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3,024,779

TIMING DEVICE FOR FUEL INJECTION PUMP

Filed Oct. 30, 1958

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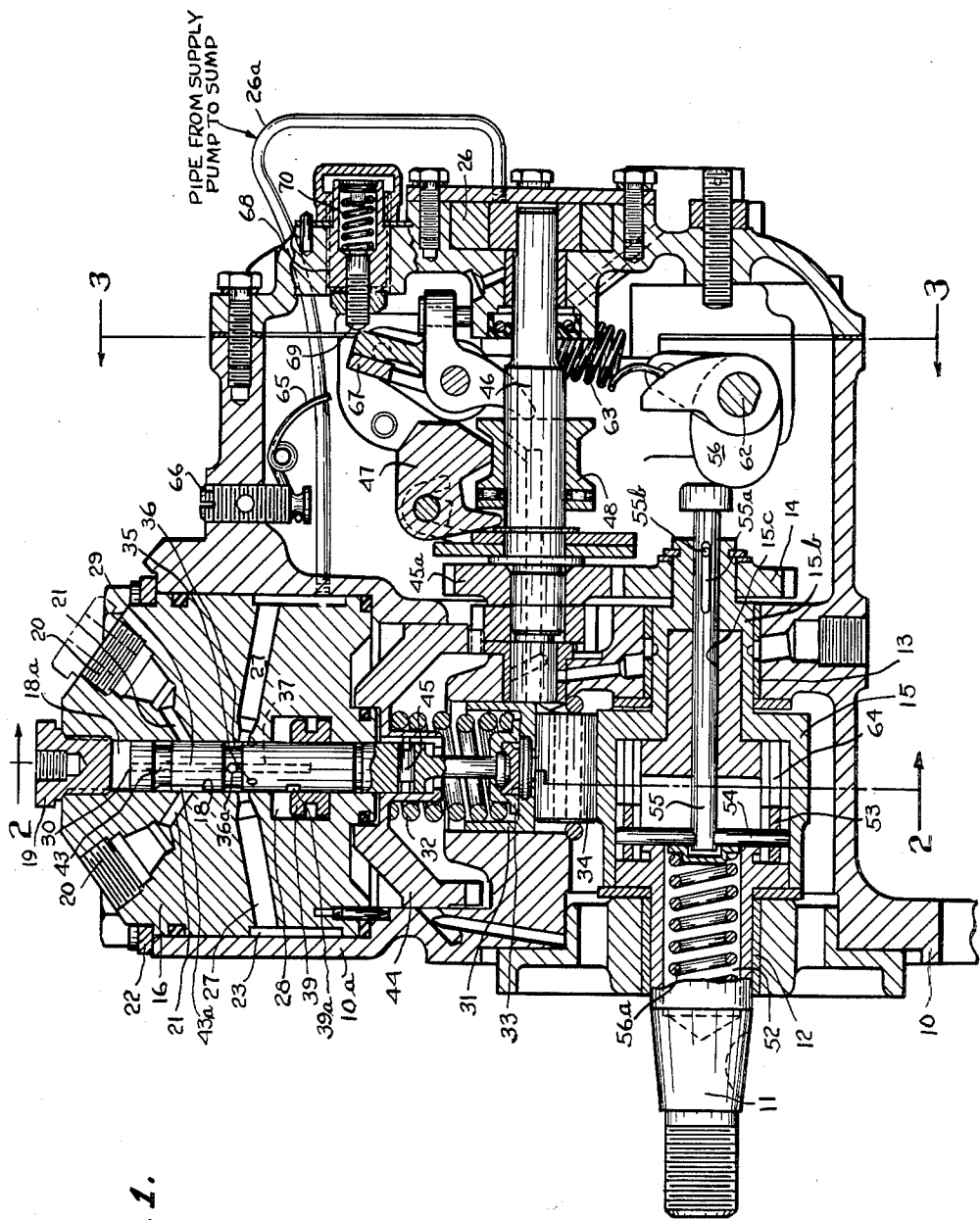


Fig. 1.

