Jan. 20, 1959 B. OXENFART ET AL 2,869,529

INJECTION PUMP ASSEMBLY

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FIG. 1

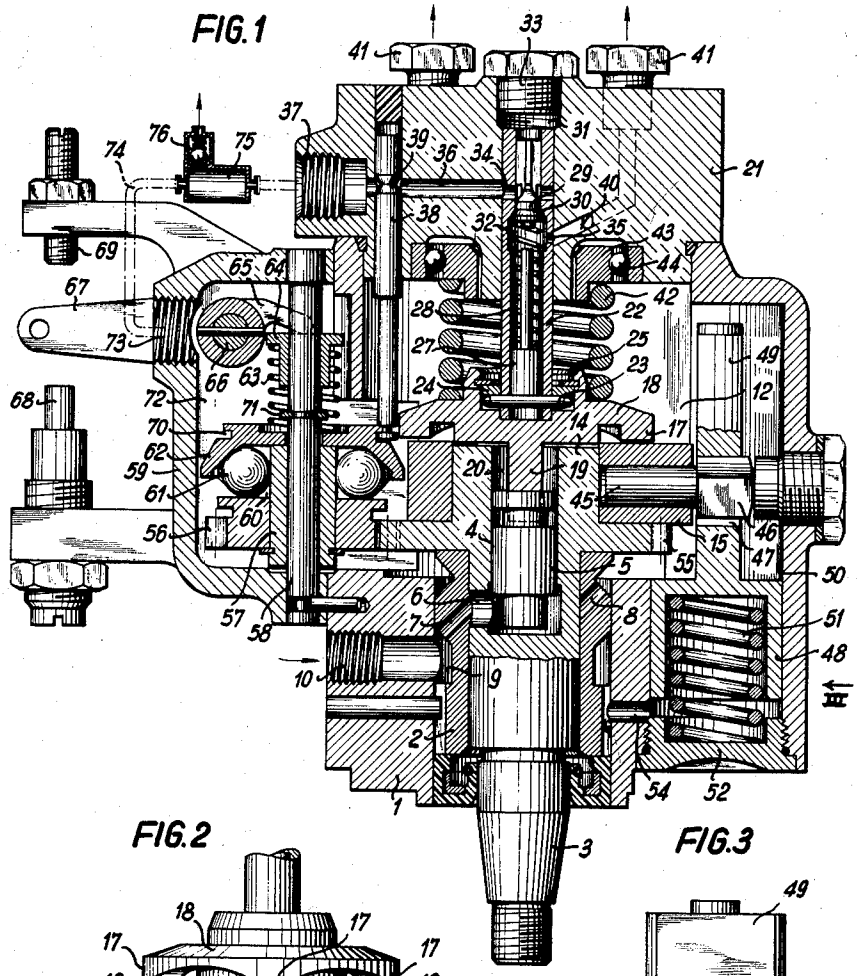


FIG. 2

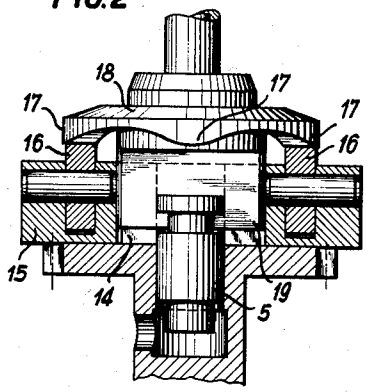
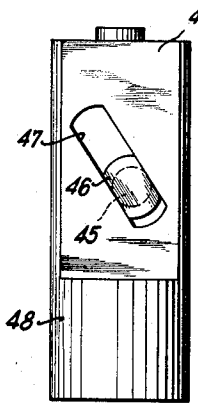


FIG. 3



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INJECTION PUMP ASSEMBLY

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12 Claims. (Cl. 123—140)

The present invention relates to internal combustion engines and more particularly to an injection pump for a multicylinder internal combustion engine and to the cooperation of such an injection pump with a supply pump for supplying fuel to the injection pump, with a governor for regulating the speed of the engine, and with a timer for timing the operation of the injection pump.

