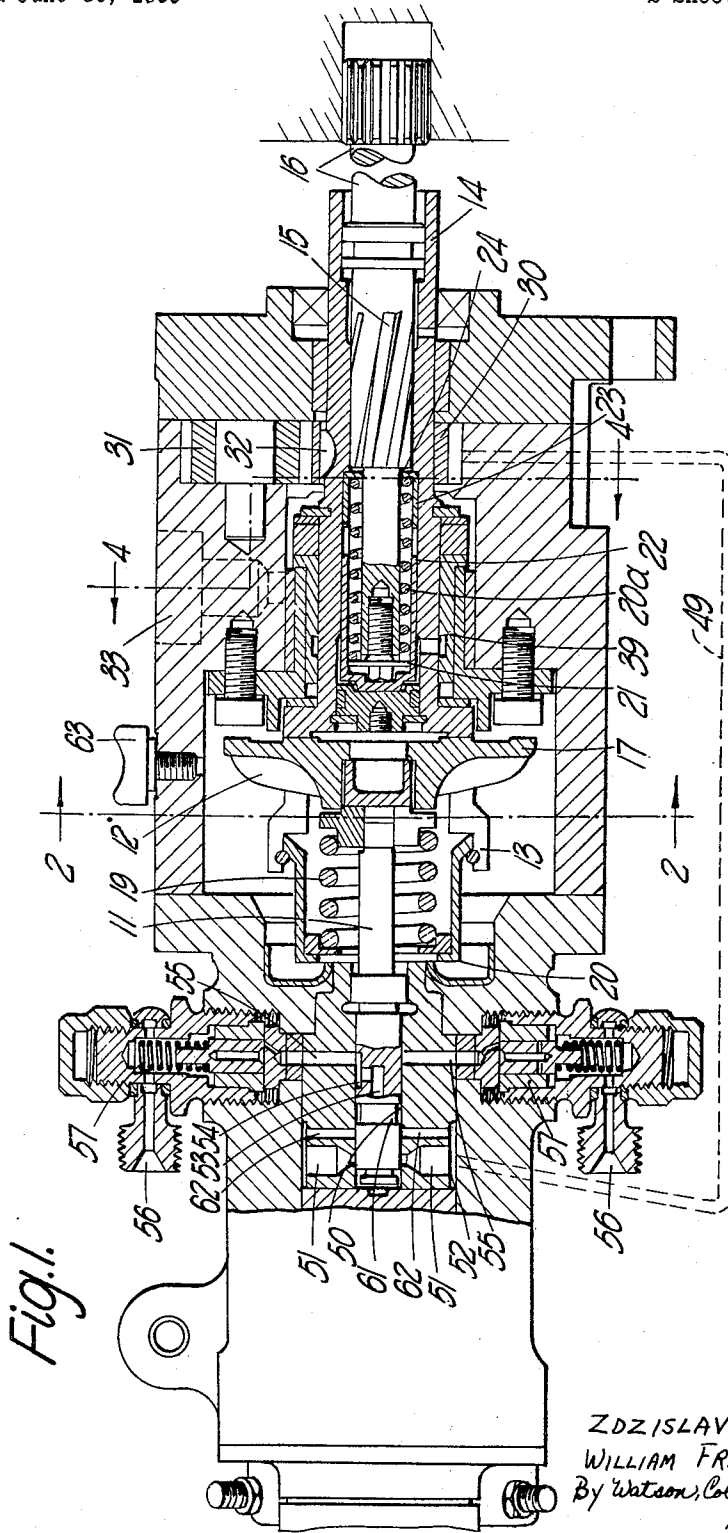
Dec. 19, 1961

Z. S. MIRACKI ET AL
FUEL INJECTION PUMPS

3,013,547

Filed June 30, 1959

2 Sheets-Sheet 1



INVENTORS
ZDZISLAV S. MIRACKI
WILLIAM FRIEDLANDER
By Watson, Cole, Grindler & Watson
ATTORNEYS

