

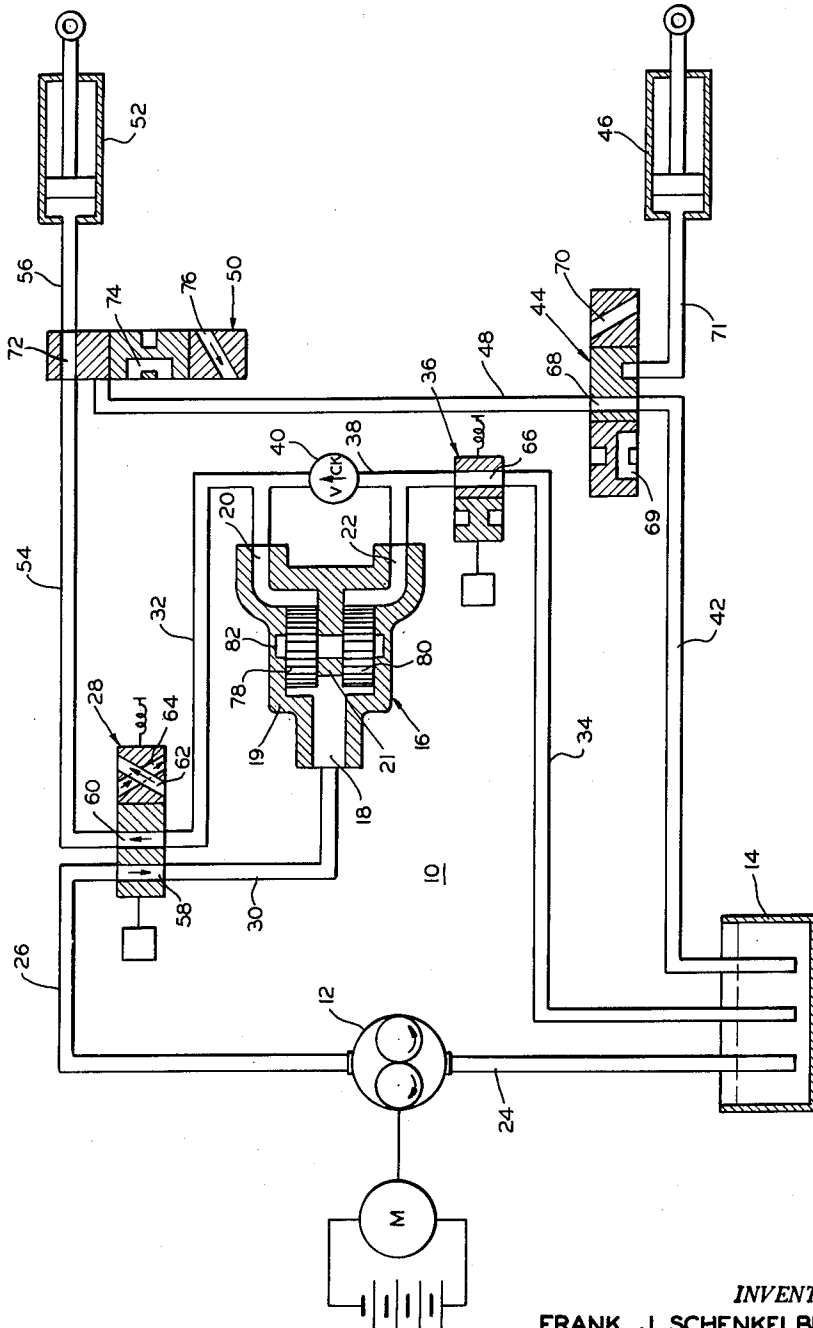
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FLOW DIVIDER SYSTEM

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FLOW DIVIDER SYSTEM

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This invention relates to flow divider systems and more particularly to multiple unit rotatable flow dividers mounted for rotation on a common shaft.

An important object of the present invention is to provide relatively simple means for variously dividing and combining the flow of fluid in a hydraulic system such that a hydraulic device may be operated at a plurality of speeds.

Another object of the invention is to provide a relatively simple, efficient, and compact flow divider means for varying the volume and pressure characteristics of fluid flowing in a hydraulic system.

