May 6, 1969

T. B. WESS

3,442,218

DUAL PURPOSE PUMP

Filed April 12, 1966

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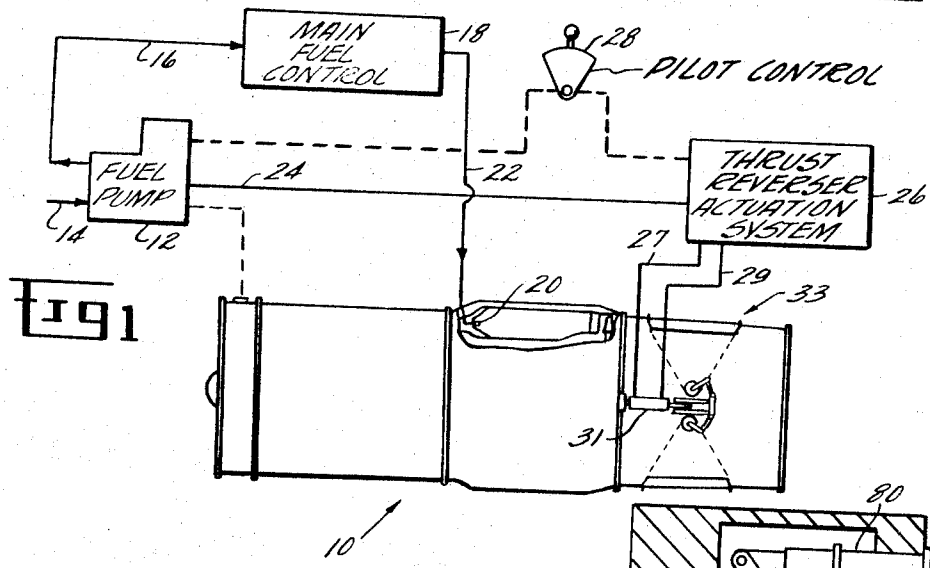


