

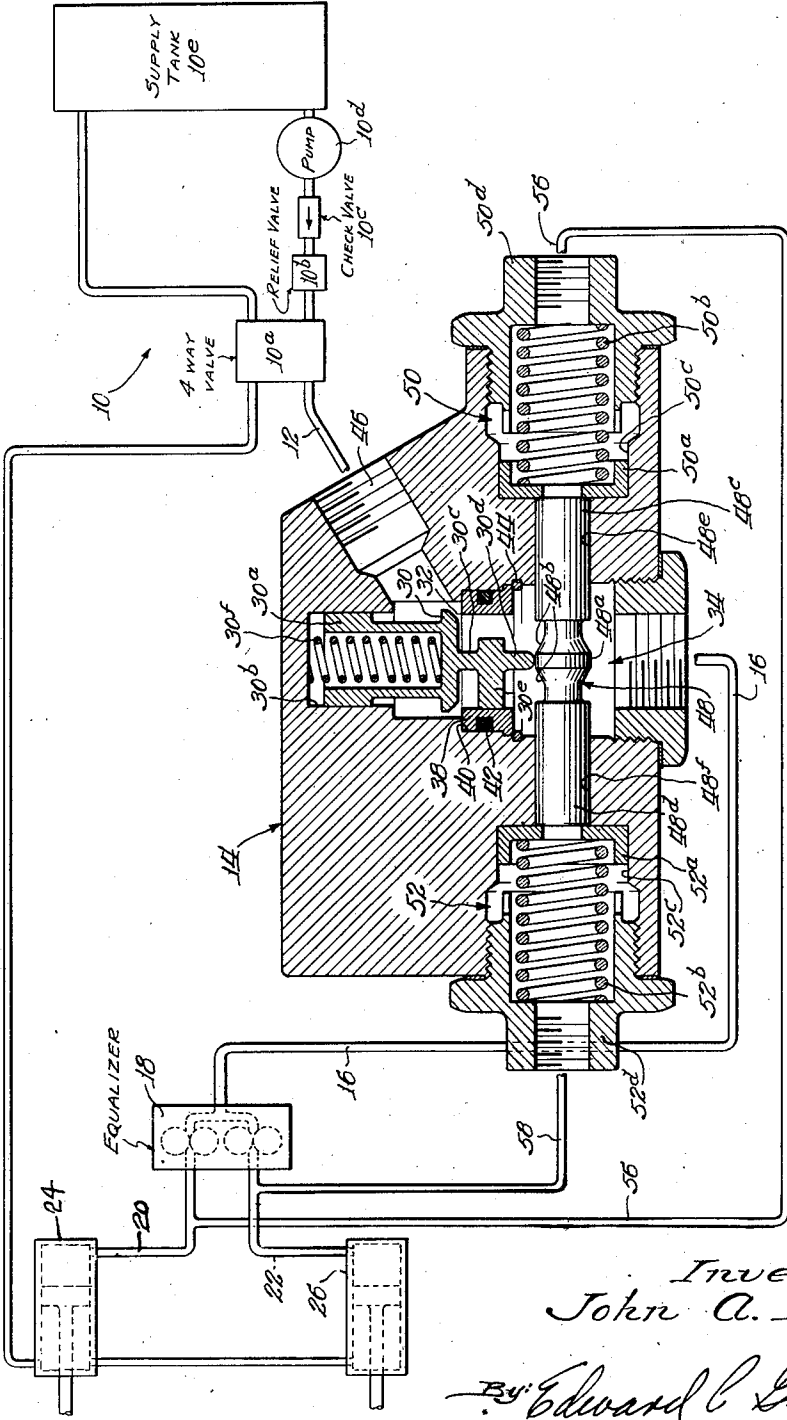
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EQUALIZER AND SHUTOFF VALVE

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EQUALIZER AND SHUTOFF VALVE

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This invention relates to pressure equalizing or fluid dividing arrangements and particularly to arrangements for controlling the inlet flow in accordance with conditions existing in the plural outlets therefrom.