A further object of the invention is to provide a system containing a flow divider device which is selectively operable either as flow division means, as passageway means for fluid flow, or as a motor-pump means capable of increasing the fluid volume normally supplied by the system.

Yet another object of the invention is to provide an improved and versatile flow divider system.

One of the extremely novel features of my invention involves, in one mode of operation thereof, the use of one portion of a flow divider as a pump to supply fluid from a reservoir to a hydraulic device while another portion thereof operates as a motor drive for the one portion while also functioning as a conduit for pressure fluid supplied by other pump means to the hydraulic device.

In carrying out my invention in one exemplary and preferred form, I provide a pump which delivers fluid at selected values of pressure and flow. This fluid is delivered to a dual section flow divider having a common opening on one side and separate openings on the other side which are connected to the opposite sides of two separate intermeshing gear sets having coaxial pairs of gears mounted on common shafts for rotation together. The said common opening may selectively function as an inlet opening or as an outlet opening, while the said separate openings may selectively function as outlet openings which either combine or divide the fluid flowing or as inlet openings which cause the flow divider device to function as a motor-pump combination as aforesaid. In the latter event the common opening then functions as an outlet opening. Plural valve means are provided for shifting from one mode of operation to another.

Objects, features, and advantages of my invention other than those above stated will appear to persons skilled in the art in the following detailed description when taken in conjunction with the drawing wherein is shown schematically a preferred embodiment of my invention.

Referring now in detail to the drawing, numeral 10 denotes generally a flow divider system which embodies the principles of my invention. A supply pump 12 is adapted to be driven by a motor M for supplying pressure fluid from a reservoir 14 to a multiple unit intermeshing gear type flow divider 16 having a common opening 18 in one side of a flow divider housing 19 and first and second openings 20 and 22 in the other side thereof formed on opposite sides of a housing wall 21. The pump 12 is connected to reservoir 14 by a conduit 24 and selectively to opening 18 or to opening 20 of divider 16 by way of a conduit 26, a two position flow control valve 28 and either one of a pair of conduits 30 and 32 which are connected to openings 18 and 20, respectively.

A conduit 34 is connected to the reservoir 14 and to

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a two-position flow control valve 36. A conduit 38 is connected to valve 36, to opening 22, and to conduit 32 by way of a one-way check valve 40 which opens in the direction illustrated. A conduit 42 is also connected to reservoir 14 and to a three-position flow control valve 44 which controls the operation of a piston motor hydraulic device 46. A conduit 48 is also connected to valve 44 and to a three-position flow control valve 50 which is adapted to control the operation of a second piston motor hydraulic device 52. A conduit 54 connects valve 28 to valve 50 and a conduit 56 connects valve 50 to device 52. As illustrated, valves 28 and 36 are solenoid actuated and valves 44 and 50 are adapted to be manually actuated to each flow control position.

Each of the flow control valves is shown in schematic form in order to simplify understanding. Valve 28 is adapted in its illustrated position to connect conduits 26, 30 and 32, 32, 54 by way of parallel passages 58 and 60, respectively, and to reverse such connections by means of cross-over passages 62 and 64 when the valve is actuated to its other position. Valve 36 connects conduits 34 and 38 by way of passage 66 in its illustrated position while blocking such connection when actuated to its other position. Valve 44 connects conduits 42 and 48 by means of passage 68 in its illustrated position in which the motor device 46 is maintained in a preselected position, connects conduit 48 to device 46 by means of passage 70 and a conduit 71 in second position, and connects device 46 to vent conduit 42 when it is actuated to its third position wherein passage 69 connects conduits 42 and 71. Valve 50 connects conduit 54 to device 52 by means of passage 72 in its first and illustrated position, connects conduits 54 and 48 by means of passage 74 when actuated to its second position, and connects conduits 56 and 48 by means of passage 76 when actuated to its third position.

The flow divider 16 comprises two reversible meshing gear sets 78 and 80, one gear of each of which sets is shown, spaced axially apart and having each pair of non-meshing gears mounted in spaced relation on a common shaft, one of which is shown at numeral 82, for rotation together. As illustrated herein the gear sets 78 and 80 are of equal size so that the volume of fluid flowing through one gear set will always be equal to that fluid volume flowing through the other gear set at whatever rotational speed the gear sets are driven on the common shafts which connect them to each other. A flow divider housing wall 21 separates openings 20 and 22 and the one side of the gear sets so that said openings are out of communication with each other within the housing 19.