One of the objects of the present invention is to provide a single assembly which includes an injection pump and a fuel supply pump therefor.

Another object of the present invention is to provide a single assembly which includes an injection pump, a fuel supply pump therefor, and a timer for the injection pump.

A further object of the present invention is to provide a single assembly which includes an injection pump and a governor.

An additional object of the present invention is to provide a single assembly which includes an injection pump, a fuel supply pump therefor, a timer and a governor.

Still another object of the present invention is to provide an assembly of the above type which is extremely compact, requires in its entirety but little space, and which at the same time is inexpensive to manufacture and very reliable in operation.

Furthermore, it is an object of the present invention to provide an assembly of the above type which has easily removable components, so that these components may be removed and replaced by other components of different sizes, for example.

With the above objects in view the present invention mainly consists of an assembly which includes an injection pump and a supply pump, this assembly including a support means and a drive shaft turnably carried by the support means and forming part of a drive to a distributor of the injection pump, this drive shaft being formed with an axially extending bore which acts as a cylinder of a supply pump for supplying fuel to the injection pump. A piston is slidable in this bore, and a transmission means cooperates with the drive shaft and the piston for reciprocating the latter in the bore during rotation of the drive shaft.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a sectional elevational view of an assembly according to the present invention;

Fig. 2 is a fragmentary partly sectional elevational view showing part of the structure associated with the drive shaft in a plane different from that shown in Fig. 1; and

Fig. 3 is an elevational view of a member responsive to fuel pressure as seen in the direction of the arrow III of Fig. 1.

The structure shown in the drawings is adapted to be used with a four-cylinder engine. Referring to Fig. 1, the housing 1 of the injection pump forms part of a support means for the various elements of the structure of the invention. Thus, the housing 1 carries a bearing sleeve 2 through which the drive shaft 3 extends, so that in this way the drive shaft 3 is supported for rotation about its axis. This drive shaft 3 is formed with an axially extending bore 4 which forms a cylinder of a fuel supply pump, and a piston 5 slides in the bore 4. The drive shaft 3 is formed with a passage 6 communicating with the bore 4 and passing through the wall of the drive shaft 3.

The bearing sleeve 2 is formed with a plurality of inlet openings 7 and outlet openings 8 all of which are located in a common plane normal to the drive shaft axis, and it will be noted that the passage 6 is also located in this plane so that during rotation of the drive shaft 3 the bore 4 will communicate through the passage 6 with the several openings 7 and the several openings 8. Only one opening 7 and one opening 8 are shown in Fig. 1. The openings 7 communicate with an outer annular groove 9 formed in the bearing sleeve 2. This annular groove 9 communicates with a fuel inlet 10 formed in the injection pump housing 1. The outlet openings 8 communicate with the interior space 12 of the hollow housing 1.

The drive shaft 3 is provided with a thickened end portion 14 which is cylindrical and which is formed integral with a gear 55 for a purpose described below. An adjusting ring 15 is freely turnable on end portion 14 of the drive shaft 3 and engages one face of the gear 55, as indicated in Fig. 1. The adjusting ring 15 turnably supports four rollers 16 which are respectively turnable about axes extending radially from the drive shaft axis and which are spaced from each other by 90° (Fig. 2). A cam disc 18 is provided with four camming portions 17 spaced from each other by 90° and cooperating with the rollers 16 in the manner indicated in Fig. 2 for displacing the cam disc 18 axially during the rotation of this cam disc with respect to the rollers 16. Thus, the rollers 16 and the camming portion 17 form a cam means for axially reciprocating the disc 18 during rotation of the latter. The cam disc 18 is integral with a projection 19 of substantially rectangular shape which extends into a correspondingly shaped slot in the end portion 14 of the drive shaft 3, so that the projection 19 connects disc 18 to the drive shaft 3 for rotation therewith while allowing the cam disc 18 to reciprocate axially. As is apparent particularly from Fig. 2 the outer ends of the projection 19 engage the inner periphery of the adjusting ring 15 so that the latter centers the projection 19 and disc 18.

