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3,024,798

FLOW DIVIDER

Filed May 16, 1957

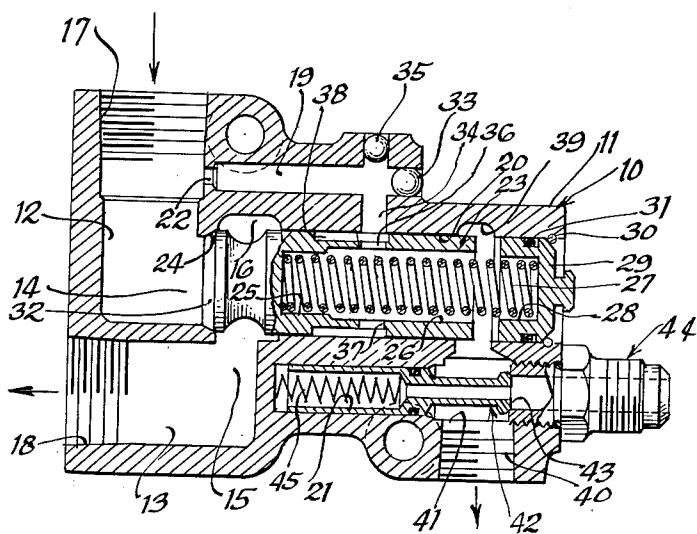


FIG. 1

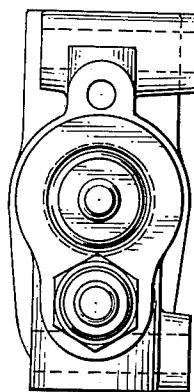


FIG. 2

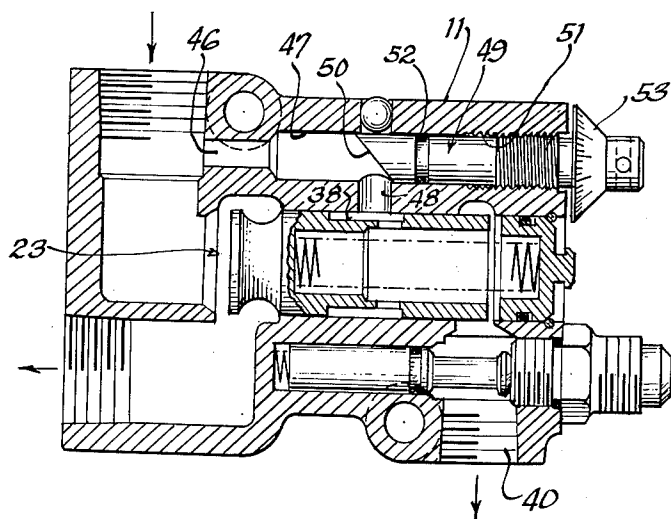


FIG. 3

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3,024,798

FLOW DIVIDER

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6 Claims. (Cl. 137-101)

This invention relates to flow dividers.

This invention is an improvement upon the valve type of flow dividers shown in my copending applications, Serial Nos. 602,581, now Patent No. 2,910,085 and 624,112, now Patent No. 2,859,762, filed August 7, 1956 and November 23, 1956, respectively. These foregoing flow dividers effect a division into two streams of a fluid stream under pressure, a spring-pressed valve in the divider producing what may be termed an excess flow stream, and an orifice in another portion of the divider producing a controlled flow stream, with means influenced by the spring pressed valve for modulating the controlled flow stream. Both of these prior devices effect such operation with a substantial reduction in the number of parts in the flow divider and with a simplification of the construction of the divider such that it could be made without resorting to precision machining and finishing of the sliding parts.

Although the foregoing prior flow dividers are simpler and less expensive than their predecessors, it is nevertheless the object of the present invention to provide a flow divider valve which uses an even simpler construction for effecting the modulation of the controlled flow stream.

Another object of this invention is to provide a variable orifice for the controlled flow stream, the orifice being manipulated by a graduated dial so that the rate of flow in the controlled flow stream may be varied at will without disassembling the valve and without resorting to trial-and-error methods to produce the desired flow.

As a more specific object, this invention seeks to provide a simple valve construction which dispenses with the usual valve sleeve, and which uses a straight bore and a poppet type seat.

These and other objects of this invention will become apparent from the following detailed description of the invention when taken together with the accompanying drawings in which:

FIG. 1 is a cross-section through a flow divider valve constructed in accordance with this invention;

FIG. 2 is an end elevation of the flow divider valve of FIG. 1;

FIG. 3 is a cross-section through a modification of the flow divider valve of FIG. 1, the modification providing a controlled and graduated means for varying the flow into one of the streams.

For a logical explanation of this invention the details of construction of the flow divider valve will be given first, followed by a description of the modification of the valve.

Referring now to FIG. 1 the valve is shown in its entirety at 10 and includes a body 11 which may be a metal casting such as cast iron, brass or one of the lighter metal alloys, the choice of material being determined by the use for which the valve is intended. Within body 11 are formed relatively large cored openings or passages 12 and 13 disposed, in the form depicted in FIG. 1, with their axes at right angles to one another. Each passage has a substantially 90° bend at its inner ends 14 and 15 respectively, the bends meeting in an annular chamber 16 formed in body 11 which may likewise be cored when the body is cast. Passages 12 and 13 are the inlet and outlet passages respectively for the valve

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and accordingly are threaded internally at their outer ends 17 and 18 to receive appropriate pipe fittings.

