Oct. 21, 1947. D. J. DESCHAMPS 2,429,403

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Filed Sept. 30, 1941 6 Sheets-Sheet 1

Fig. 3.

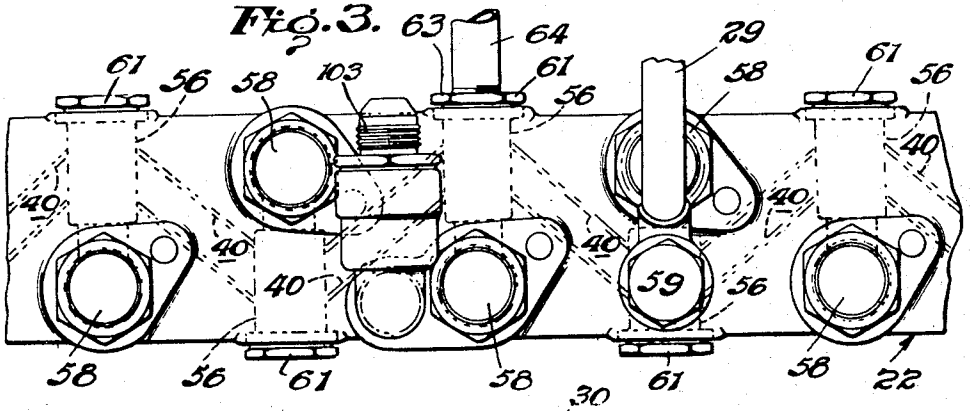


Fig. 1.

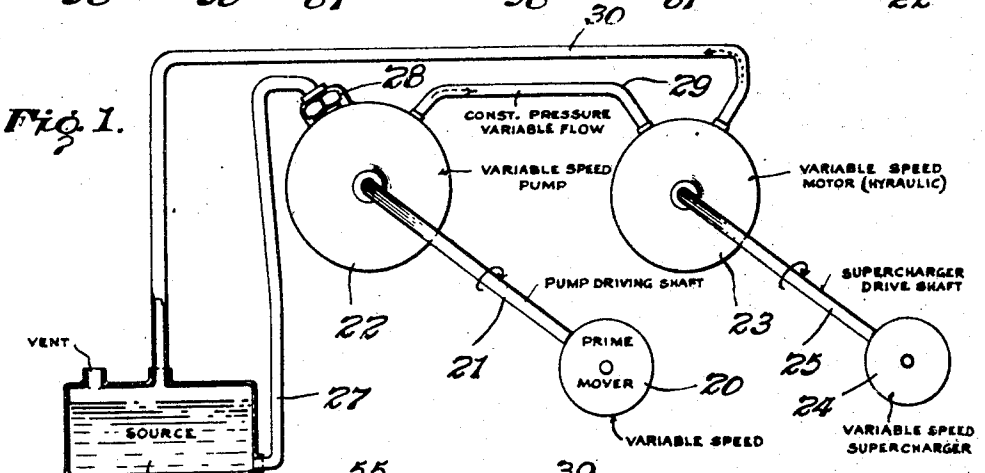
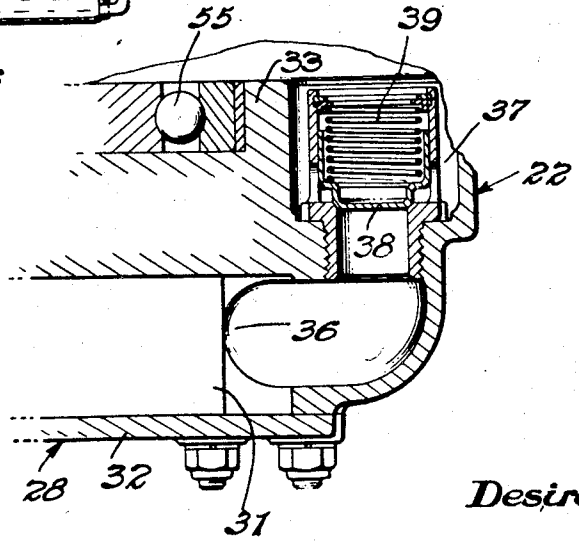


Fig. 7.