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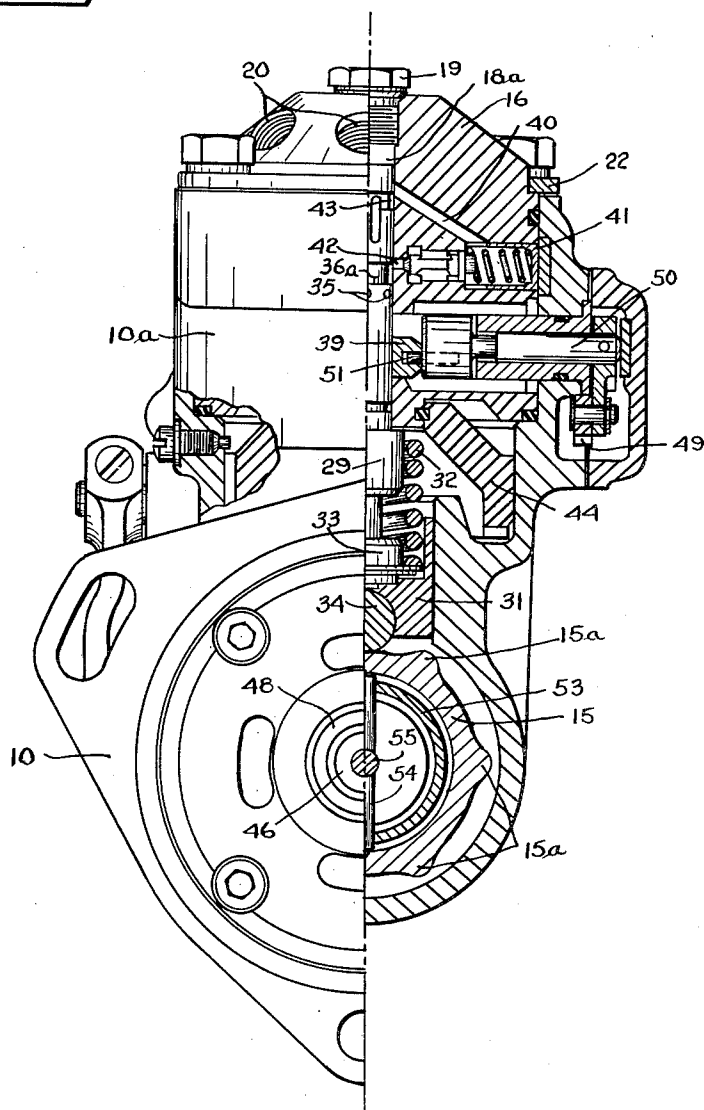
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Fig. 2.



