May 1, 1956 W. O. BISCHOFF 2,743,593

HYDRAULIC AUTOMATIC TIMER

Filed May 23, 1952 2 Sheets-Sheet 1

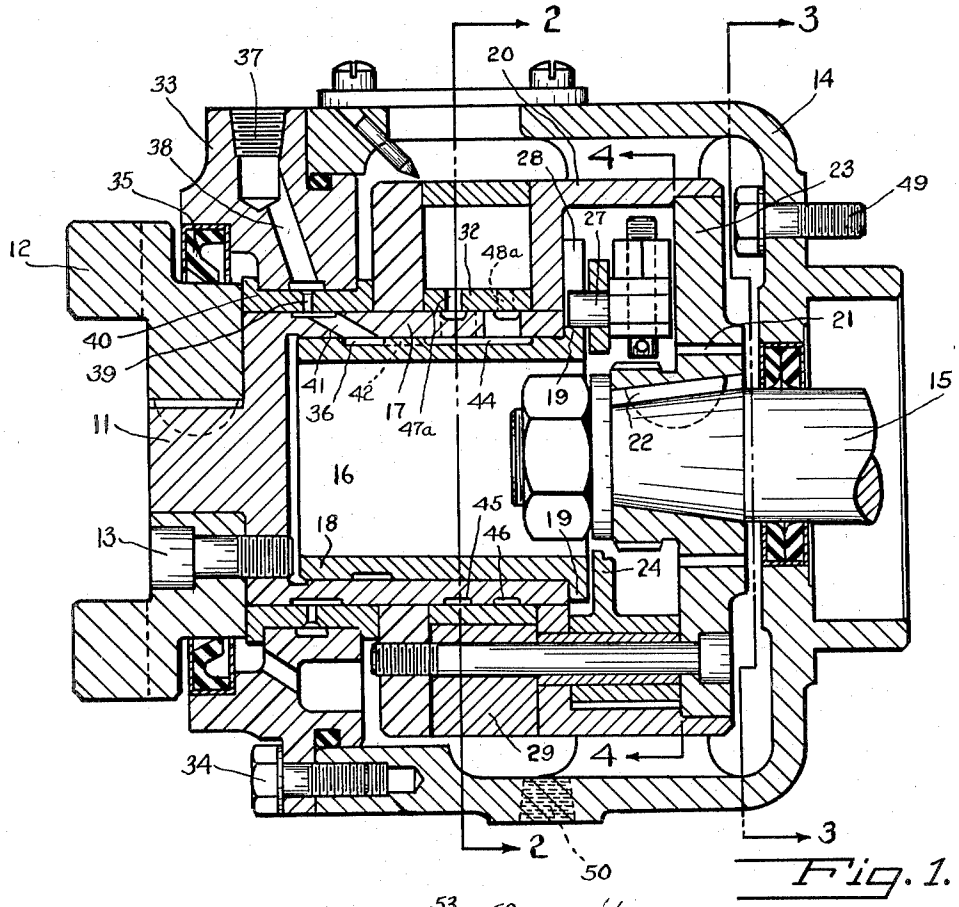



Fig. 1.

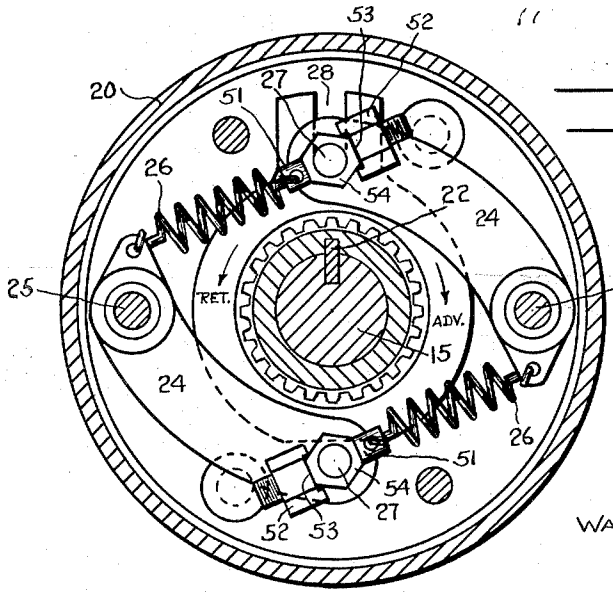



Fig. 4.