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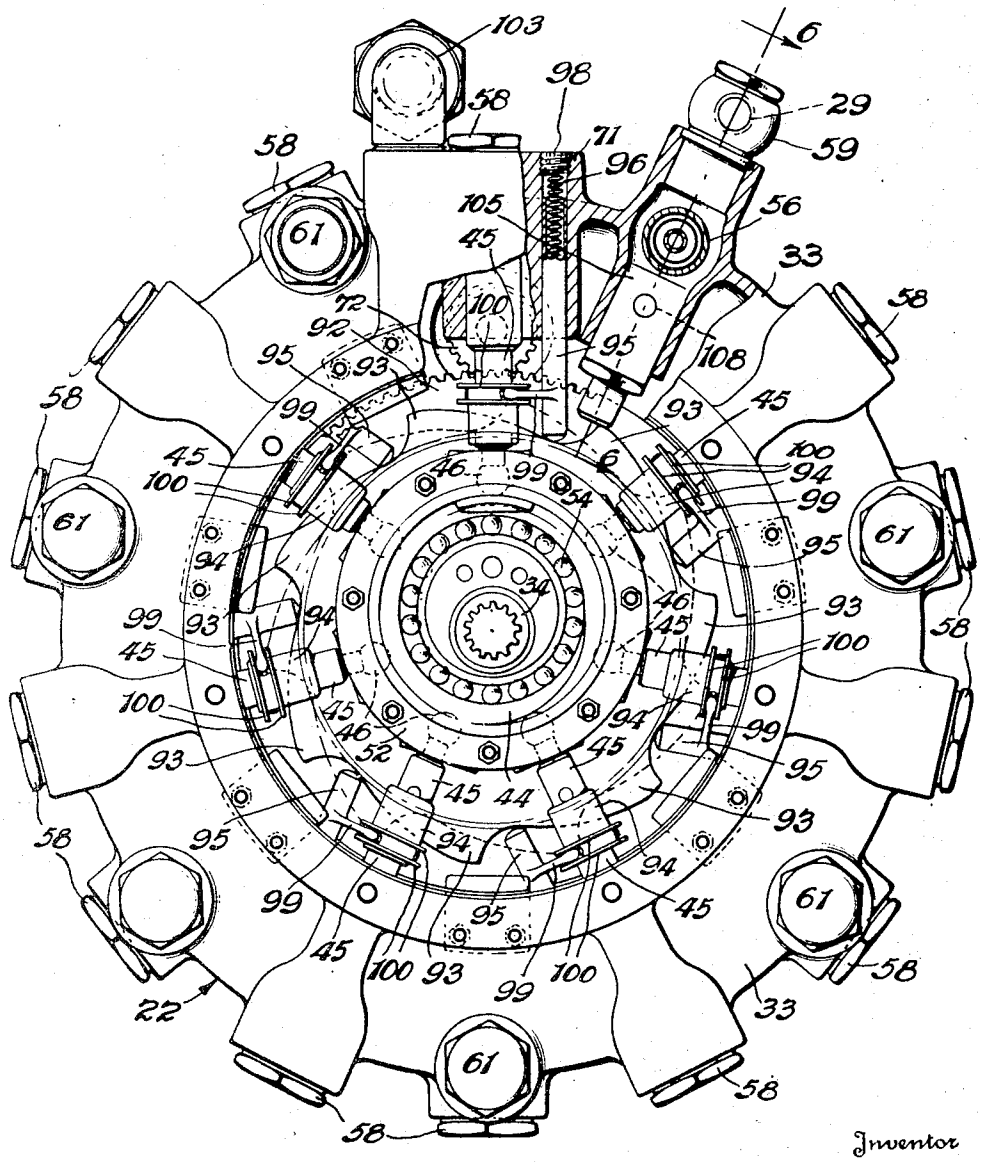
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Oct. 21, 1947. D. J. DESCHAMPS 2,429,403

PUMP

Filed Sept. 30, 1941 6 Sheets-Sheet 2

Fig. 2.



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Oct. 21, 1947. D. J. DESCHAMPS 2,429,403

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Filed Sept. 30, 1941 6 Sheets-Sheet 3

Fig. 4.

