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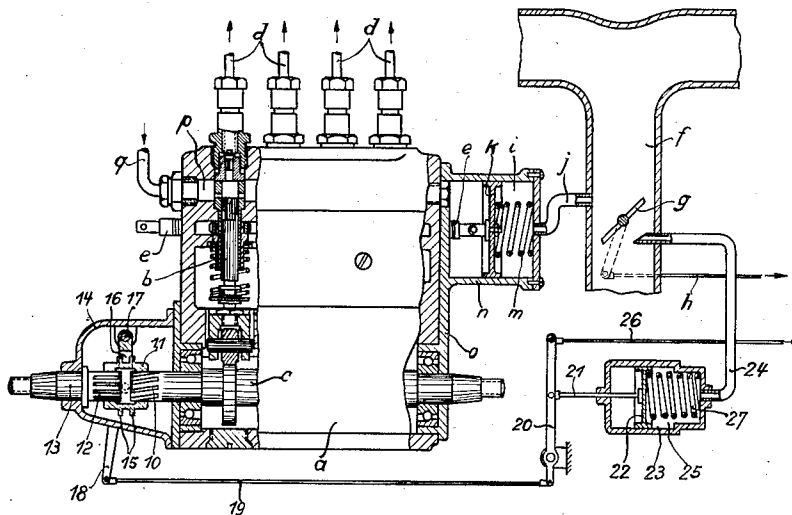
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INJECTION INTERNAL COMBUSTION ENGINE

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Fig. 1



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INJECTION INTERNAL COMBUSTION
ENGINE

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2 Claims. (Cl. 123—140)

The present invention relates to injection internal combustion engines in which the beginning of the injection is adjusted automatically in accordance with the speed of the engine independently of the quantity of fuel delivered.

It is known to adjust the beginning of the injection in dependence on the speed of the engine by a centrifugal governor or by the liquid pressure produced by a pump but a simple centrifugal governor is not adapted for the great fluctuations in speed which occur, for example, in motor vehicles whilst liquid governors have the drawback that they soon become inoperative on the slightest leakage.

According to the present invention the members for adjusting the beginning of the injection are moved by a servo-motor connected to the air suction pipe of the engine, and thus pneumatically operated, this servo-motor being adapted to adjust the beginning of the injection in dependence upon the conditions of air flow and pressure which prevail in the air suction pipe and vary in conformity with the speed. Such a servo-motor, controlled by the conditions of flow and pressure in the suction pipe, is, as regards packing, much less sensitive than a servo-motor which is controlled by a liquid pressure that fluctuates with the alterations in speed. Furthermore, it is simpler and cheaper in construction than a centrifugal governor suitable for the purpose intended, and for which, furthermore, a special drive must be provided.

One form of construction embodying this invention is illustrated in the accompanying drawing in which:

Figure 1 shows an injection pump intended for a four-cylinder engine having an injection adjuster and delivery quantity controller built thereon, as well as the suction pipe of the engine and a servo-motor connected thereto for actuating the adjuster.

a is the casing of the injection pump, in which four separate pumps are arranged side by side in a row, and the pistons *b* of which are driven by a cam-shaft *c* mounted in the casing. The fuel conveyed is delivered through the outlets *d* to the injection nozzles (not shown) and into the engine cylinders, which are also not shown. The quantity delivered by the pumps can be varied in known manner by rotating the pistons *b*, which are provided with an inclined controlling edge. This rotation is effected by means of a controlling rod *e* common to all the separate pumps and slidably mounted in the pump casing.

The fuel is supplied to the suction chamber *p*

common to all the separate pumps in the pump casing by a pipe *q*.