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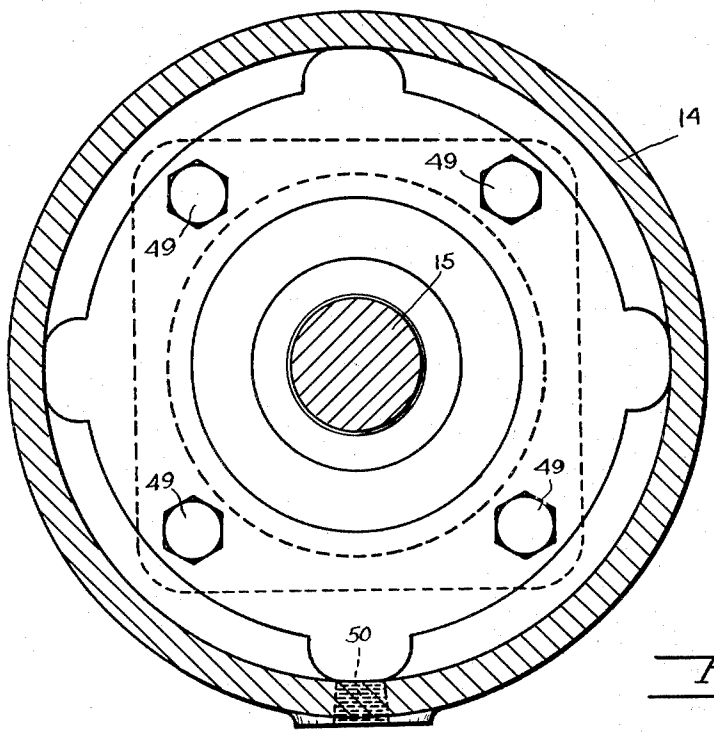
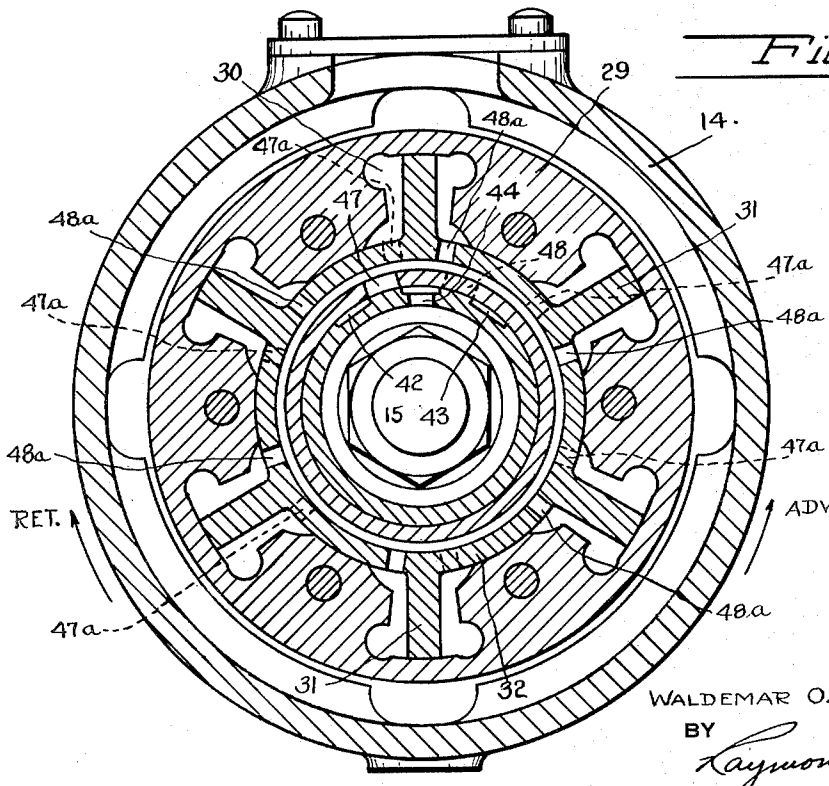



Fig. 3.

