

[72] Inventors Masayoshi Kobayashi
Higashi-Matsuyama;
Shiro Kaneko, Ogawa-machi, Hiki-gun,
both of Japan
[21] Appl. No. 23,693
[22] Filed Mar. 30, 1970
[45] Patented Dec. 21, 1971
[73] Assignee Diesel Kiki Kabushiki Kaisha
Tokyo, Japan

2,882,863	4/1959	Newton	417/212
2,919,687	1/1960	Friedlander	123/139.13
3,013,547	12/1961	Miracki et al.	123/139.13
3,147,746	9/1964	Hofer	123/139.13
3,051,154	8/1962	Kemp	123/139.13

FOREIGN PATENTS

978,936	4/1951	France	92/12.1
Primary Examiner—William L. Freeh			
Attorney—Larson, Taylor & Hinds			

[54] HYDRAULIC INJECTION TIME CONTROLLING
DEVICE IN FUEL INJECTION PUMPS
2 Claims, 2 Drawing Figs.

[52] U.S. Cl.	417/221, 123/139.13
[51] Int. Cl.	F04b 1/06
[50] Field of Search	417/212, 218; 123/139.13

[56] References Cited
UNITED STATES PATENTS
2,754,806 7/1956 Funston..... 417/218

ABSTRACT: A hydraulic injection time-controlling device comprising, a sleeve combined with drive and driven shafts, displacement of which sleeve changes phase between said shafts; a pilot valve in said drive shaft, which is moved in response to fluid pressure varied with speed of rotation, said sleeve being displaced by control of supply of pressure fluid acting on said sleeve due to the displacement of said pilot valve, and a spring between a spring seat connected to said sleeve and said pilot valve, the displacement of said sleeve being transmitted to said pilot valve through said spring.

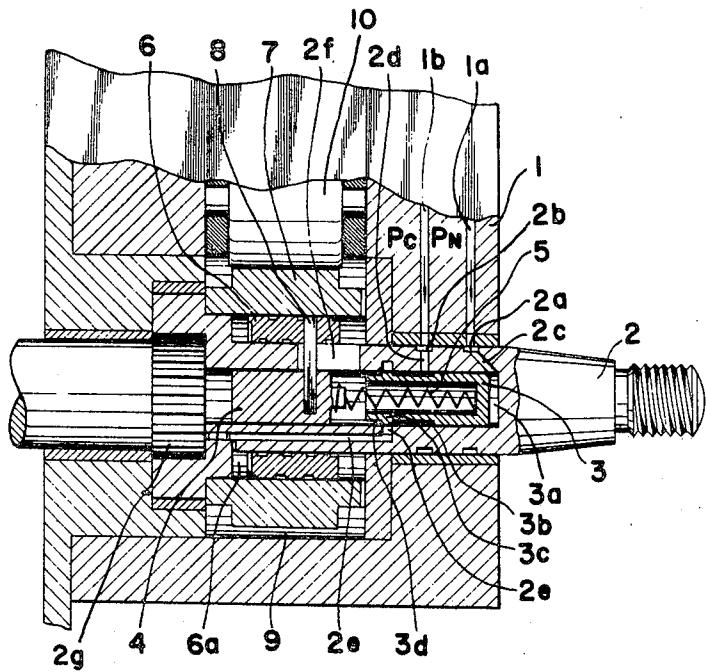


FIG. 1

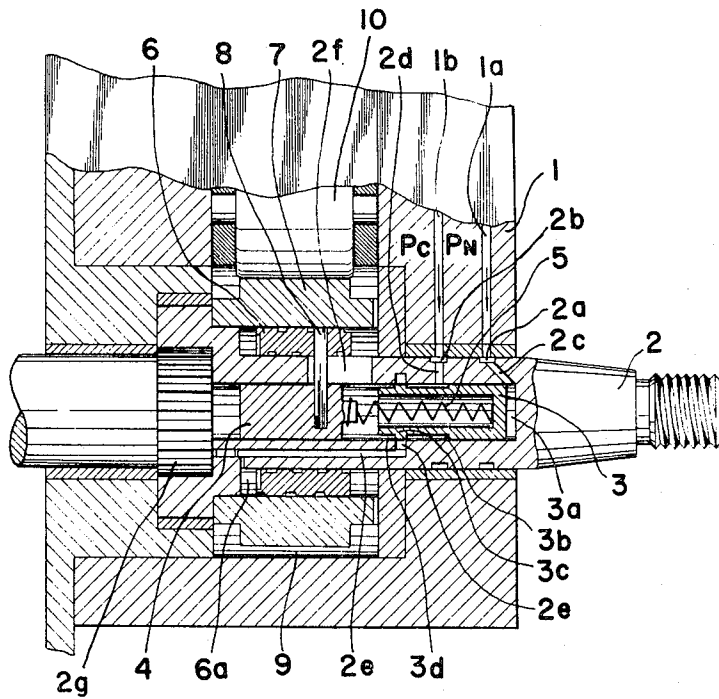
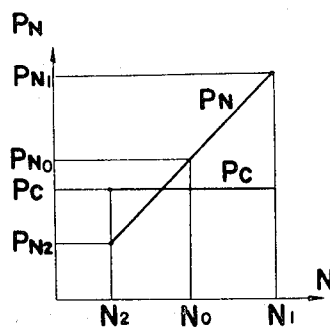