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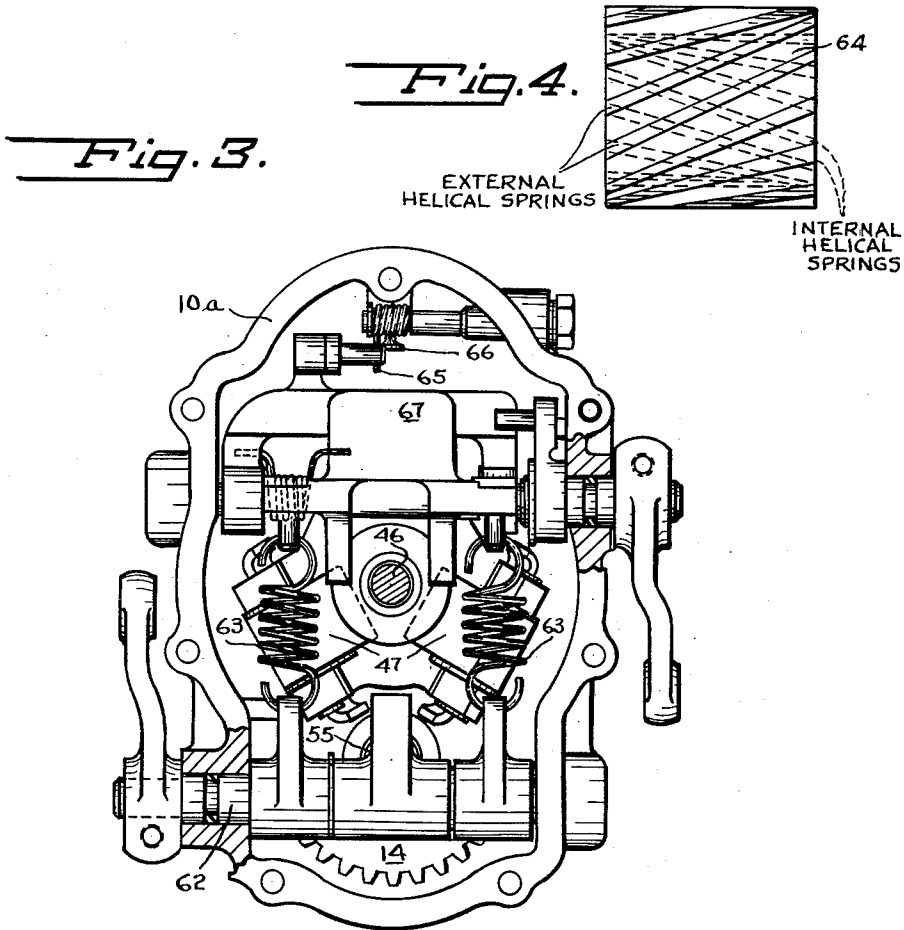
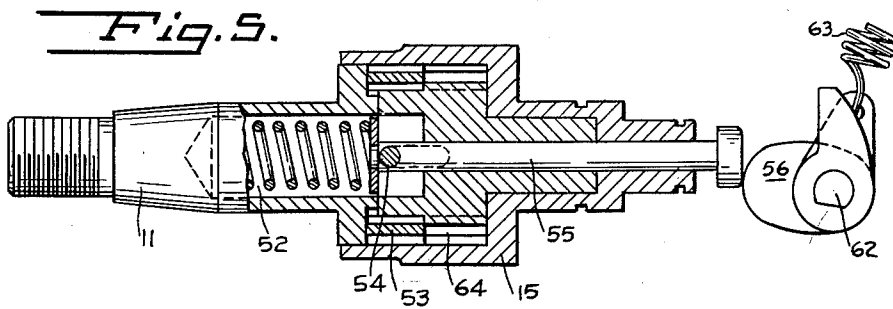
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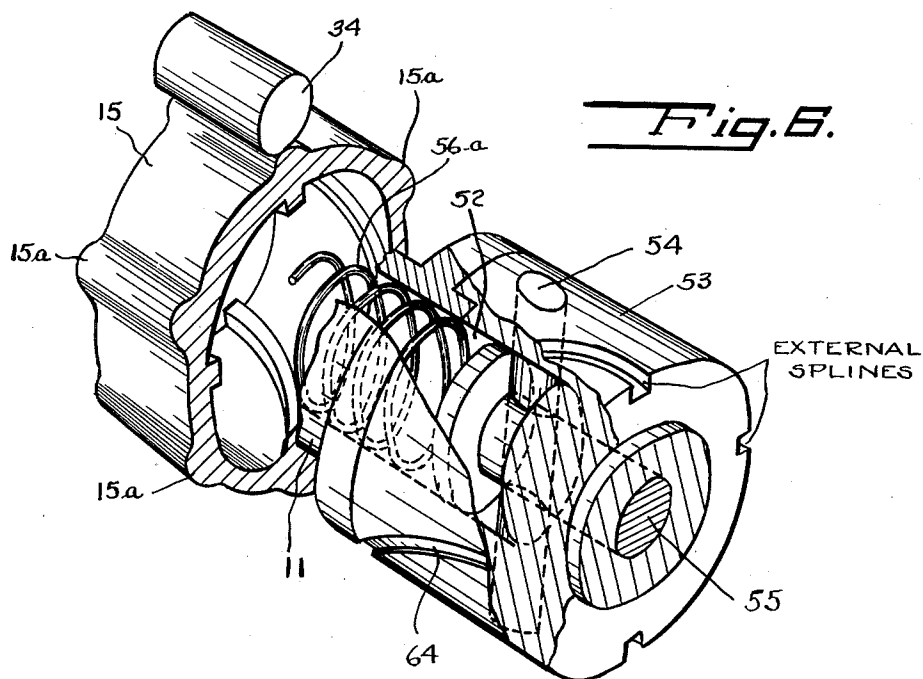
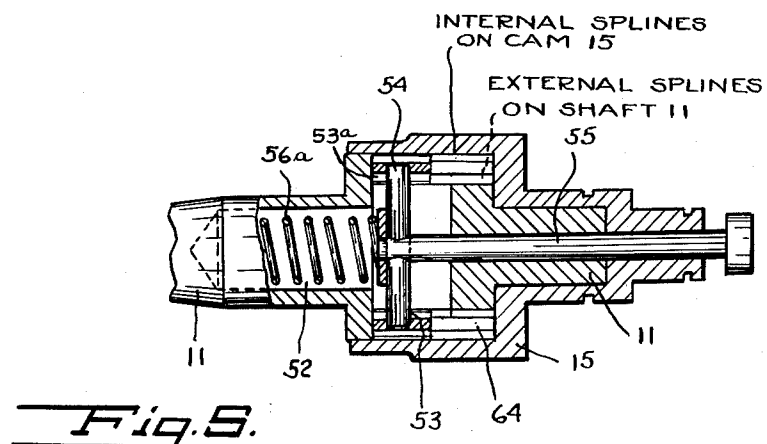
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TIMING DEVICE FOR FUEL INJECTION PUMP