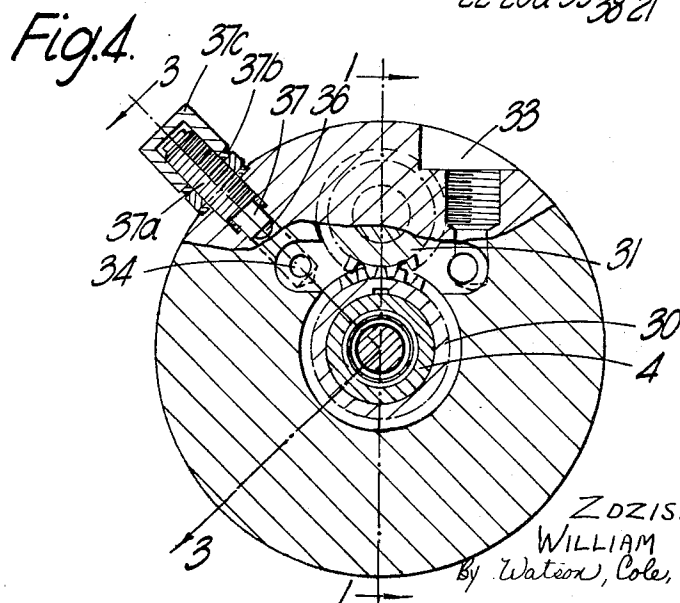
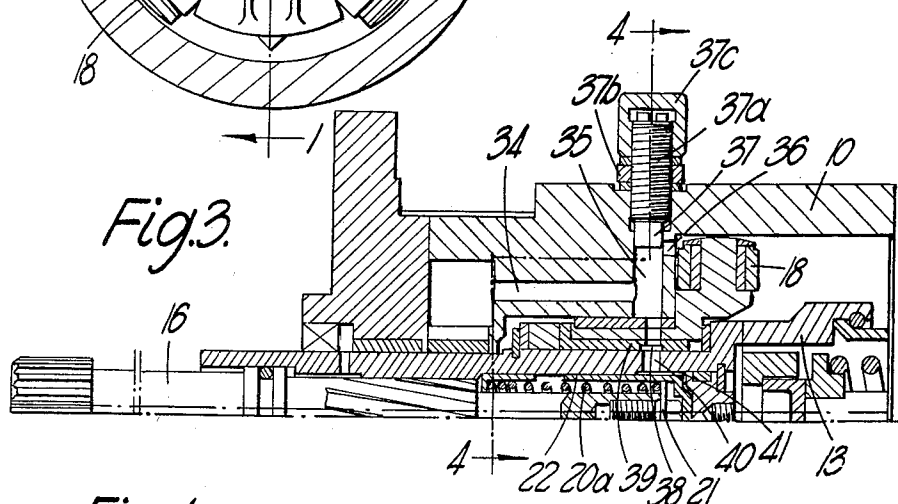
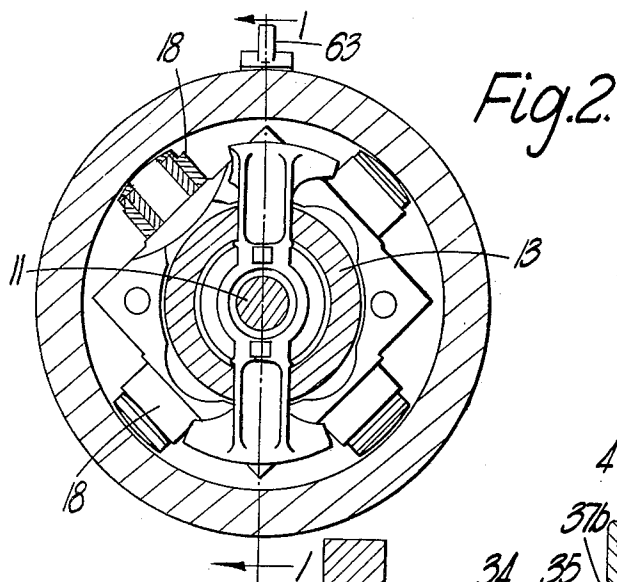
Dec. 19, 1961

Z. S. MIRACKI ET AL
FUEL INJECTION PUMPS

3,013,547

Filed June 30, 1959

2 Sheets-Sheet 2



INVENTORS
ZDZISLAV S. MIRACKI
WILLIAM FRIEDLANDER
By Watson, Cole, Grindler & Watson
ATTORNEYS

1

2

3,013,547

FUEL INJECTION PUMPS

Zdzislaw Stanislaw Miracki and William Friedlander, London, England, assignors to Mono-Cam Limited, London, England, a British company

Filed June 30, 1959, Ser. No. 823,924

Claims priority, application Great Britain July 3, 1958
3 Claims. (Cl. 123—139)

The invention relates to fuel injection pumps for internal combustion engines and more particularly, but not exclusively, to compression-ignition engines.