It is the general object of this invention to provide a novel control arrangement for regulating the flow to an equalizer in accordance with the relative pressures existing in the separate outlet streams leading from the equalizer to separate pressure responsive instrumentalities subject to varying resistances and hence imposing correspondingly varying back pressures on said equalizer.

It is a further object to provide in combination with a flow divider, a control valve for regulating the introduction of liquid thereto and means responsive to a selected differential of pressure existing in separate outlet streams from said divider effective to cause the operation of the regulating valve.

I am aware that it has been proposed heretofore to employ a valve arrangement responsive to loss of pressure in a line, such for example as when the line becomes ruptured, to shut off flow therethrough. However, I am not aware of any previously known arrangement of the present character, performing in an equivalent manner to produce the important results accomplished by my invention.

Other objects, uses and advantages of my invention will become apparent from a reading of the following specification taken in connection with the accompanying drawing forming a part thereof and wherein the single figure comprises a schematic layout view of a system incorporating a preferred embodiment of my invention.

In order to realize the most efficient operation of a hydraulic pressure equalizer or flow divider as well as to insure against such emergencies as the loss of the fluid from the system by virtue of the rupture of one of the outlet lines from the equalizer, it has been found necessary to control delivery of hydraulic fluid to the equalizer in accordance with the pressure conditions existing in the outlet line. I have discovered that the most effective way of accomplishing this is to provide a flow control valve in the inlet line to the flow divider and to provide pressure responsive means responsive to the occurrence of a selected differential of pressure between separate ones of the outlet lines for producing the operation of the inlet flow control valve.

The hydraulic pressure supply arrangement indicated generally at 10 delivers liquid under pres-

sure through inlet line 12 to a special equalizer inlet control valve arrangement indicated generally at 14 from which the pressure liquid is led through conduit 16 to the common inlet of a flow equalizer or divider 18 which is effective to divide the single inlet stream into a plurality of separate outlet streams adapted to be led through separate conduits 20 and 22 to corresponding fluid pressure responsive instrumentalities 24 and 26 subject to varying and different resistances to the operation thereof.

My inlet control and operating means therefore comprises essentially a valve proper 30 effective when closed against seat 32 to shut off the flow between inlet line 12 and the equalizer 18 together with pressure responsive means indicated generally at 34 effective upon the occurrence of a predetermined difference in the pressures in lines 20 and 22 to cause the closing of valve 30 and also responsive to the establishment of a lesser difference of pressure between these outlet lines effective to maintain valve 30 in the open position thereof providing for free flow to the inlet of divider 18.

In the preferred embodiment shown in the drawing, valve 30 has a generally mushroom form including a tubular stem extending from the back side of valve proper 30, terminating in a piston like guide portion 30a received in a complementary cylinder 30b. In addition the opposite face of valve proper 30 has extending therefrom a generally coaxial protuberance 30c terminating in a cam follower 30d and provided intermediate the terminals thereof with a second radially extending guide portion 30e. A coil compression spring 30f is received within a tubular extension of one terminal in engagement with the back side of valve 30, the other terminal engaging the housing, this spring tending to urge valve 30 in the direction of its seat 32. This valve seat is preferably provided by an annular ring 38 received within a complementary enlarged bore 40 and sealed with reference thereto by means of a sealing ring 42, this annular ring 38 being retained within the bore by means of a snap ring 44. An inlet passage 46 communicates with pressure supply inlet line 12. It will be noted that valve seat 32 has the same cross-sectional area as the cylinder 30b and hence with valve 30 in engagement with the seat the inlet pressure does not exert any opening force upon the valve. Valve 30 is guided and maintained in axial alignment by the cooperation of piston guide portions 30a thereof with cylindrical bore 30b and by the

cooperation of perforated guide 30e with the inner wall of annular ring 38.