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14 Claims. (Cl. 123—139)

This invention relates to fuel injection apparatus for internal combustion engines and has particular reference to a new and improved form of fuel injection pump in which the timing of injection by the pump may be varied.

An object of the invention is to provide a new and improved fuel injection pump having variable timing means whereby the timing of the injection by the pump may be varied.

Another object is to provide an apparatus of the type set forth wherein the means for varying the timing of injection is embodied in the pump and does not require any external timing device.

Another object is to provide a new and improved device of the type set forth which is relatively compact and simple in construction and assembly, yet efficient in operation.

Referring to the drawings:

FIG. 1 is a longitudinal sectional view of a fuel injection apparatus embodying 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 sectional view taken on line 3—3 of FIG. 1, looking in the direction of the arrows;

FIG. 4 is a plan view of the sleeve having internal and external splines; and

FIG. 5 is a fragmentary sectional view further showing the cam shaft and cam arrangement of FIG. 1.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout, the apparatus shown embodying the invention comprises a housing or casing 10 in which the drive shaft or cam shaft designated generally at 11 is journaled in the bearings 12 and 13 and which drive shaft is adapted to be operatively connected to the engine and to be driven thereby.

On the end of drive shaft 11 is mounted a spur gear 14.

The drive shaft 11 is provided with a cam 15 having the lobes 15a, the number of which depends upon the speed at which the pump is to be driven, for example, when the drive shaft 11 is connected to a four-cycle engine and adapted to operate at one half engine speed, the number of lobes 15a on the cam is equal to the number of pump outlets and where the drive shaft 11 is adapted to be driven at engine speed, the cam is provided with one half the number of lobes 15a as the pump has outlets.

In the portion 10a of the casing or housing 10 above drive shaft 11 is provided the pump head 16 which fits into a recess 17 in said portion 10a of housing 10.

The pump head 16 has the bore 18 therethrough, the outer end of which is closed by a threaded plug or the like 19 and the pump head 16 is provided with the outlets 20, one of which is provided for each cylinder or combustion chamber of the engine and which outlets 20 are connected to the bore 18 by ducts or passages 21.

The pump head or hydraulic head 16 is retained in position in casing 10a by means of the flange member 22 which is secured to casing 10a by bolts or other suitable means.

The pump head 16 is provided with a peripheral recess or groove 23 adjacent the periphery of the pump head and which, together with the adjacent wall 10a of the housing, forms a sump to which fuel is supplied through a pipe 26a which is adapted to be connected to a suit-

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able source of fuel such as to fuel supply pump 26, which may be of the impeller type gear or vane type, as desired, or if desired, an external fuel supply pump could be employed.