The invention is an improvement in or modification of the invention described in our specification Serial No. 670,105, now Patent No. 2,919,687 issued January 5, 1960, which claims a fuel injection pump for an internal combustion engine which pump comprises one or more pumping elements, means adapted to be driven by the engine for operating the pumping element (or each pumping element in turn) to supply fuel to an outlet for each injection period, means for causing the pumping element to supply fuel to a spill chamber at the end of each injection period so as to provide in the spill chamber a pressure which increases with increase in the engine speed, and means actuated or controlled by that pressure to advance the timing of the beginning and the end of each injection period in relation to the operation of the engine as the said pressure increases.

The invention provides a fuel injection pump for an internal combustion engine, which pump comprises a pumping and distributing element, means adapted to be driven by the engine for operating the pumping and distributing element whereby the said element pumps fuel and distributes it to a number of outlets in turn, fuel being supplied to an outlet for each injection period, and means actuated or controlled by fuel pressure for advancing the timing of the beginning and the end of each injection period (in relation to the operation of the engine) as engine speed increases.

Preferably the means for operating the pumping and distributing element include a rotatable drive having two parts and the said means for advancing the timing comprise a helical connection between the said two parts, means biasing the two parts axially and means for applying the said fuel pressure in opposition to the biasing means so that the relative angular relationship between the said two parts varies with the said fuel pressure.

Preferably the said fuel pressure is developed by a gear pump adapted to be driven by the engine.

Preferably the pumping and distributing element comprises a plunger which reciprocates to pump the fuel and has a distributing port which communicates in turn with the outlets.

A specific construction of a fuel injection pump embodying the invention will now be described by way of example and with reference to the accompanying drawings in which:

FIGURE 1 shows a cross-section of the pump taken on the line 1—1 of FIGS. 2 and 4,

FIGURE 2 shows a sectional view of the pump on the line 2—2 of FIGURE 1,

FIGURE 3 shows another sectional view of part of the pump, taken on the line 3—3 of FIGURE 4, and FIGURE 4 is another sectional view, taken on the lines 4—4 of FIGURES 1 and 3.

In this example, the fuel injection pump comprises a pumping and distributing element 11 connected to a cam 12. The cam 12 is free to move axially (with the element 11) in a yoke 13 which is integral with a sleeve 14. The sleeve 14 is provided with internal helical threads which engage external helical threads 15 on a splined shaft 16 adapted to be driven by the engine and movable axially relatively thereto.

The face 17 of the cam 12 abuts rollers 18 (see FIGURE 2), each free to rotate about a fixed axis and the face 17 is shaped so that as it rotates the cam 12 and element 11 are pushed axially to the left in FIGURE 1 each time a certain part of the cam face 17 passes over a roller 18. The cam face 17 is maintained always in contact with the rollers 18 by a helical compression spring 19 which surrounds the element 11 and is located in a cup 20 supported by the yoke 13.

The shaft 16 and the sleeve 14 are relatively biased axially by a helical compression spring 20a, one end of which abuts a washer 21 attached to one end of the shaft 16 and located, with part of the length of the spring 20a, in a cup 22. The other end of the spring 20a is located in a cup 23 which is supported by a shoulder 24 in the wall of the sleeve 14 so that the shaft 16 tends to move under the action of the spring 20a, into the sleeve 14.

A gear pump comprising two gears 30, 31 supplies fuel to the injection pump. One gear 30 is keyed by a key 32 to the sleeve 14. The gears 30, 31 pump fuel from an inlet 33 along a channel 34, to a small chamber 35. The chamber 35 has a small throttle hole 36 in its wall, which throttle hole may be partly or wholly closed by an adjustable plug 37, which is adjustable axially in the chamber 35. The plug 37 is in screw threaded engagement at 37a with the body 10 of the pump and is provided with a lock-nut 37b and cover 37c. The end of the chamber 35 remote from the plug 37 communicates with an annular groove 38 formed in the inner surface of a bush 39 surrounding the sleeve 14. The annular groove 38 registers with an opening 40 through the sleeve 14 and the opening 40 opens into the inside of the sleeve 14 at a part 41 thereof, the internal diameter of which part 41 is slightly greater than that of the remainder of the sleeve 14.