FIG. 2



HYDRAULIC INJECTION TIME CONTROLLING DEVICE IN FUEL INJECTION PUMPS

This invention relates to a hydraulic injection time-controlling device which automatically changes a phase, according to transmission rotation speed or engine rotation speed, between a drive shaft (on an engine side) and a driven shaft (on a pump cam side) of a fuel injection pump for internal combustion engines.

As is well known, in an injection time-controlling device of an automatic type, time required for igniting fuel in an engine cylinder and time of combustion are almost constant without regard to a speed of engine rotation, while these times would vary in inverse proportion to engine rotation speed, so that usually the fuel injection time is quickened when the rotation speed is high and delayed when it is low. In connection with these functions it has been common for conventional hydraulic injection time-controlling devices to operate the fluid supply controlling valve by centrifugal force of weight with relation to the rotation speed of the drive shaft for operating the helical spline for adjusting the shaft phase, which is interposed between the drive shaft and the driven shaft. The arrangement of this type involves advantages of sure operation and transmission of a larger driving torque, while on the other hand disadvantages of a large volume of the device due to centrifugal weight, the necessity of providing speed-increasing gears when small weights are used, and a complicated construction of the device.

The present invention has for its object to provide a hydraulic injection time-controlling device in fuel injection pumps for internal combustion engines which has eliminated such disadvantages as described, is simple in construction and small in volume, and can fulfil the characteristics as desired.

The injection time-controlling device of this invention uses the engine lubricating oil pressure, the supply fuel pressure and the like as operative fluid pressure without need of provision of any particular fluid supplying device. The invention enables to vary the fluid pressure in a wider range that acts on the pilot valve so that the range of the advance angle can be greatly enlarged. In addition, spring force and spring constant of the pilot valve as well as characteristics of the fluid pressure from the outside can be selected desirably so that preferred characteristics of advance angle can be obtained.

In order that this invention may be more readily understood, reference will now be made, by way of example, to the accompanying drawings in which:

FIG. 1 is a vertical section of a hydraulic injection time-controlling device in a fuel injection pump for internal combustion engines.

FIG. 2 is a diagram showing characteristics relative to the rotation speed of a fluid pressure supplying device acting on the present device.

In FIG. 1, a drive shaft 2 mounted on an injection pump body 1 has an axial hole in which a pilot valve 3, having a bottom and of a hollow cylindrical shape, and a spring 5 interposed in said pilot valve between a spring seat 4 and the pilot valve 3, are axially movably inserted. In the circumferential parts of the drive shaft 2 on the right in the FIG. 1 are provided grooves 2a, 2b connected to fluid inlet ports 1a, 1b on the body 1, respectively, with conducting holes 2c, 2d being communicated to cylinder bottom 3a and to a circumferential groove 3b of the pilot valve 3, respectively. The drive shaft 2 is at the left side of the drawing provided with splines 2g for connecting pump, governor, etc. (not shown). At the other end of the valve 3 is formed a small diameter portion 3d through a flange portion 3c adjacent to the circumferential groove 3b. The flange portion 3c is adapted to open or close the interconnection of the groove 3b and the small diameter portion 3d with the hole 2e of the drive shaft 2. The small diameter portion 3d communicates with a cam chamber 9. The hole 2e is connected to the left end of the sleeve 6, which has helical splines on its inner and outer surfaces and is fitted to the drive shaft 2, that is, hole 2e is connected to a chamber 6a formed by the sleeve 6, drive shaft 2, and cam ring 7. The direction of

torsion of the helical splines is provided such that the axial force component resulting from driving torque will resist against the fluid pressure acting on the end surface of the sleeve 6. The helical splines in the inner and outer surfaces are provided oppositely in order to produce a larger phase angle. There is inserted the cam ring 7 for driving, through a tappet roller 10, a plunger of a fuel injection pump, not shown, the cam ring being on the outer periphery of and fitted to the helical spline sleeve 6. The helical spline drive connections between sleeve 6 and cam ring 7 and shaft 2 may be of any conventional form commonly used in this art for effecting an angular phase change in response to relative axial movement, and hence the connections are not shown in detail. The sleeve 6 and the spring seat 4 are connected through a pin 8 passing through window 2f of the drive shaft 2 for operating integrally therewith. The cam chamber 9 is connected to an oil pan in the engine through an overflow valve, not shown. In the fluid-conducting hole 1a is delivered a fluid pressure (for example fuel oil pressure) PN-associated with the engine rotation speed as shown in FIG. 2, and in the fluid-conducting hole 1b is fed a pressure fluid Pc (a constant pressure specified in this specification) which has no particular relation to the engine rotation speed such as a lubricating oil for engines.