Fig 1

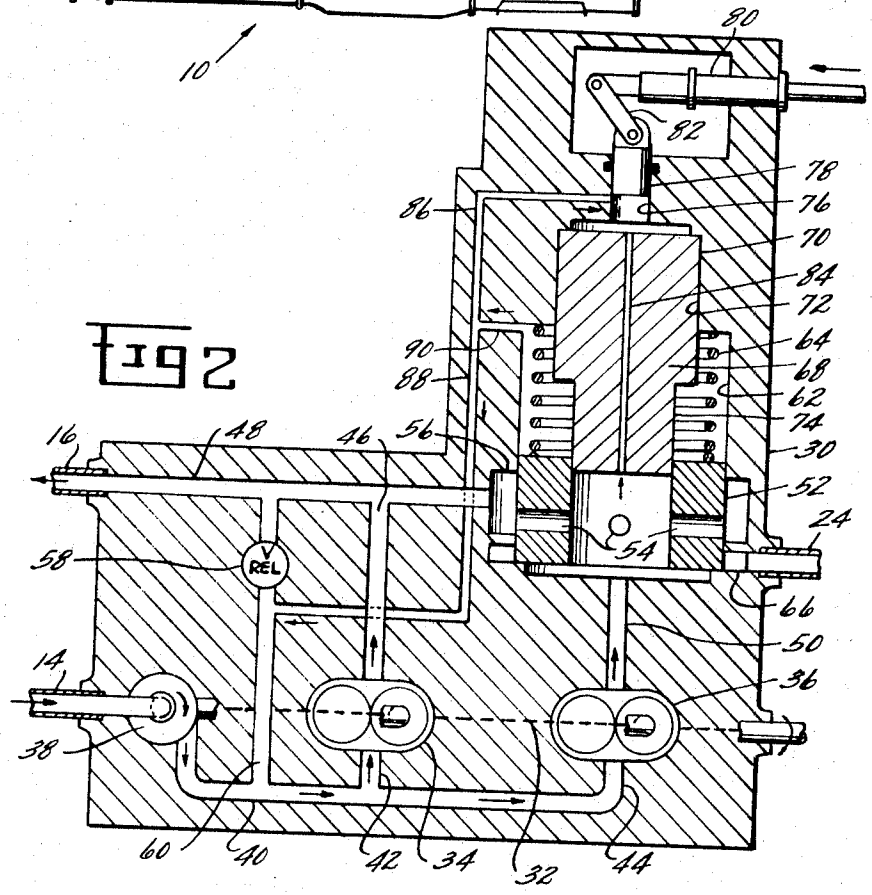


Fig 2

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Fig 3

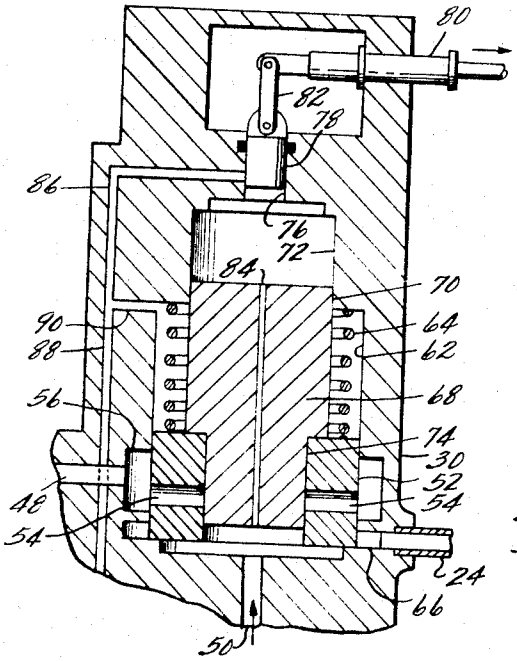


Fig 4

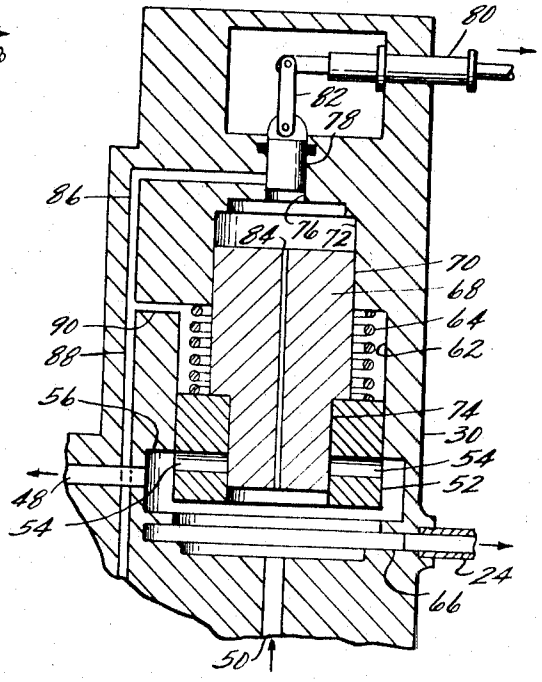
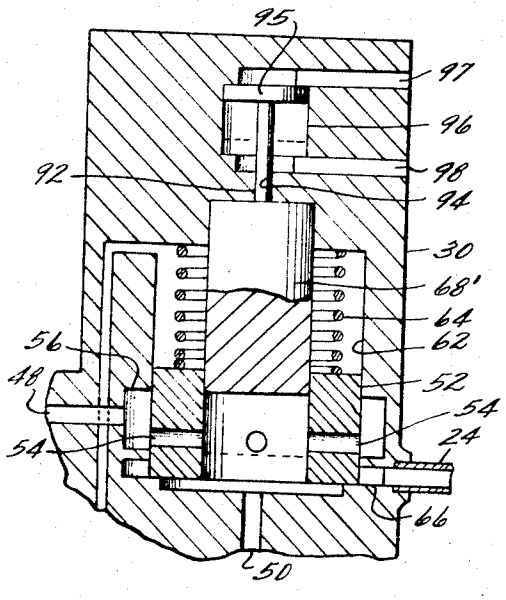