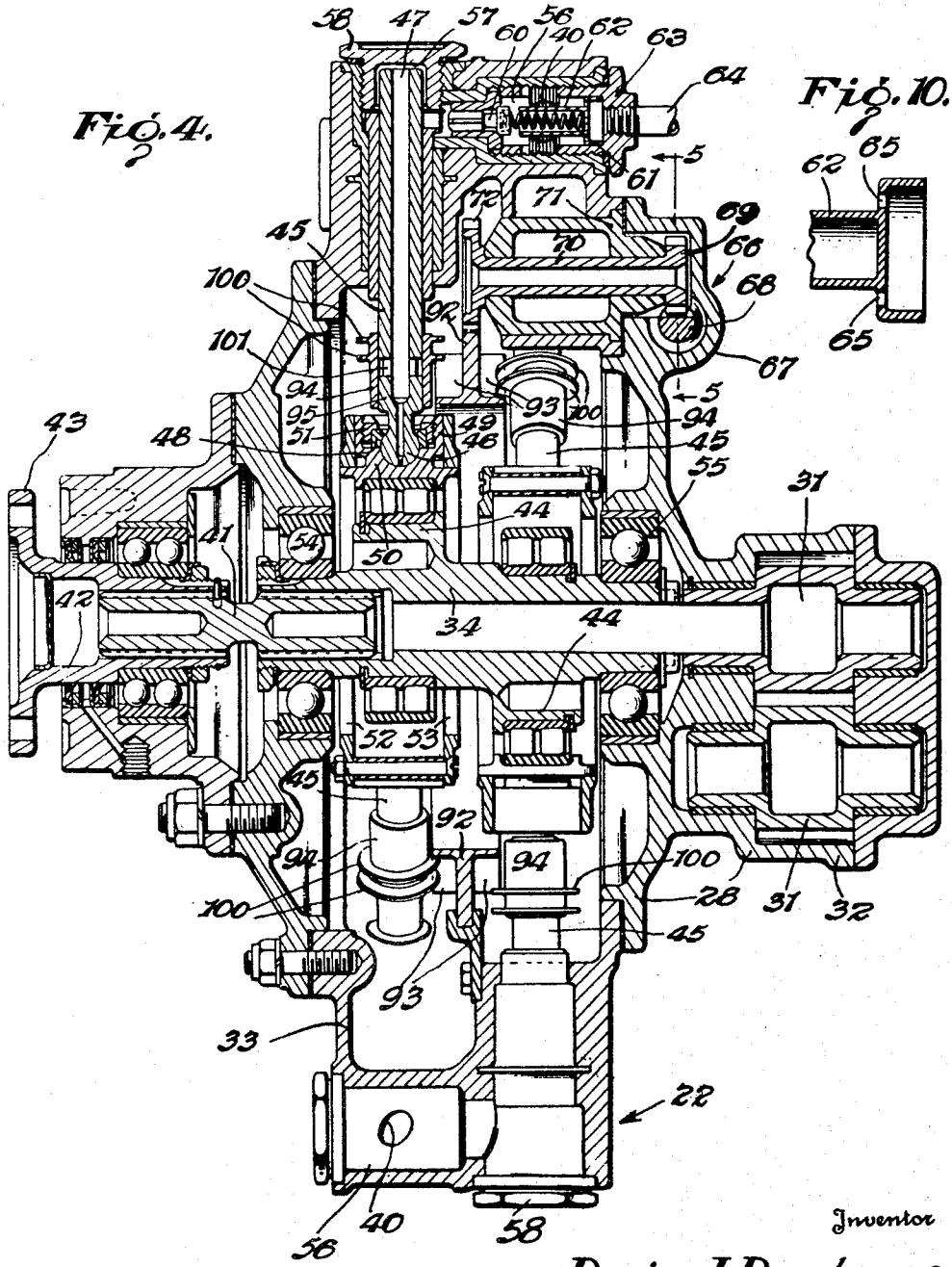


Fig. 10.

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Oct. 21, 1947. D. J. DESCHAMPS 2,429,403