Assume that, a fluid of constant pressure Pc pushes the sleeve 6 and the movement is transmitted to the pilot valve 3 through the spring 5, and the flange portion 3c of the pilot valve 3 closes the hole 2e for the fluid pressure to be settled as shown in FIG. 1, and the obtained fluid pressure Pn may be given as PNO. If the rotation speed rises from N0 to N1 the fluid pressure Pn will rise from PNO to PN1 so that the pilot valve 3 will move to the left in the figure resisting against the spring 5 and thereby the groove 3b is interconnected to the hole 2e. Consequently the constant fluid pressure Pc will act on the chamber 6a, pushing the left end of the helical spline sleeve 6 to move this to the right. Therefore, the relative phase of the drive shaft 2 and the cam ring 7 which is the driven shaft will vary with the torsion angle produced. That is, the cam ring 7 advances in angle with respect to the drive shaft 2 connected to the crankshaft of the engine. Thus, the forward end of the plunger not shown closes the fuel outlet port at a side of a plunger barrel by lift of the cam ring 7 and advances the starting time of fuel injection of the so-called Bosch type fuel injection pump. On the other hand the movement of the sleeve 6 is brought back to the pilot valve 3, that is, the rightward movement of the sleeve 6 is transformed to rightward movement of the spring seat 4 thereby compressing the spring 5. The pilot valve 3 therefore moves to the right to a position closing the hole 2e by the flange portion 3c in keeping balance of the fluid pressure PN1 with a newly added spring load and intercepts the supply of the fluid pressure Pc so that the rotation speed is established in this position.

Similarly, when the rotation speed drops from N0 to N2 the fluid pressure PNO turns to PN2 so that inversely the pilot valve 3 is pushed by the spring 5 and moves to the right in the figure. The flange portion 3c then opens the hole 2e to the cam chamber 9, so that the fluid pushing the sleeve 6 to the right in the figure flows into the cam chamber 9 by leftward movement of the sleeve 6 due to driving torque of the fuel injection pump. The leftward movement of the sleeve 6 turns to the leftward movement of the spring seat 4 thereby reducing the load of the spring 5 so that the pilot valve 3 is pushed by the fluid pressure PN2 and keeps balance of the load of the spring 5, that is, the flange portion 3c moves leftwardly to a position that it closes the hole 2e and is established in the same rotation. The leftward movement of the sleeve 6 delays the angle advance. It is apparent that the characteristics of angle advance can be modified by changing a torsion angle of a helical spline, constant of spring 5, and fluid pressure PN. Particularly, the characteristics of PN can be simply adjusted from the outside, which makes the present device more advantageous than any other apparatus.

According to the present embodiment, the fluid supply source includes those for PC and PN, of which PC acts on the

end of the sleeve 6 and ensures minimum pressure for displacing the sleeve 6 against the axial component, friction force, etc. of driving torque so that PN can be used in common and a single supply source can be used. In the present embodiment, the description concerns a fuel injection pump with a single plunger including the distribution type, the object of the invention being obtained also for the in-line type pump having several plungers by extending the cam ring 7 as a driven shaft.

Many variations may be effected without departing from the spirit of the invention. It is to be understood that these, together with other variations in details, are anticipated by the appended claim.

What is claimed is:

1. A hydraulic injection time-controlling device in fuel injection pumps for internal combustion engines comprising, a

drive shaft; a driven shaft; a sleeve having a portion formed as a fluid motor and combined with said shafts, displacement of said sleeve being adapted to change phase between said shafts; a pilot valve in an axial hole of said drive shaft, said pilot valve being moved in response to fluid pressure varied with speed of rotation, said sleeve being displaced by control of supply amount of pressure fluid acting on said fluid motor of said sleeve due to the displacement of said pilot valve; and a spring between a spring seat connected to said sleeve and said pilot valve, the displacement of said sleeve being transmitted to said pilot valve through said spring.

2. A hydraulic injection time-controlling device according to claim 1 wherein said sleeve is combined by helical splines with said shafts.

* * * * *

15
20
25
30
35
40
45
50
55
60
65
70
75