Fig 5



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3,442,218

DUAL PURPOSE PUMP

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6 Claims

ABSTRACT OF THE DISCLOSURE

A pump assembly delivers liquid at varying rates and selectively supplies high pressure liquid for hydraulic actuation of an auxiliary device. Two positive displacement pumps are employed in parallel. Selectively actuated means throttle the flow through the output passageway of one of the pumps and valve means responsive to increased pressurization, resulting from the actuation of the throttling means, connects the first pump output to the auxiliary device.

The present invention relates to improvements in pumps which serve dual functions as delivering fuel at a varying rate and also supplying the fuel for actuation of hydraulic devices.

It is common practice in gas turbine control systems to utilize the fuel supplied by a fuel pump to a main gas generator, for hydraulic actuation of auxiliary devices. In many instances, auxiliary devices require pressure levels for effective operation which are substantially greater than the pressure requirements of the main gas generator. To attain these levels the output of the pump is continuously throttled when the pressure requirements of the main gas generator are lower than those required by the auxiliary devices.

When the output of the pump is so throttled, the loads imposed on it are substantial which may result in increased wear and reduced operating life.

Accordingly, it is an object of the present invention to minimize the loads imposed on pumps which deliver liquid at varying rates and pressures and supply pressurized liquid for hydraulic actuation to thereby increase pump life.

The above ends are achieved by providing a pump assembly for delivering liquid at a varying rate and for simultaneously supplying a temporary source of pressurized liquid for hydraulic actuation of an auxiliary device. The pump assembly comprises first and second positive displacement pumps disposed in parallel and having passageways providing flow paths to a common outlet. Selectively actuated means are provided for throttling the output of the first pump. This is done when it is desired to actuate the auxiliary device during a condition of low flow output and low pressure at the common outlet. The pressure output of the first pump is thus maintained at a level necessary for effective operation of the auxiliary device. Valve means responsive to the actuation of the throttling means are provided for connecting the output of the first pump to the auxiliary device.

The above and other related objects and features of the invention will be apparent from a reading of the following description of the disclosure found in the accompanying drawings and the novelty thereof pointed out in the appended claims.

In the drawings:

FIGURE 1 is a schematic showing of a pump embodying the present invention with the cooperating elements of a gas turbine engine shown in abbreviated diagrammatic fashion;

FIGURES 2, 3, and 4 are fragmentary views of the pump in FIGURE 1 showing the operation thereof.

FIGURE 5 is a fragmentary view of the pump in FIGURE 1 showing an alternate embodiment of the present invention.

FIGURE 1 shows in block fashion a fuel control system of a gas turbine engine **10** used for aircraft propulsion. A fuel pump **12** receives fuel from a fuel tank (not shown) by means of a conduit **14** and delivers it through a conduit **16** to a main fuel control **18**. Fuel pump **12** is mechanically connected to and driven by the rotor (not shown) of the gas turbine engine **10**. The main fuel control may be any device that is adapted to deliver fuel at a prescheduled rate set by pilot demand and modified by several engine operating parameters. The main fuel control **18** feeds fuel to a series of combustor nozzles **20** (only one of which is shown) through a conduit **22**. Fuel is atomized and then ignited by means well known in the art to provide hot gases for operation of the engine **10**.

Fuel pump **12** provides a second pressure output through a conduit **24** for actuation of a thrust reverser system **26** which directs pressurized fuel through conduits **27, 29** to position a thrust reverser actuator **31**. The actuator **31** is connected by suitable means to a thrust reverser **33** (shown in simplified fashion). The thrust reverser system **26** may be mechanically actuated by a pilot controlled lever **28** which is also mechanically connected to the pump **12** and actuates mechanism for selectively pressurizing conduit **24** when the thrust reverser system **26** is to be actuated as will be apparent from the following description.