PUMP

Filed Sept. 30, 1941 6 Sheets-Sheet 4

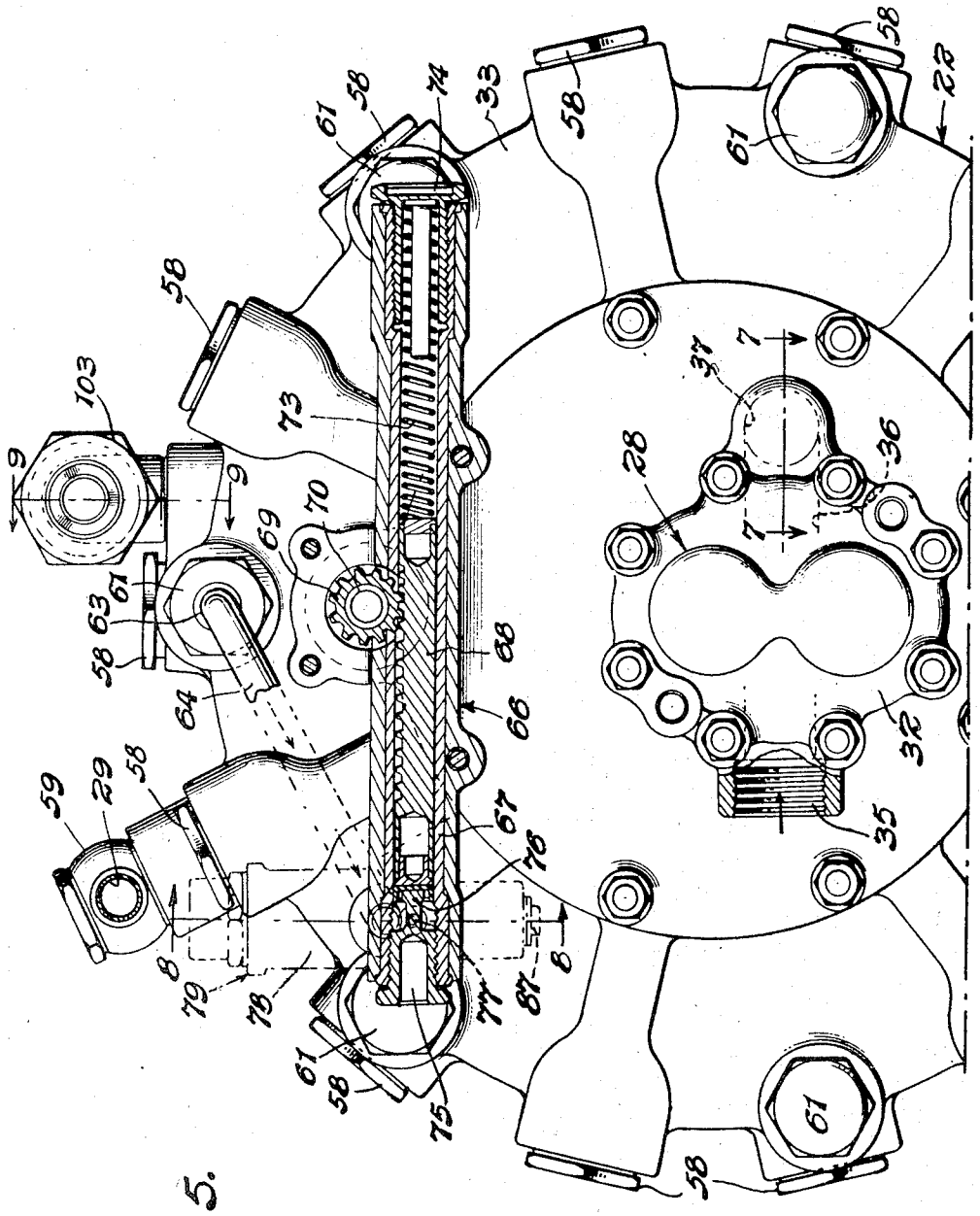


Fig. 5.

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Oct. 21, 1947. D. J. DESCHAMPS 2,429,403

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Filed Sept. 30, 1941 6 Sheets-Sheet 5

Fig. 6.

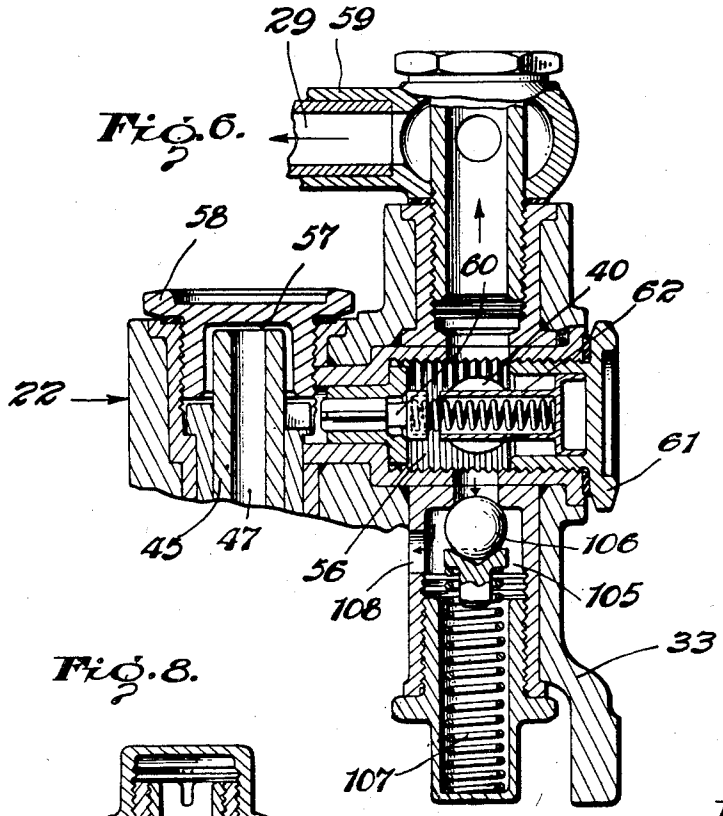


Fig. 8.

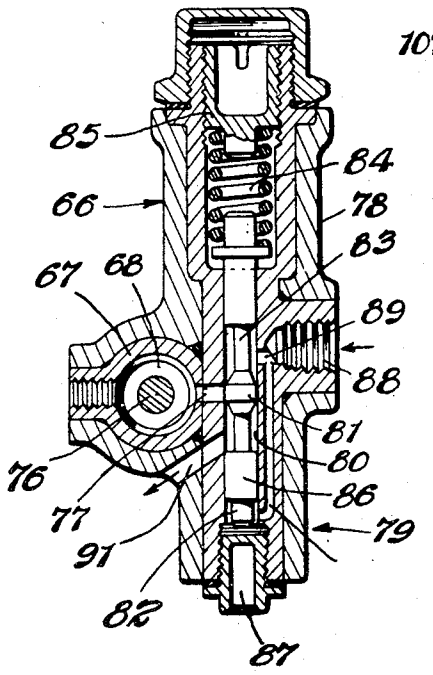
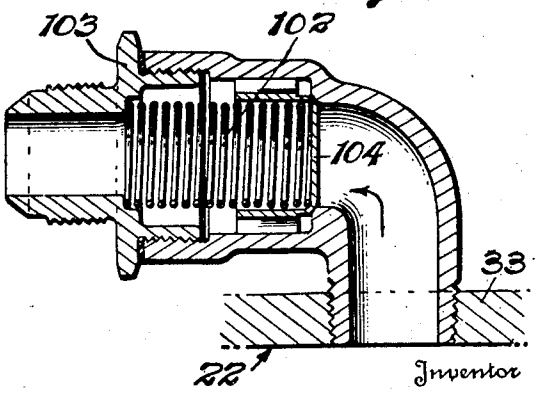


Fig. 9.