It will be apparent to persons skilled in the art that any reasonable number of gear sets in addition to the pair illustrated herein may be connected to operate together on common shaft means and that the sizes of the various gear sets may vary as between gear sets in any given installation to suit requirements. The number of increments of flow will be determined by the number of gear sets, and the volume of fluid flowing in each increment will be that fraction of the total flow which is proportional to the size of the gear set conveying such increment. The principal of my invention is well illustrated in the particular embodiment disclosed herein which utilizes only two connected pairs of gear sets of equal size, and it should be clearly understood that the invention is not limited to the exemplary embodiment hereof, but is capable of numerous variations in design and use such as broadly outlined above.

An operator can select any one of three available modes of operation of the flow divider described herein. For convenience these shall be referred to below as conditions I, II and III, and shall be related to the operation of the piston motor devices 46 and 52. Also, as a matter of convenient reference it will be assumed that supply

pump 12 delivers to conduit 26 under all conditions of operation 6 g.p.m. of fluid at 500 p.s.i. Further, the system is, for convenience, assumed to be 100 percent efficient.

In condition I all control valves are positioned as illustrated, and the pump 12 delivers its total output volume and pressure to the common opening 18 of the flow divider by way of conduits 26 and 30, and passage 58 of valve 28. The pressure fluid flowing causes the gear sets 78 and 80 to rotate together on the common shafts thereof. The gear sets pass 3 g.p.m. into each of openings 20 and 22 in accordance with the foregoing example. Since valve 50 is open to device 52 and valve 36 is open to the reservoir, the fluid discharged from opening 20 is directed to device 52 by way of conduits 32, 54 and 56, and valve passages 60 and 72 at 1000 p.s.i., while the fluid discharged from opening 22 is returned to the reservoir by way of conduits 38 and 34, and passage 66 at zero p.s.i. (gage pressure). The pressure drop across gear set 80 causes it to function as a motor to drive gear set 78 as a pump so that the pressure fluid flowing through gear set 78 is increased by the amount of pressure drop across gear set 80, the fluid flow through both gear sets remaining constant due to pump 12 supplying a constant flow. Piston motor device 52 operates, therefore, at double the normal lifting capacity and one-half normal lifting speed, normal capacity and speed being the condition of operation to be described below under condition II. During operation in condition I, spring loaded check valve 40 remains closed, of course, since zero pressure fluid in conduit 38 is unable to actuate it open against the pressure fluid in conduit 32. Thus, pressure fluid discharged into conduits 32 and 38 remains separated throughout operation in condition I.

Under normal operating conditions, i.e., condition II, valve 36 is actuated to its closed position wherein conduits 34 and 38 are out of communication and valves 28 and 50 remain in the positions illustrated, as in condition I. In this condition flow divider 16 is, in effect, out of the system functionally since the fluid which is divided between openings 20 and 22 by the flow divider is recombined in conduit 32 as a result of pressure fluid in conduit 38 causing check valve 40 to open. Fluid is therefore delivered to conduit 32, and thence to device 52 by way of conduits 54 and 56, and valves 28 and 50, at the pressure and flow of pump 12, i.e., 6 g.p.m. at 500 p.s.i., whereby device 52 will operate at normal speed and capacity which is twice the speed and one-half the capacity as in condition I.

In condition III, control valve 28 is actuated to its cross-over position wherein conduits 26 and 32 are connected by passage 64 and conduits 30 and 54 are connected by passage 62, and wherein valve 36 is placed in the illustrated open position. In this condition pump 12 will deliver fluid to opening 20 of gear set 78 at full discharge volume and pressure, 6 g.p.m. at 500 p.s.i. in the above example, since check valve 40 prevents any fluid flow from conduit 32 to conduit 38 and flow divider openings 20 and 22 are separated by housing wall 21. The entire output of pump 12 therefore passes through gear set 78 which causes this set to function as a motor driving gear set 80 at the speed of gear set 78, which in turn causes set 80 to function as a gear pump. Since valve 36 is open to reservoir 14 gear set 80 will pump a volume of fluid therefrom equal to the volume delivered to gear set 78, said pumped volume being conveyed to opening 18 at zero p.s.i. through conduits 34 and 38, valve 36, opening 22 and gear set 80. The fluid from gear set 78 combines with the fluid from gear set 80 in opening 18 to produce 12 g.p.m. flow to device 52 at 250 p.s.i. by way of conduits 30, 54 and 56, and valve passages 62 and 72. In other words, motor device 52 will produce in condition III its work output at double the speed and one-half the capacity of operation in condition II, or at four times the

speed and one-fourth the capacity of operation in condition I.