The projection 19 is formed with a cutout of T-shaped configuration extending upwardly from its bottom edge, as viewed in Fig. 2, and an end portion of T-shaped cross section of the piston 5 extends into this T-shaped cutout so that in this way the piston 5 is connected to the projection 19 and disc 18 for reciprocating movement therewith. Thus, the elements 15, 16, 17, 18 and 19 form a transmission means cooperating with the drive shaft 3 and the piston 5 for reciprocating the latter during rotation of the drive shaft.

The injection pump housing 1 has an open top which is closed by the pump body 21 which is formed with a cylindrical bore coaxial with the drive shaft 3 and slidably receiving the injection pump piston 22. The bottom end of the piston 22, as viewed in Fig. 1, extends into a recess formed in the top face of the disc 18 and is connected to the disc 18 for rotation and axial recipro-

cation therewith by a pin 23 which extends transversely through the piston 22 into cutouts in the top face of the disc 18 which correspond in shape to the free ends of the pin 23 so that the latter together with the piston 22 are constrained to rotate with the disc 18. Axial movement of pin 23 and piston 22 with respect to disc 18 is prevented by a washer 24 engaging the top face of the pin 23, as viewed in Fig. 1, and also engaging a snap ring 25 located in an inner annular groove formed in an upwardly extending annular projection of the disc 18.

The injection pump piston 22 is axially bored throughout its entire length and is closed at its end connected to the pin 23 by a stepped pin 27 having an elongated portion extending along the axis of the piston 22 and surrounded by a coil spring 28 which rests at one end against the shoulder intermediate the ends of the stepped pin 27 and at its opposite end against a valve member 29 which is pressed by the spring 28 against a valve seat 30 formed by an inwardly extending annular portion in the interior of the pump piston 22. The valve member 29 has a stem which extends upwardly to a guide fixed to this stem and extending across the interior of the piston 22 into slidable engagement with the inner surface thereof. This guide is, for example, in the form of radially extending fins and does not in any way prevent communication between the valve 29 and the working chamber 31 of the injection pump. In the illustrated closed position of the valve where valve member 29 engages the seat 30, the valve separates the chamber 31 from the chamber 32 in the interior of the piston 22 beneath the valve 29, as viewed in Fig. 1. A plug 33 threaded into the pump body 21 closes the chamber 31 from the outer atmosphere. The wall of the piston 22 is formed just above the valve seat 30 with four openings 34 which are displaced from each other by 90°, and below the valve seat 30 the piston 22 is formed with an opening 35 passing through the wall thereof. The openings 34 act as suction openings and cooperate with an inlet passage 36 which communicates with an inlet opening 37 and which is traversed by a throttling pin 38 slidable in a suitable bore of the pump body 21 and formed with an annular groove 39 which overlaps the passage 36 to a predetermined extent, as will be pointed out below.

The opening 35 in the wall of the pump piston 22 acts as a pressure discharge opening and cooperates with four discharge passages 40 formed in the pump body 21, only one of these passages 40 being shown in the drawing. These four passages 40 all communicate in a common plane with the bore in which the piston 22 slides, and the passages 40 are spaced from each other by 90° at the ends thereof which meet the cylindrical bore which accommodates the piston 22. The passages 40 lead respectively to the outlets 41 which are connected to conduits leading to the several cylinders of the engine, respectively.

A spring 42 is coiled about the piston 22, engages with one end the cam disc 18, and engages with its opposite end the inner race 43 of a ball bearing 44, so that the spring 42 turns with the cam disc 18 and at the same time maintains the camming portions 17 in operative engagement with the rollers 16.