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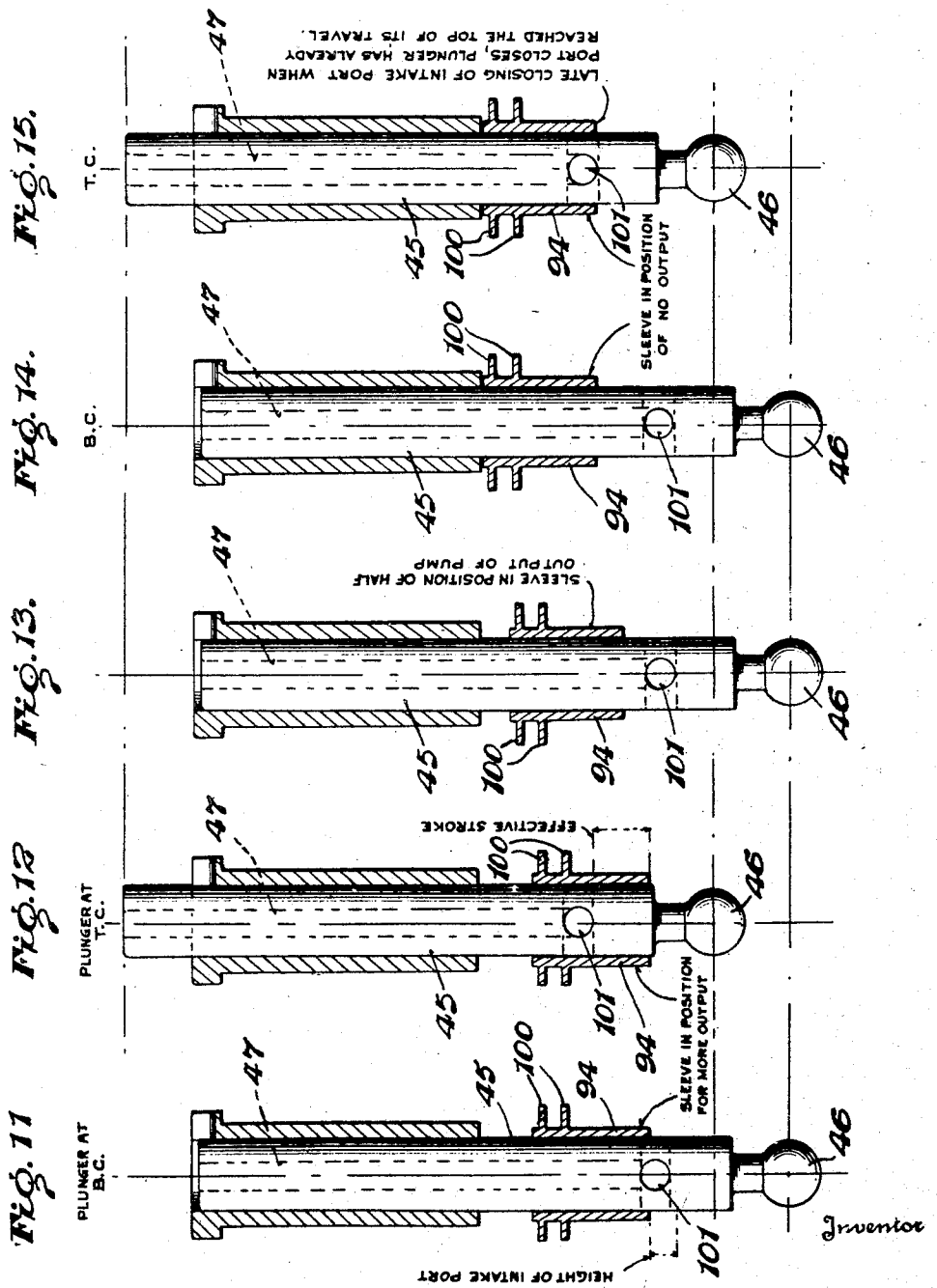
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Application September 30, 1941, Serial No. 413,055

6 Claims. (Cl. 103—41)

1

This invention relates to hydraulic systems, and particularly to pumps utilized in conjunction therewith.

One of the objects of the present invention is to provide a pump capable of being utilized in a system wherein a supercharger is employed to supply breathable air to the occupants of a closed aircraft compartment or cabin, the pump serving to operate a variable speed device for driving the supercharger in a manner that the speed of the supercharger will be sufficiently high to prevent depletion of the air supply below the minimum necessary for the breathing requirements of the occupants.

Another object of the invention is to provide a hydraulic pump of novel construction, which novel construction renders said pump desirable for use in a system of the character indicated, as well as in other applications.

These and other objects of the invention will become apparent from an inspection of the following specification when read with reference to the accompanying drawings wherein is illustrated the preferred embodiment of the invention. It is to be expressly understood, however, that the drawings are for the purpose of illustration only, and are not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawings:

Fig. 1 is a schematic diagram of a hydraulic system having my novel type of pump employed therein;

Fig. 2 is an end view of a pump constituting one of the units of the system diagrammatically shown in Fig. 1, certain of the parts being in section and with the end plate removed;

Fig. 3 is a fragmentary plan view of the pump shown in Fig. 2;

Fig. 4 is a longitudinal sectional view of the pump;

Fig. 5 is a sectional view taken along the line 5—5 of Fig. 4;

Fig. 6 is a transverse sectional view taken on the line 6—6 of Fig. 2 and showing the excess high pressure relief valve;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 5;

Fig. 8 is a transverse sectional view taken on the line 8—8 of Fig. 5 and showing the valve mechanism for feeding fluid to and from the pressure regulating plunger shown in section in Fig. 5;

Fig. 9 is a sectional view taken along line 9—9 of Fig. 5, showing a second, or low pressure, relief valve.