Fig. 2.




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# HYDRAULIC AUTOMATIC TIMER

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3 Claims. (Cl. 64—25)

This invention relates to fuel injection apparatus and has particular reference to a new and improved automatic timing device for fuel injection pumps.

An object of the invention is to provide a new and improved hydraulic automatic timing device for fuel injection apparatus.

Another object is to provide a timing device of the type set forth which is relatively simple and economical in construction and adjustment.

Another object of the invention is to provide a hydraulic automatic timing device which will alter the time of beginning of fuel injection according to the engine requirements to give improved fuel economy and improved performance.

Another object is to provide a device of the type set forth which is highly responsive to speed changes and positive in action.

Another object is to provide such a device which is of hydraulic type and which is capable of employing oil under pressure either from engine lubricating source, fuel supply or a separate oil source.

Another object is to provide a device of the type set forth which eliminates the necessity of high precision expensive manufacture of elements required in prior timing devices.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings. It will be understood that changes may be made in the details of construction and arrangement of parts without departing from the scope of the invention as set forth in the accompanying claims, as the preferred form of the invention has been given by way of illustration only.

Referring to the drawings:

Fig. 1 is a longitudinal sectional view of one form of timing device constructed according to the invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a fragmentary sectional view taken on line 3—3 of Fig. 1, looking in the direction of the arrows; and

Fig. 4 is a sectional view taken on line 4—4 of Fig. 1, looking in the direction of the arrows.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout, the apparatus shown embodying the invention comprises a drive shaft 11 adapted to be operatively connected to an engine drive by means of drive coupling 12 which is secured to drive shaft 11 by bolts or other suitable means 13.

The timing mechanism is contained within the housing 14 into which extends the end 15 of the pump drive shaft.

Drive shaft 11 has the central bore 16 within the cylindrical portion 17 and in telescoping relation with said cylindrical portion 17 is the cylindrical valve member 18 having the peripheral flange 19.

Within housing 14 is provided rotor 20 which is connected through spline 21 and key 22 to pump drive shaft 15.



On end plate 23 of rotor 20 are pivotally mounted centrifugal governor weights 24 on bolts 25 and said weights are connected through coil springs 26. Cam pin 27 on governor weight 24 operates in cam slot 28 in peripheral flange 19.

Rotor 20 includes the rotor ring 29 having the fluid pockets 30 in each of which is positioned a vane 31 on rotary valve member or ring 32 which is either formed integral with or rigidly secured to member 17.

On housing 14 is positioned cover plate 33 which is secured in position by bolts or the like 34 and the oil seal 35 is provided between cover plate 33 and drive shaft 11.

On the periphery of cylinder 18 is provided annular groove 36 which is adapted to communicate with the fluid inlet 37 through port 38 in cover 33, port 39 in bearing 40 and port 41 in the cylindrical portion 17 of drive shaft 11.

On the periphery of cylindrical valve member 18 are provided the two longitudinal grooves 42 and 43 which communicate with annular groove 36. Also in cylindrical valve member 18 is port 44 which is positioned midway between grooves 42 and 43, as shown in Fig. 2, and not communicating with groove 36.

Also on the periphery of cylindrical member 17 are provided the spaced peripheral grooves 45 and 46 and through annular member 32 are provided the ports 47*a* and 48*a* communicating with peripheral grooves 45 and 46 respectively, into the fluid pockets 30 through metering holes 47 and 48 respectively in cylindrical member 17.

The timing device can be secured to the fuel injection pump by any suitable means such as the bolt 49, shown by way of example.