Reference is now had to FIG. 2, which is a diagrammatical section showing in detail the fuel pump **12** of FIGURE 1. A housing **30** has journaled therein a rotatable shaft **32** which drives a pair of parallel positive displacement pumps **34, 36**, and a centrifugal impeller **38**. The conduit **14** is connected to the axial inlet to impeller **38** whereby the fuel is initially pressurized and discharged to a passageway **40**. Passageway **40** is connected to a pair of passageways **42, 44**, for gear pumps **34** and **36** respectively. A passageway **46** connects the output of gear pump **34** with an outlet passageway **48**.

The output of pump **36** is also connected to the outlet passageway **48** by way of a passageway **50**, through the interior of a valve **52**, ports **54** therein an annular chamber **56** surrounding the valve **52**. A pressure relief valve **58** is disposed in a passageway **60** which connects passageway **40** with passageway **48**.

The valve **52** is in the form of a sleeve reciprocable in a cylindrical chamber **62** and normally maintained in its illustrated lower position by means of a spring **64**. A second annular chamber **66** surrounds the lower end of valve **52** and connects with the high pressure discharge conduit **24**. A control valve **68** has a first diameter **70** adapted to slide in a bore **72** at the upper end of chamber **62** and a smaller second diameter **74** slidable in the sleeve **52**. A further passageway **76** extendst from bore **72** and has a slidable therein a valve **78**. Valve **78** is displaceable in response to a mechanical input to a shaft **80**, journaled in housing **30**, by means of a link **82**. A hole **84** extends through control valve **68**. A passageway **86** connects the upper end of the valve **68** to the intake sides of pumps **34** and **36** by way of the pressure relief passageway **88**.

In normal operation, as illustrated by FIGURE 1, fuel from conduit **14** is initially pressurized by centrifugal impeller **38** and passed through conduits **40, 42**, to gear pump **34**. The output of gear pump **34** flows through passage **46** to the outlet passageway **48**. The output from gear pump **36** passes through passageway **50** to the interior of the pressure regulating piston **52** and from there through ports **54** to annular chamber **56**. Fuel then flows from annular chamber **56** to the outlet passageway **48** and if a predetermined outlet pressure is exceeded, fuel

is bypassed to the passageway 40 by means of passageway 60 and pressure relief valve 58. The combined output of the two pumps then flows through conduit 16 to the main fuel control 18 of FIGURE 1 where fuel is scheduled for delivery to the fuel nozzles 20. At this time valve 52 is seated at the bottom of chamber 62 to prevent pressurization of conduit 24. The hole 84 in control valve 68 and passageways 86, 88, provide a bleed flow path from the interior of valve 52 to passageway 60. The cross sectional area of hole 84 is smaller than that of passageways 86, 88, so that the pressure drop across valve 68 is much greater than the pressure drop along the length of passageways 86, 88. The pressure acting on the upper end of the valve 68 is nearly that of the centrifugal impeller 38 output and the pressure acting on the bottom is that of the pump 36 output. Since the output pressure of pump 36 is much greater than the output pressure of centrifugal impeller 38, the force acting on the bottom area of valve 68 is larger than on the upper, thus maintaining valve 68 against the top of bore 70 as shown in FIGURE 2.

When it is desired to actuate the thrust reverser system 26 (FIGURE 1), the lever 80 is displaced causing valve plunger 78 to block off bleed passageway 86 so that there is no further flow of pressurized fuel through valve 68. Without flow through the hole 84 the pressure on the upper end of valve 68 now becomes the same as that effective on its lower end, viz. essentially the discharge pressure of pump 36. Since the area of the upper end of the valve 68 is greater than that of its lower end, it is displaced downwardly, thus causing the diameter 74 to block ports 54 of valve 52, as shown in FIGURE 3.