Fuel is supplied to the bore 18 from sump 23 by means of fill ports or ducts 27 which may be of suitable number, such as one port for each engine cylinder or any multiple thereof. From ports 27 fuel passes through radial fill ports 35 and thence through an axial passage 30 in member 29 to pumping chamber 18a.

Intermediate the ends of bore 18 there is also provided the spill sump 28.

The plunger or pumping and distributing member 29 is positioned in bore 18 in the pump head 16 and said member 29 is provided with an axial bore 30 in the end thereof adjacent plug 19 and, at its opposite end, member 29 is adapted to engage tappet 31 and to be held in engagement therewith by spring 32 which engages spring seat 33, which spring seat engages the head on the member 29 and retains it in engagement with tappet 31. Tappet roller 34 is provided between cam 15 and tappet 31.

Cam lobes 15a urge member 29 upward on its pumping and distributing stroke and spring 32 effects the return stroke of said member 29.

Member 29 is provided with radial fill ports 35, one of which is provided for each fill port 27 for supplying fuel from said ducts 27 through passage 30 to the pumping chamber 18a between the end of member 27 and plug 19 through bore 30 in the member 29, whereby bore 30 will be in communication with fill ports 27 during suction stroke of member 29 because of the relationship of ports 35 to ports 27 during the filling stroke. Adjacent to ports 35, member 29 is provided with a peripheral groove adapted to supply fuel under injection pressure to port 42 as hereinafter described.

Fill ports 27 are so positioned that during the injection stroke of the member 29, said ports 27 do not communicate with ports 35. During the early part of the injection stroke, groove 36 is in communication with fill ports 27 and permits a spill back of fuel, thereby preventing the beginning of the injection until the movement of the plunger 29 is sufficient to cause groove 36 to pass out of communication with ports 27. Groove 36 communicates with passage 30 through passage or port 36a which acts as a fill port during the latter part of the filling stroke and as the delivery port during the injection stroke.

For controlling the quantity of fuel injected by the pump, a spill passage 37 is provided which communicates with bore 30 in the member 29 and spill passage 37 is adapted to spill fuel to spill sump 28 through radial ports 39a, and sleeve 39 is adjustable to control or vary the amount of spill through said spill ports 39a to thereby control the quantity of fuel injected by the pump.

Fuel pumped by the member 29 in bore 18 passes through duct or passage 30, through port 36a to port 42, through delivery valve 41 and port 40 to annulus 43 to distributing groove 43a on the periphery of member 29, which distributing groove 43 is adapted to communicate with each outlet passage 21 successively upon rotation of member 29 to thereby distribute fuel to each of the outlets 20 in succession.

In order that the member 29 may be rotated to align distributing port 43 with each of the outlet ducts 21, a face gear 44 is provided adjacent the lower end of member 29 and surrounding said member and said face gear 44 is connected to member 29 by means of pin 45 or other suitable means for operatively connecting face gear 44 with member 29.

Face gear 44 is adapted to be rotated upon rotation of drive shaft 11 and spur gear 14 through the pinion 45a which is interposed between gears 14 and 44 and in

those constructions embodying a governor, as shown in FIG. 1, the pinion 45 may be mounted on the governor shaft 46 for simultaneously driving the governor shaft and operating the fuel supply pump 26, as shown in the construction of FIG. 1.

The governor arrangement shown is a centrifugal type governor adapted to be actuated through the centrifugal force of governor weights 47 which are adapted to actuate governor sleeve 48 along governor shaft 46 and, as said governor sleeve 48 is mechanically connected to spill sleeve 39 through linkage 49, shaft 50 and eccentric 51, movement of sleeve 48 by weights 47 will effect movement or adjustment of sleeve 39.

The governor weights 47 are pivotally mounted on spider 47a and, as will be seen from FIG. 4, three such weights are preferably provided and spider 47a is connected to governor shaft 46 by being keyed thereto as through the flat engaging edges 47b.

The timing of injection by the pump may be varied by varying the relationship of lobes 15a of cam 15 and drive shaft 11.