2

Fig. 10 is a detail section of one of the retainers;

Figs. 11 to 15, inclusive, show the effect, upon the plunger output per stroke, of the shifting of the plunger sleeves from one position to another, by the cams, under the influence of the automatic fluid pressure responsive mechanism.

Referring to Fig. 1, there is shown diagrammatically at 20 a variable speed prime mover which may be an internal combustion engine from which power may be taken by any suitable power take-off, a diagrammatic illustration of which is shown at 21 in the form of a shaft adapted to drive a variable speed, high pressure pump 22, shown in more detail in Figs. 2 to 14 inclusive. At 23 is shown a variable speed hydraulic motor, while at 24 there is shown a unit such as an aircraft cabin supercharger adapted to be driven at variable speed by the motor 23 through the agency of mechanical connections of which a diagrammatic illustration is shown at 25. A source of fluid is indicated at 26 and a conduit 27 is provided by which fluid may be drawn from said source 26 into a low pressure or booster pump 28 and subsequently delivered, by the high pressure pump 22, to the motor 23 at a pressure which is controlled so that it will not exceed a predetermined maximum. Delivery to the motor 23, from the pump 22, is by way of a conduit 29, after which the fluid may return to the source 26 by way of a conduit 30.

The low pressure pump 28 is of the gear type provided with a pair of intermeshing gears 31 rotatably mounted in a housing 32 forming part of the casing 33 of the pump 22, the driving gear of the pair being connected for operation to a shaft 34 of the pump 22. Fluid, from the source 26, is introduced into the housing 32 through an intake port 35 and pumped through an outlet port 36 in said housing 32 into the interior of the pump 22 by way of an inlet passage 37 of the casing 33, the inlet passage 37 having disposed therein a check valve 38 which is held open by the pressure of the fluid flowing through the outlet port 36 into the pump 22 so long as the gears 31 rotate; but upon cessation of rotation of the gears 31, a light spring 39 recloses the valve 38 thus preventing loss of fluid by drainage from the interior of the pump 22 when the latter is idle.

As illustrated in the drawings, the casing 33 of the pump 22 is provided with a plurality of zigzag channels 40 through which fluid is discharged from said pump 22 in a manner hereinafter made apparent. The central shaft 34 of the pump 22 is rotated by an intermediate shaft

41 which is splined to the shaft 34 at one end and to a coupling element 42 at the other end; the coupling element 42 is provided with a flange 43 to receive a complementary flange (not shown) which may be part of the driving connections from the prime mover which are diagrammatically indicated at 21 in Fig. 1.

The shaft 34 has two axially spaced eccentric portions 44 for the actuation of two rows of radial plungers 45. Each plunger 45 terminates at its inner end in a ball head 46 and is formed with a fluid outlet bore 47 opened at its outer end. Each ball head 46 of each row is held between the segments 48 and 49 of a ball receiving shoe 50 and which are secured together by a nut 51 threaded into the segment 49; the several shoes being retained by laterally arranged rings 52 and 53; corresponding in function to rings 11 and 12 of the Gordon et al., Patent No. 2,229,804 granted January 28, 1941. Such rings are shown as forming parts of the two roller bearing assemblies 54 and 55 which surround the two axially spaced eccentric portions 44 above referred to.

The casing 33 of the pump 22, interjacent the channels 40, is provided with valve chambers 56 each of which communicates with a pair of the channels 40 and with a plunger chamber 57 which receives the outer end of the respective plunger 45 and into which fluid from the bore 47 of the plunger is pumped, the chamber 57 being closed to the atmosphere by a cap 58. One of the valve chambers 56 has connected thereto a fluid outlet fitting 59 with which the conduit 29 communicates. Each of the valve chambers 56 has disposed therein a spring biased check valve 60 for controlling the passage of fluid from the plunger chamber 57 into the valve chamber 56. Plugs 61 are threaded into the chambers 56 to seal spring retainers 62 therein and to hold them in position, one of the plugs constituting a pipe terminal 63 having threaded therein the end of a pipe 64. As illustrated in Fig. 10, the retainer held by the terminal 63 is apertured at 65 to permit fluid from the valve chamber 56 to enter the pipe 64 for a purpose hereinafter made apparent.

In order to provide for control pressure in the conduit 29 leading to the motor 23, notwithstanding variations in the speed of rotation of the pump 22, the pump 22 is provided with a fluid pressure responsive mechanism 66 for varying the effective length of the work-stroke of the several plungers 45 of the pump, and thus varying the amount of fluid pumped during each revolution of the pump. As shown, the fluid pressure responsive mechanism 66 is carried by the casing 33 and comprises a cylinder 67 in which is mounted a reciprocable plunger 68 having teeth which are in constant mesh with a pinion 69 formed on one end of a hollow shaft 70 rotatably supported in a section 71 of the casing 33 and which shaft terminates at its other end in a pinion 72.