The adjusting ring 15, which forms part of the timing mechanism controlling the moments when fuel is injected into the several cylinders, is formed with a transverse bore which receives a pin 45 having an enlarged head 46 formed with opposed flat side faces which slidably engaged the opposite side faces of a slot 47 formed in an extension 49 of a pressure responsive member 48 (Fig. 3). It will be noted that the slot 47 is inclined to the axis of the member 48. The elongated portion 49 of member 48 is flattened at opposite side faces, and the member 48 itself is in the form of a hollow piston slidable in a bore 50 of the housing 1. It will be noted that the piston 48 slides along an axis parallel to that of the drive shaft 3. The bore 50 communicates with

the interior 12 of the housing 1, so that the piston 48 is responsive to pressure within the housing 1. The pressure of fuel in the interior 12 of the housing acts on the piston 48, and this pressure acting on the piston 48 is opposed by a spring 51 extending into the piston 48 and abutting against a plug 52 which closes the bore 50. The piston 48 has sufficient clearance in the bore 50 to allow fuel to move along the piston 48 to the bore 54 which communicates with the suction side of the fuel supply pump formed by the piston 5 and the cylindrical bore 4 of the drive shaft 3.

As was pointed out above the drive shaft 3 is integral with a gear 55. This gear 55 meshes with a gear 56 carried by a sleeve 57 through which a governor shaft 58 extends, this shaft 58 being parallel to the drive shaft 3 and being fixedly carried by a governor housing portion 59 which is fixed to the housing 1 in such a way that the axes of piston 48, drive shaft 3 and governor shaft 58 all are located in a common plane.

The sleeve 57 fixedly carries at opposite sides thereof four pairs of outwardly extending fins 60, respectively, and between each pair of fins 60 is located a ball 61 which acts as a flyweight of the governor. The ball members 61 act on the frusto-conical inner surface of the annular governor member 62 which is guided by the governor shaft 58 for movement axially along the latter. As is apparent from Fig. 1 with increasing speed of rotation of the gear 56 the ball members 61 will move outwardly away from the axis of shaft 58 to raise the annular governor member 62 along the shaft 58, as viewed in Fig. 1. A spring 63 is coiled about the shaft 58 and bears at one end against member 62 to maintain the latter in engagement with the ball members 61. The spring 63 bears at its opposite end against an outwardly extending annular flange of a sleeve 64 slidable along the shaft 58 which extends through the sleeve 64. The top face of the sleeve 64 engages a lever 65 which is fixed to a shaft 66 extending from the exterior of housing 59 into the latter and turnably supported by the housing 59. Of course, those portions of the housing 59 which receive shaft 66 as well as shaft 58 are sealed in a fluidtight manner to prevent leakage of fuel from the interior 72 of housing 59 which communicates with the interior 12 of housing 1. A lever 67 is fixed to a portion of shaft 66 which is located outside of the housing 59, and this lever 67 is located between a pair of adjustable stops 68 and 69 carried by projections of the housing 59, respectively. The lever 67 serves to adjust the stress of the spring 63 and in this way serves to set the governor for a particular engine speed. Any suitable known control linkage is connected to the lever 67. The governor member 62 is formed with an outer annular groove 70 to provide the member 62 with an outwardly extending annular flange which extends into an annular groove located adjacent the bottom end of throttling pin 38, this bottom end of throttling pin 38 extending into the groove 70, in the manner indicated in Fig. 1, so that the pin 38 participates in the axial movement of the governor member 62. This axial movement of governor member 62 upwardly from the position shown in Fig. 1 is limited by a snap ring 71 located in an annular groove formed in shaft 58.

The housing 59 is formed with a fuel outlet opening 73 which communicates, as shown schematically in Fig. 1, with a conduit 74 leading to the inlet opening 37 of the injection pump. The conduit 74 has a filter 75 built into the same, and the filter 75 communicates with an overflow valve 76 which in turn communicates through a suitable conduit with the fuel tank, so that excess fuel delivered by the fuel supply pump to the conduit 74 will pass through the overflow valve 76 back to the fuel tank.