The driving shaft *c* of the separate pumps has at its end which receives the drive screw-thread-like oblique grooves *10*, in which engages one-half of a displaceable sleeve *11*. The other half of the sleeve engages in longitudinal grooves *12* in the end of a shaft *13*, arranged co-axially with the pump-shaft *c*, and mounted in a cover *14* secured on the pump casing and driven from the engine. The sleeve *11* rotates with the two shafts *13* and *c*. In a groove in it between two flanges *15* engage the forked ends of a lever *16*, which is fastened on a shaft *17*, mounted in the cover *14*. An adjusting lever *18* is secured to an end of the shaft that projects from the cover, and is connected by a rod *19*, a lever *20* and a rod *21* with the piston *22* of a servo-motor. The piston *22* is arranged in a cylinder *23*, in which is also located a spring *27* which has a tendency to push the piston into its one end position in which the sleeve *11* is in a position which gives the latest beginning of the injection. To the bottom of the servo-motor cylinder *23* is connected one end of a pipe *24*, the other obliquely cut-away end of which projects into the air suction pipe *f* of the four-cylinder engine in such a way that the air current moving along the suction pipe *f* produces a strong injector-like suction action in the pipe *24* and thus also in the cylinder space *25* of the servo-motor. In the arrangement shown the end or mouth of the pipe *24* is directed away from the air inlet to the inlet pipe.

A throttle valve *g* is provided in the suction pipe behind the place, viewed in the direction of flow of the air, at which the pipe *24* projects into the suction pipe *f*, and this throttle valve can be adjusted at will by the driver by means of a rod *h*. Behind the throttle valve, one end of a pipe *j* is connected to the suction pipe *f* of the engine, and the other end of the pipe opens into a cylinder chamber *i* in which is a piston *k*. A spring *m* arranged in the chamber *i* has a tendency to push the piston coupled to the controlling rod *e* into a position in which the pump pistons *b* force the greatest delivery quantity into the pipes *d*. The cylinder *n* enclosing the piston is cast on as an extension to the bearing cover *o* for the pump shaft *c*.

The position of the piston which controls the quantity injected adjusts itself according to the adjustment of the throttle valve *g* effected by the driver and according to the speed of the engine.

The piston *22* of the servo-motor which ad-

justs the beginning of the injection to the speed
assumes a position corresponding to the air cur-
rent which prevails in the suction pipe *f*. When
the engine is running rapidly and the throttle
5 valve is open, the air current is at its strongest,
so that the piston of the servo-motor is drawn
farthest to the right and the earliest beginning
of the injection is adjusted. In order when start-
ing, and also when climbing hills, where the mo-
10 tor, notwithstanding the fully open throttle valve,
is only slowly rotating and the air current thus
does not suffice to adjust for early beginning of
injection, also to enable the beginning of the in-
jection to be advanced, a traction member such
15 as a cord *26*, operable at will by the driver, is
provided on the lever *20*.

We declare that what we claim is:

1. In an injection internal combustion engine
having an air inlet duct, a throttle valve in said
20 duct, a fuel pump, control means including a
pneumatic servo-motor connected to the air in-
let duct between the throttle valve and the en-
gine for automatically adjusting the quantity of
fuel delivered by said pump in dependence upon
25 the air current prevailing in the air suction pipe
and varying in conformity with the engine speed,
means, independent of said control means, for

automatically adjusting the beginning of the
fuel injection delivered by said pump in depend-
ence upon the air current prevailing in the air
suction pipe and varying in conformity with en-
gine speed, said last-mentioned means including
5 a servo-motor, a pipe connection from said servo-
motor to said air inlet duct on the side of the
throttle valve remote from the engine, and man-
ual means for adjusting said last-mentioned
means. 10

2. In an injection internal combustion engine
having an air inlet duct, a throttle valve in said
duct and a fuel pump, a pneumatic servo-motor
connected to the air inlet pipe between the throt-
tle valve and the engine for governing the quan-
15 tity of fuel delivered by said pump in dependence
upon the air current prevailing in the air suction
pipe and varying in conformity with engine speed,
and a second pneumatic servo-motor connected
to the air inlet pipe on that side of the valve re-
20 mote from the engine for automatically adjust-
ing the beginning of the injection delivered by
said pump according to the air current prevailing
in the air suction pipe and varying in conformity
25 with the engine speed.

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