In the operation of the device, fluid or oil under pressure which can be engine lubricating oil, fuel from the fuel supply or a separate source of fluid is introduced into the timing device through inlet 37 and ports 38 and 39 to port 41 in cylindrical member 17 by which it is supplied to annular groove 36. This fluid then passes through longitudinal grooves 42 and 43 to metering ports 47 and 48 to peripheral grooves 45 and 46 from which it passes to 47*a* and 48*a* to fluid pocket 30.

Upon rotation of drive shaft 11 by the engine drive means rotor 20 is rotated within housing 14 and this in turn effects rotation of pump drive shaft 15 for operating the pump in the usual manner. This rotation is effected through rotation of drive shaft 11 to which are secured the vanes 31 and which drive the rotor through the fluid in the fluid pockets 30.

At a predetermined engine speed governor weights 24 begin to move outward, being restrained by the springs 26. As the engine speed increases, the weights 24 move outwardly and as the engine speed decreases, the weights 24 move inwardly due to centrifugal force and spring action. As the weights 24 move, cam pin 27 moves also in slot 28 in peripheral flange 19. Cam slot 28 in which cam pin 27 is located is a part of control valve 18, so that any movement of weights 24 will impart a rotary motion to valve 18 and the amount of rotary motion imparted to valve 18 can be altered or varied by altering the shape of cam slot 28, the weights 24 and/or the springs 26.

For example, if the engine speed were increasing, with the construction shown the valve 18 would be rotated in the direction of arrow Adv. In doing so, fluid under pressure in passage 43 would be permitted to enter hole 48 from which fluid enters passage 46 and through holes 48*a* into the space between rotor vane 31 and stator 29. At the same time, drain passage 44 of valve 18 registers with hole 47 permitting oil from the opposite side of

vane 31 in fluid pocket 30 to drain through holes 47*a* and passage 45 through hole 47 and passage 44 into the sump or drain cylinder 16. As fluid under pressure is fed through holes 48*a*, rotor 17 moves relative to stator 29 and port 48 is shut off from passage 43 and port 47 is shut off from passage 44.

As the engine speed decreases, springs 26 pull weights 24 inwardly and rotate valve 18 in the direction of arrow Ret. Fluid under pressure then flows through passage 42, port 47 into passage 45 through ports 47*a* into fluid pocket 30 on the opposite side of vane 31 causing vanes 31 to move backward in relation to rotor or stator 29. Fluid from the opposite side of vane 31 then drains through holes 48*a* into passage 46 through port 48 into passage 44 into the sump or drain chamber. As fluid under pressure is fed through holes 47*a*, vane 31 moves relative to stator or rotor 29, and hole or port 47 is shut-off from passage 44.

To eliminate the excess oil from the interior of the device, a suitable pipe line is connected to port 50 in housing 14 which line is connected to a tank or other desired means, thus providing a suitable drain outlet for the passage of fluid from the interior of the housing 14.

In production it is preferable to provide for means for quickly and easily varying the tension of springs 26. In Fig. 4 is shown one means for accomplishing this result and comprising screw 51 to which is connected the hooked end of the spring 26. This screw 51 extends through cam pin 27 and on the end of screw 51 is positioned locking nut 52 which has the slot 53 cut in the face of the nut engaging head 54 on cam pin 27, and due to the combination of the matching surfaces on the head 54 of cam pin 27 and slot 53 on nut 52 and the spring tension, the adjusting nut 52 and screw are locked in their respective set positions until deliberate action is taken to separate these matching surfaces of the head 54 of the cam pin 27 and the adjusting nut 52. The operation of this adjustable arrangement will be obvious from the foregoing description and it will be seen that this construction allows quick and easy adjustment of the spring tension and positive locking of the spring at the necessary length to give the desired tension.

It will be noted that with the present device, for any one engine speed, the control valve 18 will assume one unique position and through its control of the flow of fluid forces the rotor or stator 29 to also assume a definite position for the particular engine speed involved. At any definite engine speed all fluid passages are closed to flow and a hydraulic lock exists between vanes 31 and stator or rotor 29 permitting the transmission of power through the unit whereby the drive force of the engine upon drive shaft 11 is transmitted to a pump drive shaft 15 with the phase relationship between the pump shaft and the engine shaft automatically varied to change the time of the beginning of injection by the fuel pump according to the engine requirements.