One extremely useful application of my invention has been found in conjunction with hydraulic lifting masts of industrial fork lift trucks wherein it is important to have available various lifting speeds of the load engaging means of such trucks which varies inversely with the load being elevated. An example of one type of lift truck with which this invention may be used is disclosed in U.S. Patent No. 2,906,373, issued September 29, 1959, in the names of Hastings, Jr., et al. In this single exemplary use of the many uses to which the invention may be put, it will be understood that if the piston motor device 52 is used as a load lifting device that under maximum load minimum lifting speed is achieved, i.e., condition I above; under a medium load medium lifting speed is achieved, i.e., condition II above; and under minimum load maximum lifting speed is achieved, i.e., condition III above, all of which is desirable.

In the example illustrated herein, valve 50 may be actuated to connect conduit 54 to conduit 48 by way of passage 74 whereby device 52 is out of communication with the rest of the system and the load supported thereby is held at whatever position or elevation exists at the time valve 50 is actuated. If valve 50 is actuated to connect conduit 56 to conduit 48 by way of passage 76 pressure fluid is evacuated from the piston head end of device 52 under the force of any load which may be supported thereby. Such fluid may be returned to reservoir 14 by way of valve 44 and valve passage 68 or to any other hydraulic device 46 by way of valve passage 70 when valve 44 is actuated leftwardly to connect conduits 48 and 71. Accessory device 46 may be operated also in any conditions I, II or III by connecting passage 70 of valve 44 to conduit 48 and by connecting passage 74 of valve 50 to conduits 54 and 48, as will be apparent from the foregoing description relating the operation of flow divider 16 to device 52. Retraction of the piston of device 46 is accomplished by actuating valve 44 to connect conduits 42 and 71 by way of passage 69.

While I have referred herein to device 16 as a "flow divider," for the sake of convenience, it will now be readily appreciated that the operation of device 16 is functionally different in each of the three operating conditions described above. In condition I device 16 functions to operate as a flow divider and pressure amplifier in that the total flow received is separated in two equal parts, in the example disclosed, and delivered to two different locations, viz, device 52 or 46 and reservoir 14, at different pressures. In condition II device 16 operates functionally merely as a passageway or conduit for fluid flowing in that the total flow received by device 16 is recombined in conduit 32 following discharge from the device. In condition III device 16 operates as a motor-pump and "flow amplifier" in that the total flow to the device is received in one gear section thereof and drives that section as a motor to operate the other gear section as a pump which adds an equal flow of fluid to the system and combines the same with the fluid following through the first gear section. Therefore, while device 16 will be referred to in some of the claims as "flow divider means," and the like, it should be understood that functionally device 16 has characteristics which in certain conditions of operation in the hydraulic system of this invention are unlike those normally attributed to flow dividers.

As suggested hereinabove, and as will now be apparent to persons skilled in the art, numerous modifications, rearrangements of components and parts, and uses for my invention will be readily found without departing from the spirit and scope thereof as defined in the claims appended.

I claim:

1. For use with a fluid motor, the combination of flow divider means having interconnected multiple flow divider units, a common fluid opening connected to one

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side of said units and separate fluid openings connected to each other side of said units, pump means for supplying pressure fluid to said flow divider means and to the fluid motor, first valve means for directing the output of said pump to either said common opening or to one of said separate openings, a reservoir, and second valve means for directing flow of fluid in another of said separate openings either to said reservoir, to combine with the fluid flowing from said one of said separate openings, or to said common opening.

2. For use with a fluid motor, the combination of flow divider means having interconnected multiple flow divider units, a common fluid opening connected to one side of said units and separate fluid openings connected to each other side of said units, pump means for supplying pressure fluid to the fluid motor only by way of said flow divider means, and valve means for directing the output of said pump to either said common opening or to less than all of said separate openings.