The shoulder defining the larger diameter of valve 68 now engages the top of valve 52 and is maintained thereagainst by the force differential on its opposite ends and by the force differential on opposite ends of valve 52. In this connection it will be noted that a passageway 90 connects with the bleed passageway 88 so that the upper end valve 52 is essentially at the inlet pressure to pump 36 while the higher discharge pressure of pump 36 is effective on the lower end of valve 52.

The valves 52 and 68 now function as an integral valve with a larger force on the bottom, which is sufficient to overcome the force of spring 64 and displace both upwardly, thus uncovering annular chamber 66 to make fuel under pressure available in conduit 24 for actuation of the thrust reverser system 26 as shown in FIGURE 4. Bleed passageway 90 allows exit of the normal leakage of the fuel past piston 52.

It will be apparent that the lower end of valve 52 cooperates with the lower edge of annular chamber 56 to form a variable area orifice which provides a predeterminable and preferably higher restriction to flow to pump discharge flow than the ports 54. Because the output of the positive displacement pump 36 is restricted, the pressure in passageway 50 can be greatly increased, thus making a high pressure source of fuel available in conduit 24 for hydraulic actuation of the thrust reverser system. Spring 64 regulates the area of the orifice formed by the cooperation between piston 52 and annular chamber 56 to maintain the pressure in passageway 50 at the minimum level necessary for effective operation of the thrust reverser system 26.

With conduit 24 thus pressurized, the flow into outlet passageway 48 contributed by gear pump 36 will at least, at times, be reduced. Parallelly disposed pump 34 generally supplies the additional flow to meet the requirements of the main fuel control 18 (FIGURE 1). It will be apparent that the means thus described have particular utility in actuating a thrust reverser system because engine fuel demands during its operation are generally low.

When the lever 80 is displaced to inactivate the thrust reverser system, valve plunger 78 will be raised and fuel will again flow through the hole 84 dropping pressure on the upper end of valve 68 and the resultant force will displace it upwardly relative to valve 52 to uncover ports 54. This in turn causes a force differential on valve 52 (including spring 64) which seats the valve 52 in the position shown in FIGURE 1, allowing depressurization of the thrust reverser system.

Reference is now had to FIGURE 5 which shows a modified control valve 68' which is slidable in bore 72' and in the interior of hollow pressure regulating piston 52. Control valve 68' has extending therefrom a shaft 92 slidable in a bore 94 and connecting with a piston 95 slidable in a chamber 96. Passageways 97 and 98 direct flow of servo fluid from a suitable control source (not shown) to opposite sides of piston 95.

In normal operation piston 95 is maintained against the upper end of chamber 96 (FIGURE 5), and flow of fuel is through the assembly as described before. When it is deisred to operate thrust reverser system (FIGURE 1), servo fluid is directed into passageway 97 thus displacing piston 95 downward against the lower end of chamber 96 to cause valve 68' to cover ports 54 of valve 52. The output of pump 36 is now restricted, causing an increased pressure to act on the bottom area of valve 52. The force acting on the bottom of valve 52 is now sufficient to overcome the downward force of spring 64, thus displacing valve 52 upwardly to uncover annular chamber 66 making available a high pressure source of fuel in passageway 24. The regulation of pressure in passageway 24 before described is essentially the same and will not be repeated. When actuator operation is terminated, the piston 95 is returned to its illustrated position by means of servo fluid directed through conduit 98 to chamber 96. Pressure regulating piston 52 thus returns to its illustrated position and normal flow is resumed.

The pump thus described is not limited to use in the actuation of a thrust reverser in a gas turbine fuel system but may be used in any system wherein a fluid is to be pumped at a varying flow rate while at the same time providing a temporary high pressure source of fluid for actuation of auxiliary devices during flow conditions that are similar to those existing during thrust reverser operation.