The above described structure operates in the following manner:

Upon rotation of the drive shaft 3 the cam disc 18 also rotates and is simultaneously reciprocated axially by

cooperation between the rollers 16 and camming portions 17. The piston 5 participates in the axial reciprocation of the cam disc 18. The piston 5 moves through its suction strokes when it moves upwardly, as viewed in Fig. 1, and through its pressure strokes as it moves downwardly, as viewed in Fig. 1. During its suction strokes the piston 5 draws fuel into the cylinder 4 through the passage 6, one of the inlet openings 7, and groove 9 and inlet 10. During each pressure stroke the piston forces fuel out of cylinder 4 through the passage 6 and one of the outlet openings 8 into the interior 12 of the housing, this interior 12 thus acting as a reservoir for fuel under pressure. Of course, the angular positions of the openings 7 and 8 are properly related to rollers 16 and camming portions 17 so that during the suction strokes of the piston 5 the passage 6 communicates with the openings 7 and not with the openings 8 while during the pressure strokes of the piston 5 the passage 6 communicates with the openings 8 and not with the openings 7. Thus, fuel under pressure is located in the interior 12 of housing 1 as well as in the interior 72 of the governor housing 59. The pressure responsive piston member 48 assumes a position determined by the pressure of the fuel, and the axial shifting of member 48 will be transmitted through slot 47 and pin 45 to the adjusting ring 15 to adjust the angular position thereof and thus adjust the angular position of the rollers 16 so that the latter engage the camming portions 17 at a particular time which is automatically regulated in this manner. Thus, elements 48, 45 and 15 form a timer for the injection pump. The fuel flows from the interior 12 of housing 1 into the interior 72 of housing 59 and from the latter to the conduit 74 and filter 75 and finally to the inlet 37 of the injection pump. The excess fuel flows from the overflow valve 76 back to the unillustrated fuel tank which communicates through a conduit (not shown) with the inlet 10 of the fuel supply pump.

From the inlet opening 37 of the injection pump the fuel flows during the suction strokes of piston 22 through the passage 36 and suction openings 34 into the chamber 31. During the pressure strokes of the piston 22 the openings 34 are out of register with the passage 36 and the pressure strokes of the piston 22 cause the fuel trapped in the chamber 31 to open valve 29 against the influence of spring 28, the fuel then moving by the valve member 29 into the chamber 32 of the piston 22. From the chamber 32 the fuel flows through the pressure outlet opening 35 and the particular discharge passage 40 in register therewith to one of the outlets 41 and from the latter to a particular cylinder of the engine.

If the speed of rotation of the engine increases so that the speed of rotation of drive shaft 30 which is driven by the engine also increases, then the amount of fuel supplied by the fuel supply pump 3—5 in a given unit of time is correspondingly greater. Inasmuch as overflow valve 76 acts also as a throttle, the pressure of the fuel in the interior portions 12 and 72 of housings 1 and 59, respectively, increases and thus shifts the pressure responsive piston 48 downwardly, as viewed in Fig. 1. This downward movement of the piston 48 against the influence of spring 51 results in a turning of the ring 15 because of the cooperation of the head 46 of pin 45 with the inclined slot 47, and as a result the supply of fuel by the injection pump and thus the instants when the fuel is injected into the several cylinders of the engine takes place earlier with respect to the positions of the pistons of the engine.

If the speed of the engine increases because of a reduction in the load on the engine, for example, while the position of lever 67 remains unchanged, then the flyweight members 61 move outwardly from the axis of shaft 58 and raise the annular governor member 62 against the influence of the spring 63. The upward movement of member 62, as viewed in Fig. 1, results in upward movement of the throttling pin 38, and as a result the annular groove 39 of the throttling pin 38 overlaps the passage 36 to a smaller extent so that the flow of fuel along the passage 36 to the interior of the injection pump is throttled to a greater extent. Consequently, the injection pump can only suck in and discharge a smaller amount of fuel. Because of the reduction in the fuel delivered under these circumstances to the engine, the engine speed reduces to the speed for which the governor is set.

The above described assembly of an injection pump with a fuel supply pump, with an automatically adjustable timer, and with a governor requires an extremely small space and because of the simple construction of its components is very inexpensive to manufacture.

The governor together with its housing 59 forms a subassembly which can be manufactured separately and then joined to the housing 1. This is of particular advantage because it is in this way possible to exchange one governor subassembly for another without disturbing the remainder of the structure. Also, the pump body 21 together with piston 22, cam disc 18 and spring 42 as well as throttling pin 38 form a separate subassembly joined to the housing 1 and capable, when necessary, of being easily exchanged for another subassembly.