3. For use with a fluid motor, a fluid flow system comprising flow divider means having a plurality of parallel axially spaced intermeshing gear wheel sets, a common rotatable shaft mounting one of the gear wheels of each of said gear wheel sets, an opening common to said gear sets on one side of said flow divider means and a separate opening for each gear set on the other side of said flow divider means, pump means for supplying pressure fluid to said flow divider means, and valve means operable to direct the output of said pump means either to said separate openings by way of said common opening and said gear wheel sets or to direct the output of said pump means to said common opening by way of one of said separate openings and one of said gear wheel sets.

4. For use with a fluid motor, a flow divider system comprising flow divider means having a common first opening on one side thereof in communication with separate second and third openings on the other side thereof, pump means for supplying pressure fluid sequentially to said flow divider means and to the fluid motor, control valve means operable to direct the output of said pump means to said first opening or to said second opening, a reservoir, conduit means connecting said reservoir to said third opening, and other valve means operable to permit communication of said third opening with said reservoir or with said second opening, said pump output being divided between said second and third openings by the flow divider means when directed to said first opening, and being received wholly by said first opening when directed to said second opening.

5. A flow divider system as claimed in claim 4 wherein said other valve means is operable either to communicate said third opening with said second opening or with the reservoir when the output of said pump is directed to said first opening, or to communicate said third opening with said reservoir when the output of said pump is directed to said second opening.

6. A flow divider system comprising fluid motor means, fluid pump means for actuating said fluid motor means, flow divider means interposed between the pump and motor means for varying the volume and pressure of fluid received in said motor means, said flow divider means including a common first fluid opening on one side thereof and second and third separate fluid openings on the other side thereof, said first opening receiving the pressure fluid output of said pump means and said flow divider means dividing said pressure fluid output in predetermined proportion between said second and third openings, a reservoir connected to said third opening, and valve means operable to direct the flow of pressure fluid through said third opening either to said fluid motor or to said reservoir, said fluid motor receiving fluid flow at relatively high pressure and low volume when said third opening communicates with said reservoir and at relatively low pressure and high volume

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when said third opening communicates with said fluid motor.

7. A flow divider system comprising fluid pump means, fluid motor means, flow divider means interposed between said pump and motor means for varying the pressure and volume flow of said pump means which is directed to said motor means, said flow divider means including a pair of axially spaced intermeshing gear wheel sets, a shaft mounting a pair of axially spaced gear wheels of said sets, a common opening on one side of said gear wheel sets, first and second separate openings on the other side of said gear wheel sets, a reservoir connected to said second opening, and valve means operable to direct fluid flow through said second opening either to said fluid motor or to said reservoir, said common opening receiving the pressure-volume output of said pump means, said gear wheel sets dividing said pressure-volume output between said first and second openings, said valve means operating in one position thereof to cause said fluid motor to receive from said first opening fluid at relatively high pressure and low volume and in another position to cause said fluid motor to receive fluid flow from said first and second openings at relatively low pressure and high volume.

8. A flow divided system as claimed in claim 7 wherein conduit means connects said first and second openings, said valve means including a one-way valve element in said conduit means permitting fluid flow from said second opening to combine with fluid flow from said first opening and a second valve element intermediate said second opening and the reservoir selectively permitting or inhibiting communication between said second opening and said reservoir.

9. A fluid pressure and volume control system comprising pump means, fluid motor means for receiving pressure fluid from said pump means, flow divider means intermediate said pump and motor means for varying the pressure-volume flow from said pump means which is received in said motor means including a pair of axially spaced rotatable means, means mounting said rotatable means for rotation together, a common opening on one side of said rotatable means and first and second separate openings on the other side thereof, said common opening receiving pressure fluid from said pump and said rotatable means dividing said pressure fluid in preselected proportion between said first and second openings, and valve means for either directing fluid flowing from said second opening to combine with fluid flowing from said first opening for operating said motor means at a first combination of fluid pressure and volume of flow or for directing fluid flowing from said second opening to by-pass said motor means whereby said motor means receives fluid flowing from said first opening to operate at a second combination of fluid pressure and volume of flow.

10. A control system as claimed in claim 9 wherein conduit means connects said first and second openings, and said valve means includes a first valve element permitting fluid flow only from said second opening to said first opening and a second valve element for interrupting flow through said first valve element and directing flow from said second opening to by-pass said motor means.