One end of the plunger 68 engages a spring 73, the tension of which is adjustable by means of a member 74 threaded into one end of the cylinder to control the working value of the plunger 68. The opposite end of the cylinder is closed by a plug 75 having a diametrically reduced inner end portion 76 engaging the opposite end of the plunger to limit its movement towards the plug 75 and to provide for the admittance of fluid into the cylinder from a lateral port 77 formed in the cylinder confronting relation with the portion 76.

The cylinder has formed therewith the casing 78 of a control valve 79 having an outlet passage constituting the port 77 and which casing 78 is provided with a longitudinally extending bore 80 in which is slidably mounted a pilot valve member 81 for controlling the passage 77. The member 81 is provided on its end with valve stems 82 and 83 and with the latter stem being engaged by a spring 84, the tension of which is manually adjustable by a plug 85 threaded into one end of the casing 78. The valve stem 82 is formed with a collar adjacent its free end and which constitutes a valve member 86 for controlling the passage of fluid in the bore. The free end of the stem 82 is adapted to engage a plug 87 threaded in the opposite end of the casing to limit the movement of the valve members 81 and 86. The casing 78 is provided with an inlet opening 88 in which is threaded the opposite end of the pipe 64, the latter communicating with an inlet port 89. The port 89 communicates with the bore 80 on one side of the valve member 81 and with a longitudinally extending branch 90 communicating with the bore 80 between the member 86 and the plug 87 on the opposite side of the valve member 81.

The casing 78, between the passage 77 and the plug 87, is provided with an exhaust port 91 from the bore 80 for returning fluid to the interior of the pump 22. When the working pressure of the fluid introduced into the valve 79 by way of pipe 64 varies with respect to a predetermined value, the pilot valve member 81 is operated either to permit discharging of fluid through port 91 or to admit fluid to the cylinder through port 89 and passage 77 as the case may be, whereby the plunger 68 is operated to effect actuation of the pinion 72. The pinion 72 is in constant mesh with a relatively large diameter spur gear 92 having two circular rows of cam surfaces formed therein and which surfaces are provided with cams 93 corresponding in number to the number of plungers 45 to be actuated and—like the plungers 45—the cams 93 are evenly spaced in the two circular rows extending about the circumference of the pump.

Adjacent their heads 46, the plungers 45 are provided with sleeves 94, the operating connections between the cam 93 and the sleeves 94 include a corresponding number of cam actuated rods 95 tracking the cams 93 and against which they are resiliently urged by springs 96, the latter being adjustably positioned in their respective sockets 97, and retained by adjustable nuts 98. Each rod 95 has an arm or yoke 99 having operative engagement with a pair of collars 100 formed as an integral part of each plunger sleeve 94, wherefore the positions of the cam actuated rods 95 determine the positions of the plunger sleeves 94 and thus control the rate of delivery of fluid under pressure (per stroke) to the outlet conduit 29 wherefore the delivery pressure is held to a controlled value, as determined by the setting of spring 73 of the pressure regulating assembly.

The reason why the position of each plunger sleeve 94 controls the rate of fluid delivery (per stroke) of its associated plunger 45 will now be explained. It will be observed that each plunger 45 is, as heretofore described, centrally bored as at 47 and is also laterally slotted as at 101; these lateral slots 101 constituting the entrance ports for the fluid to be pumped. However, the sleeves 94 cover these ports 101 during a portion of each stroke, and the extent of such coverage will of course, vary, as depicted in Figs. 11

to 15 with each shift of the sleeves 94 by the action of the cams 93 and the rods 95. Thus is controlled the volume of fluid taken in (pumped) through the inlet ports 101 of the several plungers. The fluid pumped through ports 101 and plunger bores 47 is delivered to the outlet conduit 29 by way of the check valves 60 and then enters the motor 23 for operating the latter.

Fluid exhausted through the port 91 of the control valve 79 enters the interior of the pump 22 to unite the low pressure fluid supply therein, the interior pressure of the pump 22 being only that which is developed by the operation of booster pump 28. This interior pressure is held low by the setting of a spring 102 of a relief valve 103 yields to permit the valve member 104 thereof to open and surplus fluid to return to the source 26 whenever the interior pressure becomes great enough to open the valve 103. This may occur, for example, in the event of an opening of the high pressure safety valve 105 in which its ball valve member 106 is normally held closed by spring 107, communicating with one of the valve chambers 56 and which spring is set at the desired high pressure output rating. The valve 105, when it opens, discharges fluid into the interior of pump 22 through the port 108 and thus may cause an opening of valve 103.

From the foregoing, it will be understood that fluid is pumped into the interior of the high pressure pump 22, from the source 26, by the low pressure pump 28, and from the interior of the pump 22, by the plungers 45, through the ports 101 and the bores 47 of the plungers, the chambers 57 and 56, channels 40 and thence from one of the chambers 56 to the motor 23 by way of the fitting 58 and conduit 29; fluid also being conducted from one of the chambers 56 to the pressure responsive mechanism 66 through the pipe 64.

As fluid is delivered to the motor 23 at a constant pressure, by reason of the pressure responsive mechanism 66 of the pump 22, it follows that the flow of fluid to the motor will always be at a rate to supply sufficient power to satisfy the requirements of the service for which the work unit 24 is intended.