The motive means indicated generally at 34 for controlling the position and operation of valve 30 in accordance with the selected value of pressure differential between fluid divider outlets 20 and 22 includes a reciprocable cam and double plunger assembly indicated generally at 48 and a pair of differential pressure responsive pistons and spring motors 50 and 52. Cam and plunger assembly 48 includes a centrally disposed elevated dwell portion 48a functioning when in mid position to hold cam follower 30d in raised position for in turn holding valve 30 in open position providing for free flow therepast. On either side of elevated dwell portion 48a there is provided a recess defined by an inclined camming surface or rise 48b effective when the cam and plunger assembly 48 is shifted from central position to allow cam follower 30d to move in valve closing direction under the influence of spring 30f. On opposite sides of the cam are opposed piston-like plungers 48c and 48d, these plungers being received respectively in cylindrical chambers 48e and 48f.

Differential pressure responsive piston and spring motive means 50 and 52, preferably similar in construction, include reciprocable pistons 50a and 52a urged by coil compression springs 50b and 52b in the direction of one another. These pistons are received within enlarged bores 50c and 52c which bores are also in alignment with smaller plunger receiving coaxial bores 48e and 48f. Plungers 48c and 48d are not actually connected to pistons 50a and 52a but engage the same respectively when the particular plunger has the end thereof projected into the enlarged piston bore 50c or 52c as the case may be. The respective differential pressure responsive motive means 50 and 52 are placed in communication with the separate fluid divider outlets 20 and 22 by lines 56 and 58. Coil compression springs 50b and 52b are substantially identical and are compressed by the same amount by suitable closure adapters 50c and 52c. The choice of springs 50b and 52b as well as the extent to which the same are compressed determines the value of the differential pressure existing between the separate divided outlet lines that is effective to produce the operation of valve 30.

In operation, under the conditions existing as illustrated in the position of the pump shown in the drawing, hydraulic fluid pressure is being delivered through inlet line 12, regulator valve inlet 46, past valve 30, and through line 16 to the common inlet of the fluid pressure divider 18 wherein the single stream is divided into a plurality of separate streams and led through conduits 20 and 22 to separate fluid pressure responsive devices shown as rams 24 and 26. So long as the back pressures in separate outlet lines 20 and 22 do not differ by an amount in excess of the value for which coil compression springs 50b and 52b are provided then these opposed pressures delivered to cylindrical bores 50c and 52c maintain the necessary counterbalancing effect upon the respective ends of plungers 48c and 48d to hold cam 48a in the mid position thereof in engagement with cam follower 30d for holding valve 30 in open position. When, however, there occurs a difference in the pressures existing in the separate outlet lines 20 and 22 the relative drop in the pressure acting on the remote end of plunger 48c or 48d as the case may be will cause the cam and plunger assembly to shift in the di-

rection of the relatively low pressure with the result that cam follower 30d is forced by springs 30f along the inclined cam rise 48b on one side or the other of elevated dwell 48a thus effecting closure of valve 30 and the shutoff of pressure through inlet 46. When this pressure differential has again been reduced below the value for which coil compression spring 50b and 52b are provided then the cam and plunger assembly will again be shifted to move elevated cam dwell 48a to the mid position thereof causing cam follower 30d to rise up along inclined cam rise 48b to thus again reopen and hold valve 30 until the selected value of differential pressure in the outlet lines is again exceeded.

While, as pointed out above, the motive means for operating shutoff valve 30 may be made responsive to a selected differential of pressure occurring in the divided outlet lines 20 and 22 the arrangement is particularly adaptable for insuring against the loss of fluid from the entire system by rupture of one or the other of the outlet lines and I have found, for example, that highly satisfactory operation is obtained where the same is arranged to close valve 30 in response to the occurrence of a pressure differential in excess of 300 lbs. per square inch.

While the herein disclosed shutoff valve arrangement is applicable in connection with fluid dividers generally adapted to supply fluid pressure consuming instrumentalities subject to varying resistances, I have found that the same operates to particular advantage in connection with a gear type divider such as that shown in Johnson patent, No. 2,291,578 and indicated schematically at 13. In this type of divider the volumetric efficiency of the respective gear units varies with variations in the back pressures in the separate outlet lines. Where the divider is employed to deliver equal quantities of pressure fluid to operate and synchronize remotely located rams and the instrumentalities operated by these rams encounter sufficiently widely differing resistances to the operation thereof then the back pressures in the outlet lines may differ so greatly that the rams are no longer maintained in synchronism. Under such conditions the system should not be continued in operation but flow thereto should be shut off. This would be particularly true where the rams are employed to operate the landing flaps of an aircraft since the stability of the plane under such conditions will depend upon the landing flaps being operated in substantially complete synchronism. It will thus appear that my special arrangement of shutoff valve and differential pressure responsive means for operating the same is not limited to the single emergency conditions resulting from rupture of one of the lines 20 or 22 but is equally applicable where it is desirable to shut off the main inlet flow in response to any selected differential of pressure appearing between the two outlet lines 20 and 22.