11. In combination, flow control means including a pair of axially spaced rotatable flow divider means having common shaft means for causing the flow divider means to rotate in unison, a common opening on one side of the flow divider means for directing pressure fluid through said pair of flow divider means to rotate same in one direction or for receiving pressure fluid from said flow divider means when the same is caused to rotate in the opposite direction, first and second separate openings on the other side of said pair of flow divider means for receiving that portion of pressure fluid which is directed thereto by each element of the pair of flow divider means when the same is rotated in said one direction or for directing pressure fluid to said common opening through

said pair of flow divider means to rotate same in said opposite direction, and valve means for directing pressure fluid to said common opening or to said first opening, said second opening being adapted to communicate with an independent source of fluid when said first opening receives pressure fluid and directs same through one of said pair of flow divider means to said common opening.

12. A combination as claimed in claim 11 wherein second valve means is operable to combine the flow through said first and second openings when said flow divider means are rotated in said one direction to communicate said second opening with said independent fluid source when pressure fluid is received in said first opening to rotate said flow divider means in said opposite direction for increasing the volume of fluid flowing.

13. A combination as claimed in claim 12 wherein said second valve means is adapted also to direct fluid flow to said independent fluid source when said second opening receives fluid flow from said common opening.

14. A flow control system comprising pump means, fluid motor means, a fluid pressure-volume control means interposed between said pump and motor means having a pair of rotatable flow divider means operable together, a common opening on one side of the flow divider means and first and second separate openings on the other side thereof, valve means for directing the output of said pump either to said common opening or to said first opening, whereby said flow divider means are rotated in either a first or second direction, fluid source means, and second valve means for directing the fluid flow received in said second opening to combine with the fluid flow received in said first opening when said first mentioned valve means directs pump output to said common opening and for communicating said second opening with said fluid source means when said first mentioned valve means directs pump output to said first opening, said fluid motor receiving a variable pressure-volume flow at a given pump output depending upon whether said pump output is directed by said first mentioned valve means to said common opening or to said first opening.

15. A flow control system as claimed in claim 14 wherein said second valve means is also adapted to communicate said second opening with said fluid source means when said first mentioned valve means directs pump output to said common opening.

16. A flow control system comprising fluid motor means, pump means for supplying pressure fluid to said motor means, a reservoir, pressure and volume flow control means intermediate said pump and motor means including a pair of rotatable means mounted for rotation together for dividing fluid flowing in one direction therethrough and for amplifying fluid flowing in the other direction therethrough, a common opening on one side of said rotatable means and first and second openings on the opposite side thereof, first conduit means connecting said pump means to said common opening, said first opening to said motor means and said second opening to said reservoir, second conduit means for connecting said first opening to said pump means, said second opening to said reservoir and said common openings to said motor means, and valve means forming a portion of both said first and second conduit means operable selectively to connect said common and first and second openings as aforesaid.

17. A flow control system as claimed in claim 16 wherein said valve means when forming a portion of said first conduit means causes a first portion of said pump output to be directed to said fluid motor by one of said pair of rotatable means and a second portion thereof to be directed to said reservoir by the other of said pair of rotatable means, and said valve means when forming a portion of said second conduit means causing said pump output to be directed to said fluid motor by way of said first and common openings and one of said pair of rotatable means and an additional volume of fluid to be pumped

from said reservoir by the other of said pair of rotatable means and directed to said fluid motor by way of said second and common openings.

18. A flow control system as claimed in claim 17 wherein second valve means is operable to interrupt communication between said second opening and said reservoir and direct fluid received in said second opening from said common opening to combine with fluid received in said first opening from said common opening for operating said fluid motor means under full pressure-volume output of said pump means.

19. A flow control system as claimed in claim 16 wherein said pair of rotatable means comprises a pair of axially spaced intermeshing gear sets rotatable together for dividing the fluid flowing in said first conduit means to said common opening between said first and second openings and for amplifying the fluid flowing from said pump means in said second conduit means.