Drive shaft or cam shaft 11 is provided with an axial bore 52 and a diametrical slot or opening 53 passing through said bore 52 and in said slot or opening 53 is positioned a pin or member 54 which is connected at its opposite ends to timing sleeve 64 as shown in FIG. 2. Slots 53a are provided in drive shaft 11 to allow movement of pin 54.

Cam 15 has the sleeve and reduced extension portion 15b positioned between the journal 13 and the reduced end of drive shaft 11 and is also provided with a bore 15c aligned with bore 52.

In bore 15c is positioned a plunger member 55 which is connected to pin 54. Coil spring 56a on the opposite side of pin 54 from plunger 55 engages said pin 54 and thereby the opposite end of plunger 55 is retained in engagement with cam 56 on control lever shaft 62 which is held in operative position by spring 63.

Plunger 55 is provided with a slot 55a through which extends pin 55b which limits the movement of said plunger 55.

Between cam 15 and drive shaft 11 is provided the timing sleeve 64 having external and internal helical grooves adapted to mesh with said external and internal splines on drive shaft 11 and cam 15, respectively.

FIG. 5 is a sectional view taken on a line normal to the section of FIG. 1 and shows more clearly the cam shaft and cam arrangement.

FIG. 6 is a fragmentary perspective view, partly in section, showing the connection between the cam shaft and cam.

It will be seen that any change in the position of the operating lever and shaft 62 will simultaneously effect adjustment of plunger member 55 which adjusts sleeve 64 to thereby change the phase relationship between drive shaft 11 and cam 15 and thereby change the phase relationship between the cam lobes 15a and the drive shaft 11 to vary the timing of injection by the pump.

The idle control is provided by spring 65 which is connected to idle adjusting screw 66 which is adapted to adjust the position of spring 65 relative to governor lever 67.

Full load adjusting screw 68 is provided for controlling the desired full load fuel quantity and is provided with torque control screw 69 which is resiliently urged into full load position by spring 70, which allows torque control screw 69 to move slightly beyond full load position for providing the desired torque backup. The screw 68 is screwed into place to retain the unit in full load fuel position and then the torque control screw 69 is adjusted to desired position.

In the operation of the device, when the control lever shaft 62 is adjusted to vary the fuel quantity, the cam 56 is simultaneously adjusted to vary the injection timing. As will be seen from the drawing, pivoting of the shaft 62 will cause cam 56 to move plunger 55 against the force

of spring 56 or allow said plunger 55 to be moved by spring 56 and through the helical grooves of sleeves 64 and splines on drive shaft 11 and cam 15 adjust the relative position or phasing of cam lobes 15a and drive shaft 11.

It will be seen that with the cam 15 and cam lobes 15a integral with sleeve 15b, which is journaled in bearing 13, that a simplified, rugged and compact construction will result whereby the timing of injection may be adjusted without disturbing the phase relationship between the cam 15 and plunger 29.

From the foregoing it will be seen that I have provided new and improved means for obtaining all of the objects and advantages of the invention.

I claim:

1. In a device of the character described, a drive shaft and a cam shaft having adjacent portions in telescoping relation, a pumping and distributing member adjacent said cam shaft and adapted to be reciprocated thereby, cam means on said cam shaft for effecting such reciprocation of said pumping and distributing member, gear means carried by said cam shaft for effecting rotation of said pumping and distributing member, means between the adjacent portions of said drive shaft and cam shaft for altering the phase relation between said drive shaft and cam means to change the phasing between said drive shaft and plunger without disturbing the relation of said gear means and pumping and distributing member, a pin mounted for sliding movement in said drive shaft and having its opposite ends connected to said means between said cam shaft and drive shaft, resilient means in said drive shaft for urging said pin in one direction and a rod extending through aligned bores in said cam shaft and drive shaft and operatively connected to said pin for adjusting said pin against the force of said resilient means and means for limiting the movement of said rod.

