

[54] FUEL PUMP

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[58] Field of Search..... 417/462, 214, 221

[56]

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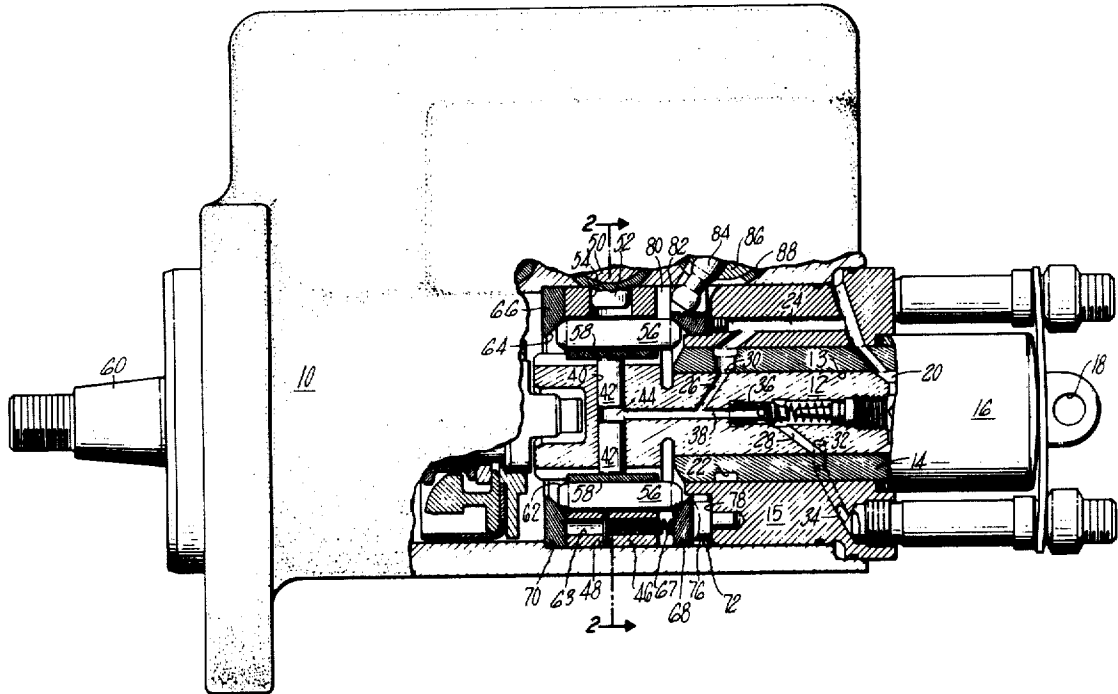
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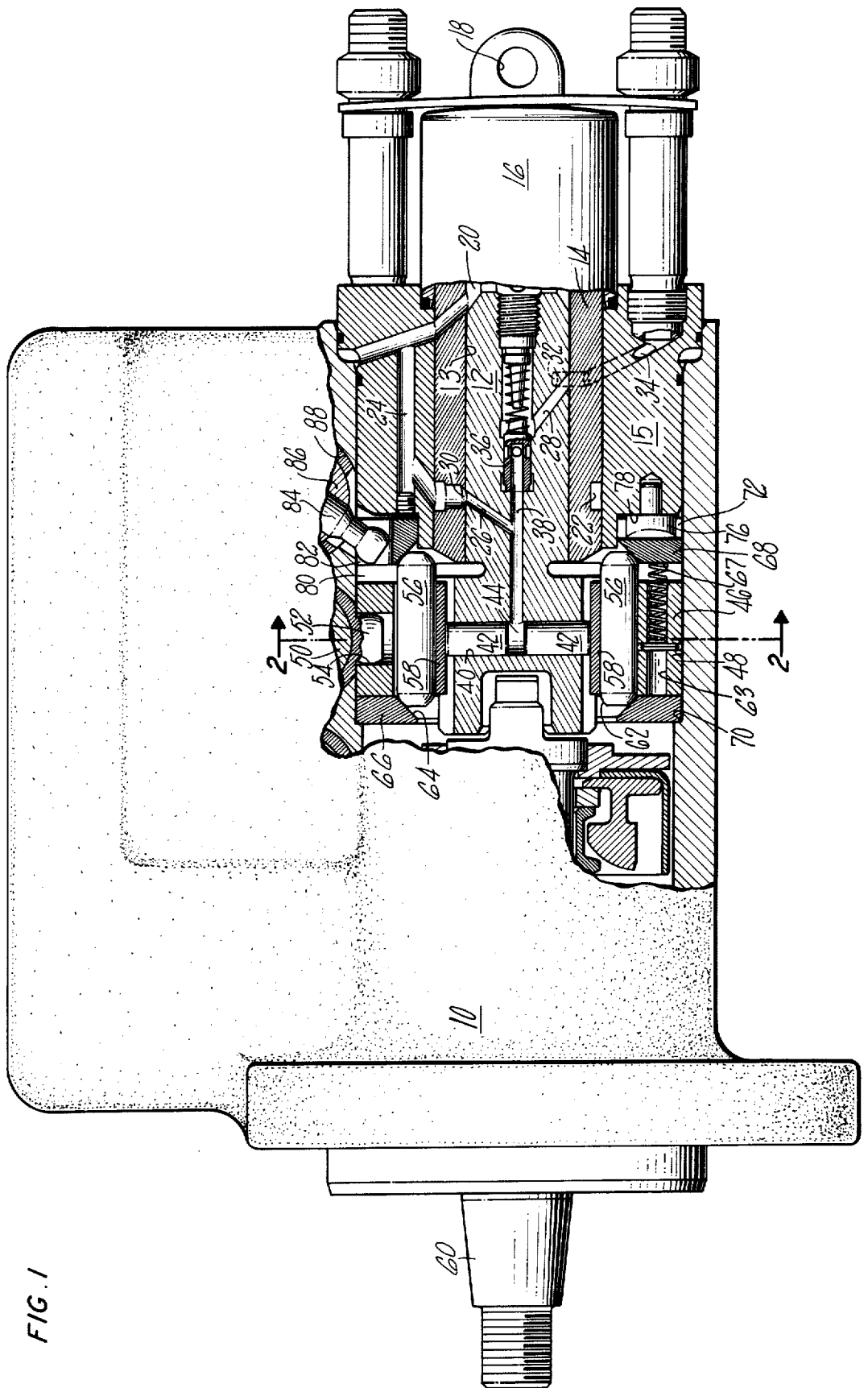
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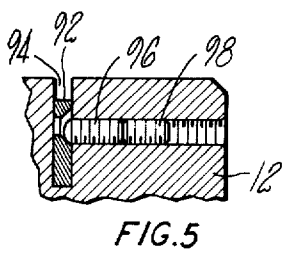
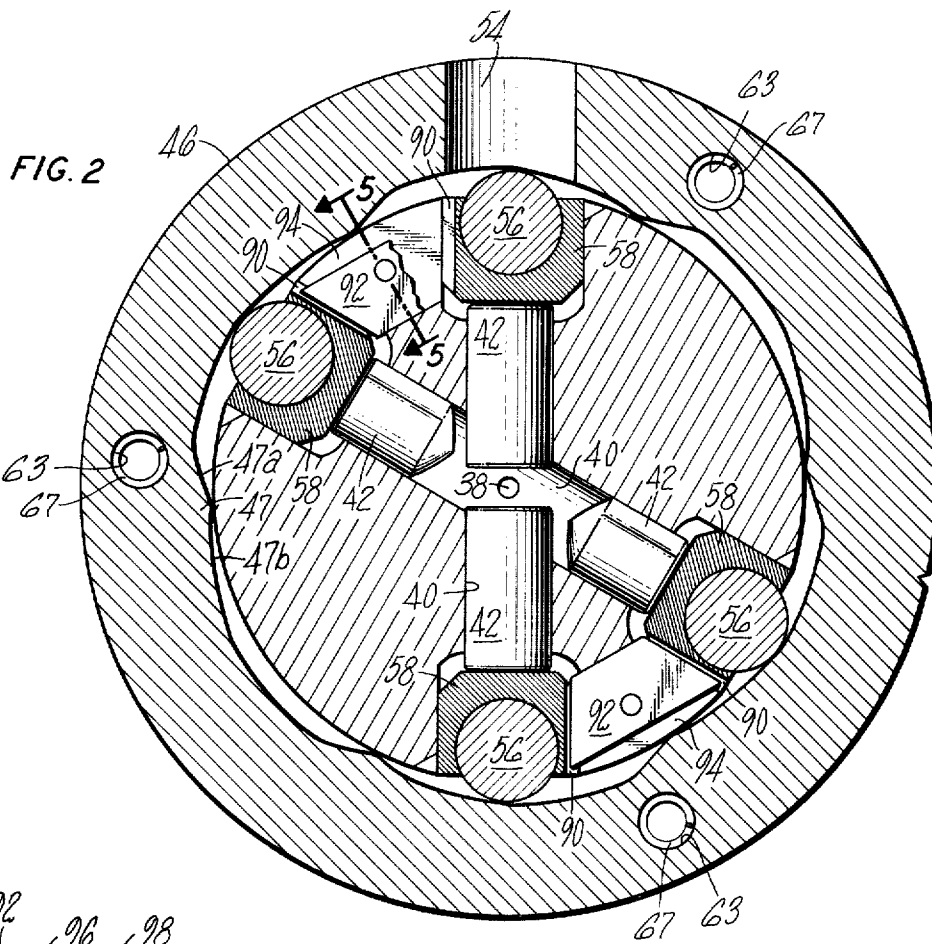
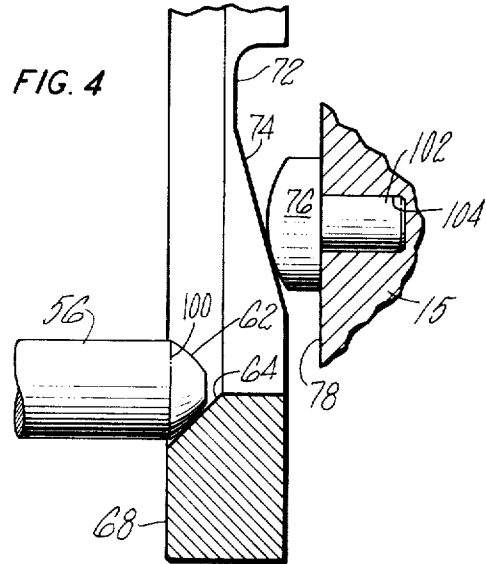
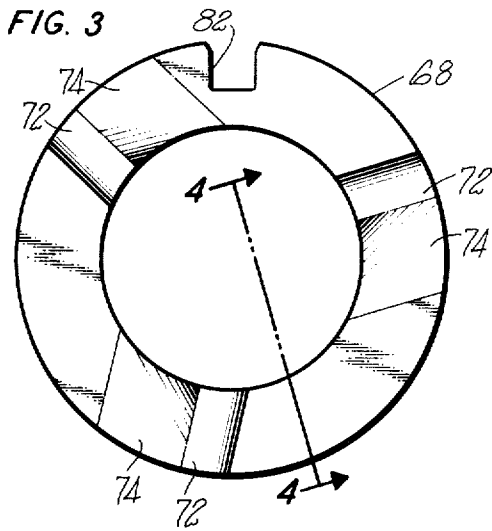
[57] ABSTRACT

The ends of rollers interposed between a cylindrical cam ring and the radial pump plungers of a rotary distributor pump engage a pair of conical rings which move axially toward each other to adjust the outward movement of the plungers and mechanically regulate the amount of fuel injected per pumping stroke.

11 Claims, 5 Drawing Figures







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FUEL PUMP

The present invention relates to fuel pumps employed for supplying discrete measured charges of liquid fuel to an associated internal combustion engine and more particularly to a rotary distributor type pump for an engine of the compression-ignition type.

A principal object of this invention is to provide a new and improved fuel injection pump wherein the measured charges of fuel sequentially delivered to the engine are regulated by the control of the pump plunger travel.

Another object of this invention is to provide an improved fuel injection pump which offers the advantages of easier charging, improved versatility of fuel control under all operating conditions, and a lower manufacturing cost.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

A better understanding of the invention will be obtained from the following detailed description and the accompanying drawings of an illustrative application of the invention.

IN THE DRAWINGS

FIG. 1 is a side elevational view, partly broken away, of a fuel injection pump embodying the present invention;

FIG. 2 is an enlarged cross-sectional view taken along the lines of 2—2 of FIG. 1;

FIG. 3 is an end view of an adjusting cone ring used in the practice of the invention;

FIG. 4 is an enlarged fragmentary view taken along lines 4—4 of FIG. 3 with associated parts added; and

FIG. 5 is a fragmentary sectional view taken along lines 5—5 of FIG. 2.

As disclosed in the figures of the drawing, an exemplary rotary distributor pump of the type commercially used for supplying discrete measured charges of liquid fuel to an associated compression-ignition engine is disclosed for illustrating the invention. The pump includes a housing 10 and a distributor rotor 12 journaled in the bore 13 of a fuel distribution sleeve 14 which is sealed within a bore provided by the hydraulic head 15 within the housing.

Mounted at one end of the rotor 12 to rotate therewith is a low pressure or transfer pump 16 having an inlet 18 to which fuel is supplied from a supply tank (not shown). The outlet 20 of the pump 16 is connected to annulus 22 provided by the sleeve 14 through passage 24.

The rotor 12 is provided with an inlet passage 26 and a discharge passage 28.

As the distributor rotor 12 turns, the inlet passage 26 of the rotor registers sequentially with a plurality of ports 30 (only one of which is shown) uniformly spaced around the periphery of the sleeve 14 in a plane perpendicular to the axis of the rotor to provide communication between the annulus 22 and the passage 26 for supplying fuel to the rotor. The discharge passage 28 similarly communicates sequentially with a plurality of ports 32 (only one of which is shown) uniformly spaced around the sleeve 14 in the plane of rotation of the discharge passage 28. As the rotor turns the discharge passage 28 sequentially discharges fuel pressurized in the rotor to a plurality of delivery passages 34 for sequen-

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tial delivery of the fuel to the cylinders of the associated engine.

A delivery valve 36 located in axial passage 38 of the rotor controls the backflow of pressurized fuel from the discharge passage 28.

The rotor 12 is provided with a plurality of radial passages 40 each of which mounts a plunger 42 for reciprocation therein with the space between the inner ends of the plungers 42 forming a high pressure pump chamber 44 connected to inlet passage 26 and discharge passage 28 by axial passage 38 to alternately receive and discharge fuel as the rotor 12 turns.

Surrounding the plungers 42 in the plane of revolution thereof is a generally circular cam ring 46. The cam ring 46 is mounted in a bore 48 of the housing 10 for limited angular movement and its angular position is controlled by a timing piston 50 operatively connected thereto by a connector 52 which is received in a bore 54 of the cam ring.

As best shown in FIG. 2, cam ring 46 has an inwardly directed surface formed by a plurality of inwardly extending cam lobes 47 which are positioned to actuate the plungers 42 inwardly simultaneously, it being understood that the rollers 56 and the roller shoes 58 are disposed between the plungers 42 and the cam ring 46 so that the rollers act as cam followers for translating the cam contour into the reciprocable movement of the plungers 42.

In operation, as the rotor 12 is driven by the engine through drive shaft 60, fuel under low pressure from the transfer pump 16 is delivered through a port 30 to the rotor inlet passage 26 to the pump chamber 44, it being understood that the rollers 56 are so disposed with respect to the cam lobes 47 to permit the plungers 42 to move outwardly in passages 40 so that fuel can enter chamber 44. As the rotor 12 continues to turn, the inlet passage 26 moves out of registry with port 30 and each roller 56 rolls up the leading surface 47a of a cam lobe 47 to power the plungers inwardly and pressurize the charge of fuel in the pump chamber 44 to a high pressure. At this time the discharge passage 28 has moved into registry with a delivery passage 34 connected to one of the several cylinders of the engine for the injection of the charge of fuel thereto under high pressure.

Continued rotation of the rotor repeats the process for sequential delivery of a charge of fuel to each of the cylinders of the engine in timed relation therewith.

Because of the essentially unrestricted flow of fuel from the transfer pump 16 to the pump chamber 44 during the filling period, the filling of the pump chamber 44 takes place under a positive pressure thereby eliminating any possible fuel vaporization problems that may result when the charge chamber 44 is filled under a reduced pressure.

According to the present invention, positive mechanical means are provided for regulating the quantity of fuel to be injected per pumping stroke without the dumping of any of the fuel pressurized in the pump chamber 44. This is accomplished by the use of a unique mechanical control arrangement which regulates plunger travel to provide the variations in the quantity of the fuel to be injected per pumping stroke.

As shown in FIG. 1, the rollers 56 extend beyond the ends of the roller shoes 58 and the generally conical ends of the rollers are engagable with the inclined generally conical surfaces 64 of cone rings 66 and 68, re-

spectively which are disposed on opposite sides of cam ring 46.

Cone rings 66 and 68 are mounted so as to be relatively axially adjustable. As shown, cone ring 66 is axially fixed in a recess 70 formed in the housing and the mating cone ring 68 is axially adjustable with respect to cone ring 66. As best shown in FIGS. 3 and 4, the radial wall of cone ring 68 opposite the cam ring 46 is provided with a plurality of recesses 72 having equiangularly spaced axially facing inclined surfaces 74 which are engagable with similarly spaced reaction buttons 76 supported by the fixed wall 78 (FIG. 1) of the hydraulic head 15.

The axially adjustable cone ring 68 is spaced from the cam ring 46 by a gap 80 and, as will be readily apparent, the rotation of the adjustable cone ring 68 will shift the point of contact of the reaction buttons 76 and the inclined surfaces 74 to change the distance between cone rings 66 and 68. Both ends of the rollers 56 are supported to control the outward movement of the rollers 56 to provide a stable and precise support to control the stroke of the plungers 42. A plurality of springs 67 received in recesses 63 of cam ring 46 apply a biasing force between cone ring 68 and cam ring 46.

The rotational disposition of cone ring 68 is controlled by a connector 84 received in a notch 82. Connector 84 is operatively driven by a plunger 86 mounted in transverse bore 88. The axial position of the plunger 86 in the bore 88 may be controlled by one or more control mechanisms (not shown) for controlling the operation of the fuel pump. It will be apparent that the plunger 86, by controlling the rotational disposition of the cone ring 68, will control the outward travel of the rollers 56 which will in turn control the movement of the pump plungers 42 and the charge of fuel delivered by the pump during each pumping stroke.

A rotational movement of the cone ring 68 will cause an axial movement of the roller 56 so that both ends of the rollers 56 engage the cone rings 66 and 68, respectively.

In accordance with another aspect of this invention, means are provided for maintaining the roller shoes 58 in a fixed axial position and to maintain the axes of rollers 56 parallel to the axis of the rotor 12 as the rollers 56 engage one or the other of the cone rings 66, 68 during the adjustment of the pumping stroke.

In the illustrated embodiment, the roller shoes 58 are provided with generally radial slots 90 at a mid-point position in a side wall thereof and a trapezoidal shaped guide plate 92 is slidably received therein to limit the movement of the shoes to movement in a radial direction. Peripheral slots 94 are provided in the rotor 12 between adjacent shoes 58 and guide plates 92 are fixed therein by fasteners 96 which are locked in place by lock members 98.

While the grooves 90 and the guide plates 92 are dimensioned for a close sliding fit, it is readily apparent that a minor amount of tilting of the roller shoes 58 relative to the axis of rotor 12, and hence the rollers 56, may take place. The termination of movement of the rollers 56 against the conical surfaces of cone rings 66 and 68 may impose destructive stresses due to the inertia thereof if the contact takes place at the sharp juncture 100 between the conical and the cylindrical surfaces of the rollers 56 engages the cone rings 66, 68. In order to limit such stresses, the generally conical sur-

faces 62 of the rollers are provided with a finite radius of such a curvature as to prevent point contact therebetween despite the presence of some cocking of the rollers 56 relative to the cone rings 66, 68.