20. A flow control system comprising fluid motor means, pump means for operating said fluid motor means, a reservoir, fluid flow control means receiving the output of said pump means and operable to communicate to said motor means either a portion of said output, all of said output, or a fluid volume greater than said output, said fluid flow control means including a common opening on one side thereof and first and second separate openings on the other side thereof, first valve means operable to direct the output of said pump either to said common opening or to said first opening, and second valve means operable to direct a portion of fluid flowing through said second opening when the pump output is received in said common opening either to said fluid motor or to said reservoir and operable to direct fluid from said reservoir to said second opening when said pump output is directed by said first valve means to said first opening.

21. A flow control system as claimed in claim 20 wherein said flow control means includes a pair of axially spaced gear wheel sets rotatable in one direction when pump output is received in said common opening and rotatable in the opposite direction when pump output is received in said first opening, said second valve means being operable to cause the pump output when received in the common opening to be directed to said fluid motor from said first and second openings or being operable to direct that portion of the output received in said first opening to said fluid motor and that portion of the output received in said second opening to said reservoir, and the gear wheel set connected to said first opening directing pump output when received in said first opening to said fluid motor through said common opening and being operable to drive the other gear wheel set as a second pump means to direct a volume of fluid from said reservoir to said fluid motor through said second and common openings.

22. A flow control system as claimed in claim 20 wherein one combined position of said first and second valve means effects operation of said motor means at a pressure and volume equal to the pressure and volume output of said first mentioned pump means, a second combined position of said first and second valve means effects operation of said motor means at a pressure higher than and a volume lower than the output of said pump means, and a third combined position of said first and second valve means effects operation of said motor means at a pressure lower than and a volume higher than the output of said pump means.

23. A fluid pressure-volume flow control means comprising a housing, a pair of rotatable flow control devices in said housing, a shaft mounting said flow control devices for rotation together, an opening in said housing on one side of said flow control devices common thereto, a first opening on the other side of one of said flow control devices, a second opening on the other side of the other of said flow control devices independent of said first opening, and means for supplying pressure fluid se-

lectively to either said common opening or said first opening, said pair of flow control devices being operable in one mode to divide the volume of pressure fluid received in said common opening in predetermined ratio between said first and second openings, and said pair of flow control devices being operable in another mode such that the one flow control device receives pressure fluid from said first opening being driven thereby as a motor and driving the other flow control device as a pump which supplies fluid from said second opening to said common opening.

24. A fluid pressure-volume flow control means comprising a housing, a pair of interconnected flow control devices in said housing, an opening in said housing on one side of said flow control devices common thereto, a first opening on the other side of one of said flow control devices, a second opening on the other side of the other said flow control devices independent of said first opening, and means for supplying pressure fluid selectively to either said common opening or said first opening, said pair of flow control devices being operable in one mode to divide the volume of pressure fluid received in said common opening in predetermined ratio between said first and second openings, and said pair of flow control devices being operable in another mode such that the one flow control device receives pressure fluid from said first opening and drives the other flow control device which supplies an additional quantity of fluid from said second opening to said common opening.

25. A fluid flow amplifier system comprising a hous-

ing, a pair of rotatable flow devices in said housing, a shaft mounting such flow devices for rotation together, an opening in said housing on one side of said flow devices common thereto, a first opening on the other side of one of said flow devices, a second opening on the other side of the other of said flow devices independent of said first opening, fluid pressure generating means for supplying pressure fluid to said common opening by way of said first opening said one flow device, a source of additional fluid, conduit means connecting said other fluid device to said source, said one flow device being driven as a fluid motor by the pressure fluid passing from said first opening to said common opening and in turn driving said other flow device as a pump to direct an additional quantity of fluid to said common opening from said fluid source.

26. A fluid flow amplifier system as claimed in claim 25 wherein said pair of flow devices comprise a pair of axially spaced intermeshing gear wheel sets and a shaft common thereto for rotating said gear wheel sets together, and said pressure generating means comprises a pump for delivering pressure fluid to said first opening and one of said gear wheel sets.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,039,266

June 19, 1962

Frank J. Schenkelberger

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 11, for "imporant" read -- important --; column 2, line 18, strike out "32,", second occurrence; column 3, line 75, for "opeartion" read -- operation --; column 8, line 43, and column 9, line 4, for "comon", each occurrence, read -- common --; column 10, line 8, for "presure buid" read -- pressure fluid --; line 9, after "opening" insert -- and --.

Signed and sealed this 9th day of October 1962.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents