This invention relates to liquid fuel pumps for internal combustion engines, of the kind comprising a feed pump, an injection pump, the latter being provided with a plunger or plungers contained in a transverse bore in a rotary member and operable by an annular cam, which is adjustable to vary with speed the instant at which injection commences, and an adjustable throttle for controlling the rate of supply of fuel from the feed pump to the injection pump. An example of this kind of pump is disclosed by Patent No. 2,660,992 (V. D. Roosa).

The character of such a pump that the instant at which injection commences becomes progressively later with reduction of the quantity of fuel supplied by the injection pump and when the engine is running at idling speeds this becomes particularly objectionable.

The object of the invention is to provide in a convenient form a means for automatically advancing the instant of initiation of the discharge of the injection pump in each cycle of action at idling speeds.

A device in accordance with the invention comprises the combination of a cylinder associated with the part containing the cam, a plunger slideable in the cylinder and connected to the cam, an abutment piece of larger diameter than the plunger contained in an enlarged part at one end of the cylinder, and a spring located between the plunger and abutment piece, the cylinder being provided with passages for conveying fuel from the feed pump to each end of the cylinder, one of the passages containing a non-return valve, and the passage leading to the end of the cylinder containing the abutment being controlled by a normally closed and spring loaded control valve.

In the example illustrated by the accompanying drawing, the angularly adjustable annular cam a of the injection pump (which latter comprises a pair of plungers b contained in a rotary cylinder c) is contained in a housing d on which is formed or secured a cylinder e which contains a slideable plunger f. In the latter is formed a lateral gap g which is occupied by one end of a short radial arm h, extending from the cam.

At one end the bore of the cylinder e is made of larger diameter than the part containing the plunger f, and in the said end is contained a slideable abutment i of piston-like form, the movement of which in one direction is restricted by a stop formed by an annular shoulder k at the junction of the parts of the cylinder of different diameter. Between the abutment and the adjacent end of the plunger is contained a spring m.

Formed on the cylinder wall is a longitudinal passage n having between its ends an entrance o for fuel supplied by the feed pump (not shown). At one end this passage leads through a non-return valve p to the end of the cylinder remote from the abutment i, this end of the cylinder being in communication with the housing d by way of a restricted passage which may be formed by a groove f in the plunger f or by a peripheral clearance between this plunger and the adjacent part of the cylinder. At its other end it leads to the larger end of the cylinder through a control valve q which is loaded by a spring r.

Also this end of the cylinder is in communication with the housing d by way of a restricted passage which may be formed by a peripheral clearance between the abutment i and the adjacent part of the cylinder, or by a restricted aperture s in the abutment.

The arrangement is such that while the engine is idling and the feed pump is supplying fuel at a low pressure the plunger f is moved by pressure of the fuel on the end of the plunger remote from the spring m, so causing the cam to be moved in the direction for advancing the instant of discharge of the injection pump. When the engine speed is increased and the delivery pressure of the feed pump attains a given value, the increased pressure exerted by the fuel opens the control valve q and so causes fuel to enter also the adjacent end of the cylinder. The preponderating fuel pressure then acting on the abutment moves the latter and, through the spring m, causes the plunger to move in the direction for retarding the instant of discharge of the injection pump. When the abutment is arrested by the shoulder in the cylinder as shown in the drawing, continued increase of pressure of the fuel from the feed pump on the end of the plunger remote from the abutment, reverses the direction of movement of the plunger and causes the instant of discharge of the injection pump to be advanced with increase of speed of the engine.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In liquid fuel pump structure comprising an injection pump provided with a rotary member and at least one plunger slideable in a transverse bore in the rotary member for supplying liquid fuel to an internal combustion engine, a feed pump, an adjustable throttle for controlling the rate of supply of liquid fuel from the feed pump to the injection pump, and an adjustable stop for effecting discharge of the injection pump, means for automatically varying the instant of discharge of the injection pump, which means comprise in combination a cam-adjusting plunger having an operative connection with the cam, a cylinder having a bore in which the plunger is slideable to effect adjustment of the cam, and a passage for receiving liquid fuel from the feed pump, an abutment piece of larger diameter than the plunger slideable in an enlarged extension of one end of the cylinder bore, a spring located between the plunger and abutment piece, a spring-loaded control valve which is situated between the cylinder passage and the outer end of the cylinder bore extension, and past which liquid fuel can flow from the passage to the said extension when the fuel pressure in the passage attains a predetermined value, and an unloaded non-return valve which is situated between the cylinder passage and the end of the cylinder bore remote from the said extension, and past which liquid fuel from the cylinder passage can flow to the cylinder bore.

2. A liquid fuel pump structure according to claim 1, and having between the cylinder bore and the enlarged extension thereof, a shoulder which serves by contact with the abutment piece to determine the extent of movement of the latter under the pressure of liquid fuel admitted to the outer end of the said extension.

References Cited in the file of this patent

UNITED STATES PATENTS
2,660,992 Roosa ------------------ Dec. 1, 1953