What is claimed is:

1. A device of the character described, comprising in combination, a pressure pump having a fluid receiving chamber and a driving shaft extending centrally therethrough, a plurality of pumping plungers movable in lines radiating from the axis of said driving shaft in response to rotation of said shaft, each of said plungers having a conduit extending longitudinally therein, said conduit opening at one end of said plunger, and a lateral port formed in the plunger opening at the other end of said conduit, a sleeve slidably mounted on each of said plungers, rods for longitudinally adjusting the position of said sleeves in relation to said lateral ports, a cam for controlling the position of said rods, whereby the period of admission of said fluid medium to said ports may be controlled, an outlet conduit leading from the said one end of said plunger, and a pressure responsive mechanism for controlling said cam, said pressure responsive mechanism operatively connected to said outlet conduit for varying the adjustment of said cam in accordance with said outlet pressure so as to maintain said outlet pressure at a substantially constant value.

2. A device of the character described, comprising, in combination, a pressure pump having

a fluid receiving chamber and a driving shaft extending centrally therethrough, a plurality of pumping plungers movable in lines radiating from the axis of said driving shaft in response to rotation of said shaft, each of said plungers having a conduit extending longitudinally therein, said conduit opening at one end of said plunger and a lateral port formed in the plunger opening at the other end of said conduit, a sleeve slidably mounted on each of said plungers, rods for longitudinally adjusting the position of said sleeves in relation to said lateral ports, a cam for controlling the position of said rods whereby the period of admission of said fluid medium to said ports may be controlled, gearing means for operating said cam, an outlet conduit leading from said one end of said plungers, and a pressure responsive mechanism for actuating said gearing means, said pressure responsive mechanism operatively connected to said outlet conduit for varying the adjustment of said gearing means in accordance with said outlet pressure so as to maintain said outlet pressure at a substantially constant value.

3. A device of the character described, comprising, in combination, a pressure pump having a fluid receiving chamber and a driving shaft extending centrally therethrough, a plurality of radially extending pumping plungers movable in response to rotation of said shaft, each of said plungers having a conduit extending longitudinally therein and opening at one end of said plunger, and a lateral port formed in the plunger opening at the other end of said conduit, a sleeve slidably mounted on each of said plungers, rods for longitudinally adjusting the position of said sleeves in relation to said ports, means for controlling the position of said rods whereby the period of admission of said fluid medium to said ports may be controlled, an outlet conduit leading from said one end of said plungers, and a pressure responsive mechanism for controlling said means, said pressure responsive mechanism operatively connected to said outlet conduit for varying the adjustment of said means in accordance with said outlet pressure so as to maintain said outlet pressure at a substantially constant value.

4. A pump comprising means providing a fluid receiving chamber, a driving shaft, a plurality of pumping plungers movable in response to rotation of said shaft, each of said plungers having a conduit extending longitudinally therein, said conduit opening at one end of said plunger, and a lateral port formed in the plunger opening at the other end of said conduit, a sleeve slidably mounted on each of said plungers, rods for longitudinally adjusting the position of said sleeves in relation to said lateral ports, a cam for controlling the position of said rods, whereby the period of admission of said fluid medium to said ports may be controlled, an outlet conduit leading from the said one end of said plunger, and a pressure responsive mechanism for controlling said cam, said pressure responsive mechanism being operatively connected to said outlet conduit for varying the adjustment of said cam in accordance with said outlet pressure so as to maintain said outlet pressure at a substantially constant value.

5. A pump comprising means providing a fluid receiving chamber, a driving shaft, a plurality of pumping plungers movable in response to rotation of said shaft, each of said plungers having a conduit extending longitudinally therein, said conduit opening at one end of said plunger, and

a lateral port formed in the plunger opening at the other end of said conduit, a sleeve slidably mounted on each of said plungers, rods for longitudinally adjusting the position of said sleeves in relation to said lateral ports, a cam for controlling the position of said rods, whereby the period of admission of said fluid medium to said ports may be controlled, gearing means for operating said cam, an outlet conduit leading from said one end of said plungers, and a pressure responsive mechanism for actuating said gearing means, said pressure responsive mechanism being operatively connected to said outlet conduit for varying the adjustment of said gearing means in accordance with said outlet pressure so as to maintain said outlet pressure at a substantially constant value.

6. A pump comprising means providing a fluid receiving chamber, a driving shaft, a plurality of pumping plungers movable in response to rotation of said shaft, each of said plungers having a conduit extending longitudinally therein and opening at one end of said plunger, and a lateral port formed in the plunger opening at the other end of said conduit, a sleeve slidably mounted on each of said plungers, rods for longitudinally adjusting the position of said sleeves in relation to said ports, means for controlling the position of said rods whereby the period of admission of said fluid medium to said ports may be controlled, an outlet conduit leading from said one end of said plungers, and a pressure responsive mechanism for controlling said means, said pressure responsive mechanism being operatively connected to said outlet conduit for varying the adjustment of said means in accordance with said outlet pressure so as to maintain said outlet pressure at a substantially constant value.

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