2. In a device of the character described, a drive shaft and a cam shaft having adjacent portions in telescoping relation, a pumping and distributing member adjacent said cam shaft and adapted to be reciprocated thereby, cam means on said cam shaft for effecting such reciprocation of said pumping and distributing member, gear means carried by said cam shaft for effecting rotation of said pumping and distributing member, means between the adjacent portions of said drive shaft and cam shaft for altering the phase relation between said drive shaft and cam means to change the phasing between said drive shaft and plunger without disturbing the relation of said gear means and pumping and distributing member, a pin mounted for sliding movement in said drive shaft and having its opposite ends connected to said means between said cam shaft and drive shaft, resilient means in said drive shaft for urging said pin in one direction and a rod extending through aligned bores in said cam shaft and drive shaft and operatively connected to said pin for adjusting said pin against the force of said resilient means and means for limiting the movement of said rod, said means for limiting the movement of said rod comprising a slot in said rod and a pin extending through said slot and having its ends connected to said cam shaft.

3. In a device of the character described, a drive shaft and a cam shaft having adjacent portions in telescoping relation, a pumping and distributing member adjacent said cam shaft and adapted to be reciprocated thereby, cam means on said cam shaft for effecting such reciprocation of said pumping and distributing member, gear means carried by said cam shaft for effecting rotation of said pumping and distributing member, means between the adjacent portions of said drive shaft and cam shaft for altering the phase relation between said drive shaft and cam means to change the phasing between said drive shaft and plunger without disturbing the relation of said gear means and pumping and distributing member, a pin mounted for sliding movement in said drive shaft and having its opposite ends connected to said means between

adjacent ends in telescoping relation, a pumping and distributing member, said cam shaft having cam means for effecting reciprocation of said pumping and distributing means, gear means carried by said cam shaft for effecting rotation of said pumping and distributing member and means for changing the phase relation between said drive shaft and pumping and distributing member without disturbing the phase relation between said gear means and said pumping and distributing member, said means comprising a helical spline between the adjacent portions of said drive shaft and cam shaft and means for adjusting said spline to vary the phase relation of said drive shaft and cam shaft.

12. In a device of the character described, a drive shaft, a cam shaft, said drive shaft and cam shaft having their adjacent ends in telescoping relation, a pumping and distributing member, said cam shaft having cam means for effecting reciprocation of said pumping and distributing means, gear means carried by said cam shaft for effecting rotation of said pumping and distributing member and means for changing the phase relation between said drive shaft and pumping and distributing member without disturbing the phase relation between said gear means and said pumping and distributing member, said means comprising a helical spline between the adjacent portions of said drive shaft and cam shaft and means for adjusting said spline to vary the phase relation of said drive shaft and cam shaft, an operating lever, and means operatively connected to said spline and actuated by said operating lever for adjusting said spline to vary the phase relation between said drive shaft and cam shaft.

13. In a device of the character described, a drive shaft, a cam shaft, said drive shaft and cam shaft having their adjacent ends in telescoping relation, a pumping and dis-

tributing member, said cam shaft having cam means for effecting reciprocation of said pumping and distributing means, gear means carried by said cam shaft for effecting rotation of said pumping and distributing member and means for changing the phase relation between said drive shaft and pumping and distributing member without disturbing the phase relation between said gear means and said pumping and distributing member, said cam shaft having a portion journaled in a bearing intermediate said cam portion and said gear means.

14. In a device of the character described, a drive shaft, a cam shaft, said drive shaft and cam shaft having their adjacent ends in telescoping relation, a pumping and distributing member, said cam shaft having cam means for effecting reciprocation of said pumping and distributing means, gear means carried by said cam shaft for effecting rotation of said pumping and distributing member and means for changing the phase relation between said drive shaft and pumping and distributing member without disturbing the phase relation between said gear means and said pumping and distributing member, said means comprising a helical spline between the adjacent portions of said drive shaft and cam shaft and means for adjusting said spline to vary the phase relation of said drive shaft and cam shaft, a pin extending through a slot in said drive shaft and connected adjacent its opposite ends to said spline, a plunger positioned in a bore in said drive shaft for urging said pin and spline in one direction, a pump operating shaft, resilient means for urging said pin against said plunger and cam means intermediate said plunger and said pump operating shaft for actuating said plunger and spline upon adjustment of said pump operating shaft.

No references cited.