As is apparent from Fig. 3, the axial shifting of the pressure responsive piston 48 will turn the adjusting ring 15 through a relatively small angle, and the left portion of the ring 15, as viewed in Fig. 1, is cut away through a sufficient distance to allow the governor member 62 to rotate freely at all angular positions of the ring 15.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of combined injection pumps and fuel supply pumps therefor differing from the types described above.

While the invention has been illustrated and described as embodied in assemblies including an injection pump, a fuel supply pump, a timer and a governor, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a pump, in combination, support means; a drive shaft turnably carried by said support means and being formed with an axially extending bore which acts as the cylinder of the pump; a piston slidable in said bore; and transmission means cooperating with said drive shaft and piston for reciprocating the latter in said bore during rotation of said drive shaft.

2. In a pump, in combination, support means; a drive shaft turnably carried by said support means and being formed with an axially extending bore which acts as a cylinder of the pump; a piston slidable in said bore; cam means and follower means, one of said means being connected to said drive shaft for rotation therewith and for axial movement with respect to the same and the other of said means cooperating with said one means for reciprocating the latter axially during rotation of said one means with said drive shaft; and means connecting said one means and piston together for axial movement together, so that said piston reciprocates in said bore.

3. In a pump, in combination, support means; a drive shaft turnably carried by said support means and being formed with an axially extending bore which acts as a

cylinder of the pump; a piston slidable in said bore; transmission means cooperating with said drive shaft and piston for reciprocating the latter in said bore during rotation of said drive shaft; and means controlled by rotation of said drive shaft with respect to said support means for regulating the flow of liquid into and the discharge of liquid from said bore.

4. In a pump, in combination, a bearing sleeve having a pair of wall portions located in a common plane normal to the sleeve axis formed respectively with an inlet opening and an outlet opening; a drive shaft extending through and turnably supported by said sleeve and being formed with an axially extending bore which acts as the cylinder of the pump, and said drive shaft being formed with a passage communicating with said bore and extending through a wall portion of said drive shaft, said passage being located in said plane so that during rotation of said drive shaft said bore communicates through said passage with said inlet opening in one angular position of said drive shaft and with said outlet opening in another angular position of said drive shaft; a piston slidable in said bore; and transmission means cooperating with said drive shaft and piston for reciprocating the latter during rotation of said drive shaft and for moving said piston along its suction stroke when said passage communicates with said inlet opening and along its pressure stroke when said passage communicates with said outlet opening.

5. In an assembly which includes an injection pump, a governor, and a timer for the injection pump, in combination, support means; an injection pump drive shaft rotatably carried by said support means; a governor shaft carried by said support means for shiftably supporting a governor member which shifts along said governor shaft in response to a change in the speed of rotation of said injection pump drive shaft; and a fuel pressure responsive member shiftably carried by said support means for movement along a given axis to regulate a timer for the injection pump, said latter axis and the axes of said drive shaft and governor shaft all being located in a common plane, and all being parallel to each other.

6. In a pump, in combination, a bearing sleeve formed with an inlet opening and an outlet opening extending through said sleeve transversely to the axis thereof; a drive shaft extending through and turnably supported by said sleeve and being formed with an axially extending bore which acts as a cylinder of the pump, and said drive shaft being formed with passage means communicating with said bore and extending to the exterior of said drive shaft, said passage means communicating with said inlet opening in one angular position of said drive shaft and with said outlet opening in another angular position of said drive shaft so that during rotation of said drive shaft the bore therein alternately communicates with said inlet opening and said outlet opening; a piston slidable in said bore; and transmission means cooperating with said drive shaft and piston for reciprocating the latter during rotation of said drive shaft and for moving said piston along its suction stroke when said passage means communicates with said inlet opening and along its pressure stroke when said passage means communicates with said outlet opening.

7. In a pump arrangement, in combination, a support; a drive shaft turnably carried by said support and being formed with a bore acting as a pump cylinder and extending in axial direction away from an end face of said drive shaft; cylinder means arranged co-axially with said drive shaft beyond said end face thereof; piston means arranged in said cylinder means, said cylinder means and piston means being slidable relative to each other in axial direction thereof and one of said means being carried by said support; a piston slidable in said bore and connected to the other of said means for simultaneous movement in axial direction so that said piston and said other means extend in opposite direction and form one reciprocatable unit; and means for reciprocating said unit during rotation of said drive shaft.