As shown in FIG. 4, the reaction buttons 76 are swivelly mounted by cylindrical shanks 102 in axially extending bores 104 and are provided with cylindrical surfaces for engagement with the inclined surfaces 74 of cone ring 68. This construction serves to reduce the stresses which results from the shock impact as the rollers 56 engage the cone rings 66, 68, where the inclined surfaces 74 are generated as a plane surface.

As shown in FIG. 2, the trailing surface 47b of cam lobe 47 has a more gentle slope than the leading surface 47a thereof.

Since outward movement of the rollers 56 is terminated abruptly by engagement with the surfaces 64 of cone rings 66, 68 and the impact forces of the rollers on these surfaces is proportional to the square of velocity of their radial outward movement, the use of a gentle slope on the trailing surface 47b of the cam lobes which limits the rate of outward radial movement of the rollers minimizes the stresses which would otherwise result from the high velocity impact between the rollers 56 of the cone rings 66, 68.

From the foregoing, it is apparent that this invention provides for the precise and positive mechanical control of the measured charges of fuel delivered by each pumping stroke without resort to reduced pressure feeding or the dumping of a portion of the fuel pressurized to high pressure. Moreover, by the simple expedient of controlling the axial spacing of a pair of cone rings by the rotation of one of them, the invention provides versatility of control in a simple and efficient manner.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teachings of the present invention.

I claim:

1. In a fuel pump for an internal combustion engine with a housing having inlet and outlet passages, a fuel distributing rotor journaled in a bore in the housing and having an inlet port and an outlet port which communicate alternately with said inlet and outlet passages during the rotation of said rotor to permit alternate admission and discharge of fuel, plungers slidably mounted in radial passages of said rotor to sequentially pressurize charges of fuel for delivery through said outlet passages, a cam ring surrounding said rotor in the plane of revolution of said plungers and having an inwardly directed contour formed by cam lobes, roller shoes engagable with the ends of said plungers mounting rollers which act as cam followers for translating the cam contour into reciprocable movement of the plungers, and positive mechanical means for regulating the quantity of fuel to be injected per pumping stroke, the improvement wherein said regulating means comprises a pair of cone rings having generally conical inner surfaces engagable with each end of the rollers and means for moving said cone rings axially relatively to each other for adjusting the outward movement of the rollers.

2. The device recited in claim 1 wherein one of said cone rings is provided with axially facing inclined surfaces and the pump includes axially fixed abutments engagable with said inclined surfaces whereby rotation

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of such cone ring moves the ring axially relative to the other cone ring.

3. The device of claim 2 wherein a hydraulically actuated piston is connected to said cone ring for controlling the rotational position thereof in correlation with an operating condition of the engine.

4. The device of claim 2 wherein said abutments comprise a plurality of buttons rotatably mounted in axial recesses of the housing.

5. The device of claim 4 wherein said buttons are provided with generally cylindrical reaction surfaces for engaging with said inclined surfaces.

6. The device of claim 1 wherein the ends of said rollers engagable with said cone rings are generally conical and have a finite radius of curvature.

7. The device of claim 1 wherein said rollers extend axially beyond the ends of said roller shoes.

8. The device of claim 1 wherein guide members

fixed to said rotor are engagable with said shoes to maintain the axis of the rollers parallel to the axis of the distributing rotor.

9. The device of claim 8 wherein said roller shoes provide a generally radial groove for closely and slidably receiving said guide members.

10. The device of claim 9 wherein the rotor is provided with radially extending peripheral slots and said guide members comprise generally trapezoidal plates fixed therein in alignment with the grooves.

11. The device of claim 1 wherein the trailing surfaces of the cam lobes has a more gentle slope than the leading surfaces thereof and the trailing surfaces limit the velocity of movement of the rollers radially outwardly thereby to minimize the impact loading between the rollers and said cone rings.

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