The pumping and distributing element 11 comprises a plunger which reciprocates and rotates in a barrel 50 having inlet ports 51 fed from a low pressure gallery 52 supplied by the gear pump through a passage 49. The element 11 has an axial passage 53 which extends through it from its end face to a port 54. The port 54 communicates in turn with outlet ports 55 as the element 11 rotates. The outlet ports 55 communicate respectively with outlets 56 controlled by delivery valves 57. The reciprocation of the element 11 causes fuel to be pumped from the inlet ports 51 through the passage 53 and the port 54 to supply fuel to each of the outlets 56 in turn for injection periods. Each injection period is ended by an annular spill port 61 on the element 11 communicating with spill ports 62. The annular port 61 communicates with the axial passage 53. The spill ports 62 communicate with the low pressure gallery 52. A removable air-bleed plug 63 is provided.

The operation of the fuel injection pump is as follows. The shaft 16 is driven by the engine and causes the yoke 13, cam 12 and pumping and distributing element 11 to rotate.

The cam face 17 causes the cam and element to move axially as already explained to pump and distribute fuel. If the engine speed increases the gears 30, 31 deliver fuel at a greater rate to the chamber 35. Fuel pressure increases in the chamber 35, due to the throttling action of the hole 36, and this pressure acts upon the outer face of the closed end of the cup 22 causing it and the shaft 16 to move axially within the sleeve 14 against the action of the helical compression spring 20a. This axial movement of the shaft 16 causes the sleeve 14 to rotate relatively to the shaft 16 to advance the timing of the beginning and the end of each injection period in relation to the operation of the engine. The degree of relative movement between the shaft 16 and the sleeve 14 for a given increase in engine speed can be adjusted by vary-

3

ing the position of the plug 37 in the chamber 35 to vary the cross-section of the throttle opening 36.

The structure at the left hand end of FIGURE 1 houses an optional governor mechanism which is not relevant to the present invention.

The invention is not limited to the details of the specific embodiment described by way of example.

We claim:

1. A fuel injection pump for an internal combustion engine, which pump comprises a shaft, means for drivingly connecting the said shaft to the engine while permitting axial movement of the shaft relative thereto, resiliently yieldable means urging said shaft in one axial direction, a sleeve surrounding the said shaft coaxially and having helical engagement therewith, and constrained against axial movement, whereby axial movement of the shaft causes relative angular movement between the sleeve and the shaft about their axis, a pumping and distributing plunger element coaxial with the shaft and sleeve, coupling means operative between the sleeve and the plunger element to drive the said element from the sleeve so that the said element rotates about the said axis, cam means drivingly connected to the sleeve and operative to cause axial reciprocation of the said element to pump fuel, a plurality of fuel outlets, a distributing port carried by the said element and communicating in turn with the outlets as the element rotates, whereby the said element distributes fuel to the outlets in turn, a rotary positive-displacement auxiliary pump

4

including a rotary pumping member coaxial with, and drivingly connected to the sleeve, a fuel inlet to the said auxiliary pump, a chamber fed from the outlet of the auxiliary pump, a restricted outlet from the said chamber, whereby the fuel pressure in the chamber is dependent upon the engine speed, means for applying the said fuel pressure to the said shaft in the other axial direction, whereby the axial position of the shaft and consequently the relative angular relationship of the sleeve and the shaft and consequently the timing of the beginning and the end of each injection period in relation to the operation of the engine, are dependent upon the engine speed.

2. A fuel injection pump as claimed in claim 1, in which the said rotary positive-displacement auxiliary pump is a gear pump including rotary intermeshing gears and the said rotary pumping member is one of the gears thereof.

3. A fuel injection pump as claimed in claim 1, in which the said shaft has a projecting end formed with external splines extending parallel to the said axis and constituting the said means for drivingly connecting the shaft to the engine.

References Cited in the file of this patent

UNITED STATES PATENTS

2,372,180	Edwards	Mar. 27, 1945
2,660,992	Roosa	Dec. 1, 1953