It will be apparent that any desired arrangement may be provided for supplying the inlet line 12 with hydraulic pressure and I have merely indicated schematically that the same may comprise a four-way valve 10a capable of selectively delivering said pressure through inlet line 12 or returning the same therefrom, a relief valve 10b, a check valve 10c, a pump and motor unit 10d as well as a supply tank 10e and the necessary additional conduit lines for returning the fluid from the rear side of the cam to the supply tank.

While I have described my invention in connection with certain specific embodiments thereof, it is to be understood that this is by way of example and that I intend my invention to be defined by the appended claims.

I claim:

1. In a flow divider arrangement including means defining a hydraulic pressure supply line, means defining a flow divider having a common inlet communicating with said supply line and a plurality of separate divided outlets adapted to be led to corresponding pressure consuming devices subject to varying resistances to the operation thereof, the combination therewith of means defining a shut off valve positioned in said inlet line to said divider, means for controlling the position of said valve including means for holding the same in open position so long as the respective pressures in said outlet do not differ by an amount which exceeds a selected value, said means being responsive to the occurrence of a pressure differential in excess of said selected value to effect closing of said valve to shut off the flow to said divider.

2. In a flow divider arrangement including means defining a hydraulic pressure supply line, means defining a flow divider having a common inlet communicating with said supply line and a plurality of separate outlets adapted to be led to corresponding pressure consuming devices subject to varying resistances to the operation thereof, the combination therewith of means defining a shutoff valve positioned in said inlet line to said divider, means for operating said shutoff valve to opened and to closed position comprising means responsive to outlet pressures in said respective outlet lines, said last named means being operable in response to the occurrence of a predetermined pressure differential between said separate outlet lines due to different resistances to flow therethrough to effect closing of said inlet line valve and operable in response to a reduction of said differential pressure to effecting opening thereof.

3. In a flow divider arrangement including means defining a hydraulic pressure supply line, means defining a flow divider having a common inlet communicating with said supply line and a plurality of separate outlets adapted to be led

to corresponding pressure consuming devices subject to varying resistances to the operation thereof, the combination therewith of means for biasing said valve toward closed position, means defining a shiftable cam having a normal position engaging said follower and holding said valve in inset position, means responsive to the occurrence of a selected maximum differential between the pressures in said separate outlets from said divider for effecting shifting of said cam to a position away from said follower whereby said valve closes and flow to said divider is shut off.

4. In a flow divider arrangement including means defining a hydraulic pressure supply line, means defining a flow divider having a common inlet communicating with said supply line and a plurality of separate divided outlets adapted to be led to corresponding pressure consuming devices subject to varying resistances to the operation thereof, the combination therewith of means defining a shutoff valve positioned in said inlet line, means for holding said valve in opened position, effecting the movement of said valve to closed position and for effecting the opening of said valve, said means comprising a pair of opposed plungers, a valve operating and holding cam interposed between said plungers for operation thereby, means placing the remote end of one of said plungers in communication with the pressure in one of said divided outlet lines and means placing the remote end of said other plunger in communication with the pressure in another outlet line, spring means urging said plungers and cam toward a mid position wherein said cam is effective to hold said valve in opened position, said plungers being responsive to the occurrence of a predetermined maximum differential of pressure between said outlet lines to move said cam from the mid-position and effect the closing of said valve to shut off the supply of inlet fluid pressure, said plungers being responsive to the reestablishment of pressures within said outlet lines differing by an amount less than said selected maximum value to effect the movement of said cam to cause the reopening of said valve.

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