Having thus described the invention what is claimed as novel and desired to be secured by Letters Patent of the United States is:

1. A pump assembly for delivering liquid at a varying rate and for simultaneously supplying a temporary source of pressurized liquid for hydraulic actuation of an auxiliary device, said pump assembly comprising:

first and second positive displacement pumps disposed in parallel and each having an outlet passageway for providing a flow path, for the respective pump, to a common outlet,

selectively-actuated means for throttling the flow through the output passageway of said first pump when it is desired to actuate said auxiliary device during a condition of low flow output and low pressure at said common outlet to thereby maintain the pressure output of said first pump at a level necessary for effective operation of said auxiliary device, said selectively-actuated means comprising an element disposed in the passageway from said first pump to said common outlet, said element being displaceable between a first position, providing a relatively low resistance flow path through said passageway, and a second position, providing a throttling of flow therethrough.

valve means responsive to increased pressurization of the output of said first pump, resulting from movement of said element to said second position for connecting said first pump output to said auxiliary device and means for blocking the flow to said auxiliary device when said element is in its first position.

2. A pump assembly as in claim 1 wherein said element is selectively activated by means which comprise:

yieldable means for urging said element into said first position,

means for at least substantially reducing flow through the relatively low resistance flow path, the output pressure of said first pump on said element being increased thereby.

said element being displaced against the action of said yieldable means to said throttling position in response to increased pump pressure thereon.

3. A pump assembly as in claim 2 wherein

said passageway includes a cylindrical chamber receiving at one end the output of said first pump,

said element comprises a sleeve slidable in said chamber and maintained against said end by said yieldable means,

said sleeve having at least one radial port providing the relatively low resistance flow path therethrough,

said means for substantially reducing the flow through said low resistance flow path comprises a piston received at one end in said sleeve and slidable therein between a first position which permits flow through said port and a second position which blocks the flow therethrough,

said chamber having an outlet providing a flow path to said common outlet,

said chamber outlet being disposed for cooperating with said sleeve to provide a relatively low resistance flow path when said port is open and further cooperating with said sleeve when the sleeve is displaced by the output pressure of said first pump when said port is blocked to throttle the output of said first pump.

4. A pump assembly as in claim 3 wherein:

said valve means is formed in part by said sleeve and further comprises a connecting passageway which cooperates with said sleeve to connect the output of said first pump with said auxiliary device when said sleeve is displaced to the throttle position and cooperates to block the flow to said auxiliary device when the sleeve is in the position providing the relatively low resistance flow path.

5. A pump assembly as in claim 3 wherein:

the other end of said piston has an enlarged diameter,

a bore at the other end of said chamber slidably receives said enlarged diameter,

said piston having a passageway providing a bleed flow path from the interior of said sleeve to said bore,

means for discharging bleed liquid from said bore to thereby cause a pressure differential across said piston, the action of which maintains said piston in a position which allows flow through said sleeve port, and

means for terminating the discharge of liquid from said bore when it is desired to actuate said auxiliary device, whereby said piston is displaced by the increased force on said enlarged diameter to engage said sleeve and block the flow of liquid through said port.

6. A pump assembly as in claim 3 wherein said piston is actuated by means comprising:

a rod extending from said piston and out of said chamber,

means for displacing said rod between a first position in which said piston permits flow through said port and a second position in which said piston blocks flow of liquid through said port.

References Cited

UNITED STATES PATENTS

2,905,191	9/1958	Vander Kaay	137—108
3,279,558	10/1966	Allen et al.	137—108
2,643,516	6/1953	Carlson	103—11 X
2,778,191	1/1957	Thompson	60—39.28 X
2,769,394	11/1956	Lauck	103—4
2,805,038	9/1957	Towler	103—11 X
3,033,277	5/1962	Cowles et al.	103—11 X
3,034,292	5/1962	Binford et al.	60—39.28

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U.S. Cl X.R.

137—108, 567; 103—11; 60—97, 39.28