It is pointed out that because of the provision of peripheral grooves 45 and 46, that only one set of metering ports 47 and 48 is required to control the flow of fluid to and from all the fluid pockets 30 regardless of the number of such pockets and these grooves 45 and 46 eliminate the necessity of high precision and accuracy in locating passages or ports 47*a* and 48*a* and the number of ports 47 and 48 is reduced to a minimum as stated above, thus simplifying the construction of the device and reducing the cost of its manufacture.

From the foregoing, it will be seen that I have provided relatively simple, economical and efficient means for obtaining all of the objects and advantages of the invention.

I claim:

1. In a device of the character described, a housing adapted to be secured to a fuel injection pump, a rotor in said housing adapted to be operatively connected to the drive shaft of said fuel injection pump, a cylindrical rotary valve member in said housing, means for operatively connecting said rotary valve member to an engine for effecting rotary motion of said rotary valve member, a cylindrical valve member in telescoping relation with said rotary valve member and pivotally adjustable relative thereto, fluid pockets in said rotor, vane members on said rotary valve member and extending into said fluid pockets for effecting rotation of said rotor upon rotation of said rotary valve member, and means connected to said rotary valve member for effecting relative pivotal adjustment between said cylindrical rotary valve member and said cylindrical valve member, said means for effecting relative adjustment being centrifugally actuated, said cylindrical valve member having vane members also having a pair of annular grooves, one of said grooves being in communication with said fluid pockets on one side of each of said vane members and the other of said grooves being in communication with said fluid pockets on the opposite side of said vane members, and said valve member having passages communicating with said annular grooves.

2. In a device of the character described, a housing adapted to be secured to a fuel injection pump, a rotor in said housing adapted to be operatively connected to the drive shaft of said fuel injection pump, a cylindrical rotary valve member in said housing, means for operatively connecting said rotary valve member to an engine for effecting rotary motion of said rotary valve member, a cylindrical valve member in telescoping relation with said rotary valve member and pivotally adjustable relative thereto, fluid pockets in said rotor, vane members on said rotary valve member and extending into said fluid pockets for effecting rotation of said rotor upon rotation of said rotary valve member, and means for effecting relative pivotal adjustment between said cylindrical rotary valve member and said cylindrical valve member, said means for effecting relative adjustment being centrifugally actuated, said cylindrical valve member having vane members also having a pair of annular grooves, one of said grooves being in communication with said fluid pockets on one side of each of said vane members and the other of said grooves being in communication with said fluid pockets on the opposite side of said vane members, and said valve member having passages communicating with said annular grooves, said means for effecting relative adjustment comprising centrifugally actuated means connected to said cylindrical valve member and effecting pivotal adjustment thereof.

3. In a device of the character described, a housing adapted to be secured to a fuel injection pump, a rotor in said housing adapted to be operatively connected to the drive shaft of said fuel injection pump, a cylindrical rotary valve member in said housing, means for operatively connecting said rotary valve member to an engine for effecting rotary motion of said rotary valve member, a cylindrical valve member in telescoping relation with said rotary valve member and pivotally adjustable relative thereto, fluid pockets in said rotor, vane members on said rotary valve member and extending into said fluid pockets for effecting rotation of said rotor upon rotation of said rotary valve member, and means for effecting relative pivotal adjustment between said cylindrical rotary valve member and said cylindrical valve member, said means for effecting relative adjustment being centrifugally actuated, said cylindrical valve member having vane members also having a pair of annular grooves, one of said grooves being in communication with said fluid pockets on one side of each of said vane members and the other of said grooves being in communication with said fluid pockets on the opposite side of said vane members, a pair of radial ports each communicating with one of said grooves and said valve member having passages adapted to communicate with said annular grooves

through said radial ports, said means for effecting relative adjustment comprising a centrifugally actuated pin member and a cam slot for said pin member and centrifugal means for actuating said pin member in said slot.

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