8. In a pump arrangement, in combination, a support; a drive shaft turnably carried by said support and being formed with a bore acting as a pump cylinder and extending in axial direction away from an end face of said drive shaft; cylinder means arranged co-axially with said drive shaft beyond said end face thereof; piston means arranged in said cylinder means, said cylinder means and piston means being slidable relative to each other in axial direction thereof and one of said means being carried by said support; a piston slidable in said bore and connected to the other of said means for simultaneous movement in axial direction so that said piston and said other means extend in opposite direction and form one reciprocatable unit; and means actuated by rotation of said drive shaft for reciprocating said unit during rotation of said drive shaft.

9. In a pump arrangement, in combination, a support; a drive shaft turnably carried by said support and being formed with a bore acting as a pump cylinder and extending in axial direction away from an end face of said drive shaft; cylinder means arranged co-axially with said drive shaft beyond said end face thereof; piston means arranged in said cylinder means, said cylinder means and piston means being slidable relative to each other in axial direction thereof and said cylinder means being carried by said support; a piston slidable in said bore and connected to said piston means for simultaneous movement in axial direction so that said piston and said piston means extend in opposite direction and form one reciprocatable unit; and means actuated by rotation of said drive shaft for reciprocating said unit during rotation of said drive shaft.

10. In a pump arrangement, in combination, a support; a drive shaft turnably carried by said support and being formed with a bore acting as a pump cylinder and extending in axial direction away from an end face of said drive shaft; cylinder means arranged co-axially with said drive shaft beyond said end face thereof; piston means arranged in said cylinder means, said cylinder means and piston means being slidable relative to each other in axial direction thereof and said cylinder means being carried by said support; a piston slidable in said bore and connected to said piston means for simultaneous movement in axial direction so that said piston and said piston means extend in opposite directions and form one reciprocatable unit; and means actuated by rotation of said drive shaft and located between said piston and said piston means for reciprocating said unit during rotation of said drive shaft.

11. In a pump arrangement, in combination, a support; a drive shaft turnably carried by said support and being formed with a bore acting as a pump cylinder and extending in axial direction away from an end face of said drive shaft; cylinder means arranged co-axially with said drive shaft beyond said end face thereof; piston means arranged in said cylinder means, said cylinder means and piston means being slidable relative to each other in axial direction thereof and one of said means being carried by said support; a piston slidable in said bore and connected to the other of said means for simultaneous movement in axial direction so that said piston and said other means extend in opposite direction and form one reciprocatable unit; means for reciprocating said unit during rotation of said drive shaft; and means controlled by rotation of said drive shaft for regulating the flow of liquid into and the discharge of liquid from said bore.

12. In a combined injection pump and supply pump therefor, in combination, a support; a bearing sleeve fixed to said support and being formed with an inlet opening and an outlet opening extending through said sleeve transversely to the axis thereof; a drive shaft extending through and turnably supported by said sleeve and being formed with a bore acting as cylinder of the supply pump and extending in axial direction away from an end face of

said drive shaft, said drive shaft being formed with passage means communicating with said bore and extending to the exterior of said drive shaft, said passage means communicating with said inlet opening in one angular position of said drive shaft and with said outlet opening in another angular position of said drive shaft so that during rotation of said drive shaft the bore therein alternately communicates with said inlet opening and said outlet opening; cylinder means carried by said support and being arranged co-axially with said drive shaft beyond said end face thereof; piston means arranged in said cylinder means and being slidable relative thereto in axial direction thereof; a piston slidable in said bore and connected to said piston means for simultaneous movement in axial direction so that said piston and said piston means extend in opposite directions and form one reciprocatable unit; and means cooperating with said drive shaft for reciprocating said unit during rotation of said drive shaft and for moving said piston along its suction stroke when said passage means communicates with said inlet opening and along its pressure stroke when said passage means communicates with said outlet opening.

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