To the right of passages 12 and 13 as viewed in FIG. 1 are three parallel openings 19, 20 and 21 which may be drilled and reamed from the right hand side of valve body 11 as viewed in FIG. 1, thereby facilitating production of the valve by automatic equipment. Opening 19 communicates with inlet passage 12 through an orifice 22 of predetermined area which, in the completed valve, determines the amount of flow in the second outlet or controlled flow stream as will be described in detail hereinafter. Opening 20 is the largest of the three and connects with chamber 16. Said opening 20 has a modulating valve 23 slidably disposed therein which extends through said chamber 16 into proximity with a frusto-conical seat 24 formed at the end of right angle bend 14 of inlet passage 12. Valve 23 has a recess 25 and a counterbore 26 therein in the former of which is received one end of a compression spring 27, the other end of said spring being received in a recess 28 in a plug 29 held in opening 20 by a snap ring 30 and sealed with respect thereto by an annular packing ring such as O ring 31. The left hand end of valve 23 as viewed in FIG. 1 has a sharp corner 32 which is adapted to engage seat 24 to close off the inner end of passage 12 to chamber 16. Thus valve 23 is urged toward seat 24 by spring 27 and away from said seat by the pressure of the incoming fluid in passage 12. These opposing forces are utilized in a manner hereinafter to be described to modulate the second stream produced by the valve 10.

Drilled opening 19 is closed at its free end by a ball 33 or other suitable plug pressed or otherwise retained in the opening. An outlet is provided for opening 19 by a cross bore 34 which connects opening 19 with opening 20, the outer end of said cross bore being closed by a similar ball or plug 35. Communication with the interior of valve 23 is made possible by two or more cross bores 36, 37 extending inwardly of the valve from an annular groove 38 on the exterior of valve 23, said groove being sufficiently wide to receive fluid unrestrictedly from cross bore 34 in all possible positions of valve 23 in its opening 20. Adjacent the free end of valve 23 is a peripheral groove 39 which receives the fluid from the interior of valve 23 and conducts it to a connecting transverse passage 40 leading to the exterior of the valve body 11.

Passage 40 is intercepted by the enlarged portion 41 of drilled opening 21 in which is disposed a relief valve 42, said relief valve having an apertured seat 43 formed in the end of a threaded fitting 44 received in the internally threaded end of opening 21. A spring 45 normally urges valve 42 to the right as viewed in FIG. 1 against seat 43 to close the opening in fitting 44 to the fluid in passage 40. The effective diameter of seat 43 is smaller than the diameter of recess 21 so that valve 42 is always subject to fluid pressure which is unbalanced in favor of moving the valve to the left as viewed in FIG. 1 against the action of spring 45, to raise the valve from its seat 43 and thereby open passage 40 to the interior fitting 44. Thus valve 42 functions as a relief valve and, depending upon the strength of spring 45, may be made to limit the pressure in passage 40 to any desired amount.

The operation of the valve shown in FIG. 1 is as follows:

Fluid under pressure from a pump or other source is admitted to passage 12 where it enters orifice 22 and also bears against the end of valve 23. The fluid passes through orifice 22 into opening 19 and thence through cross bore 34 into groove 38, and from groove 38 through cross bores 36 and 37 to the interior of valve 23. It then passes to the right as viewed in FIG. 1 along the interior

of the valve, around the right-hand end of the valve as shown in FIG. 1 into peripheral groove 39 and then out through connecting passage 40. The fluid issuing from passage 40 may be termed the "controlled flow" in that the volume of fluid issuing therethrough remains substantially constant regardless of fluctuations in pressure of fluid in the passage 12. This control of the flow is effected by the action of the fluid under pressure against valve 23, the valve moving to the right as viewed in FIG. 1 a distance which is proportional to the pressure exerted upon the valve. As the valve moves in that direction, it progressively restricts the space between the free end of said valve 23 and the opposed inner end of plug 29 so that the greater pressure tending to increase the volumetric flow of the fluid, the greater the restriction upon such flow produced by valve 23, the net result being a substantially constant flow of fluid in outlet 40 which is independent of fluctuations of pressure in passage 12.

The movement of valve 23 to the right as viewed in FIG. 1 unseats the valve, and allows fluid to flow from passage 12 around the corner 32 of the valve and into annular chamber 16D, from which it passes through the right angle bend 15 and passage 13 to form the second stream of fluid issuing from the valve 10. This second stream may be termed the "excess flow" stream inasmuch as all fluid not passing into the controlled flow stream issuing from passage 40 finds its way into passage 13.

It may be observed that the construction of the valve shown in FIG. 1 is extremely simple in that all sleeves are eliminated and the various valve openings and passages are arranged in right angular relationship with respect to one another so that a minimum of chucking operations is required to machine the valve bores and connecting passages.

Inasmuch as orifice 22 of the FIG. 1 form is of fixed diameter, the flow issuing from passage 40 is similarly fixed. Thus the flow through the controlled flow opening 40 is determined by the size of orifice 22 and to accommodate users requiring different flow rates, a series of valve bodies having different sized orifices is necessary.

For greater ease of adjusting the flow rate to another value, particularly where it is desired to do so without disassembling the valve, the form shown in FIG. 3 may be used. The FIG. 3 form is designed to provide a variable volume flowing through passage 40, the particular volume desired being readily selectable with the aid of a graduated valve. Thus, the FIG. 3 is substantially identical to the FIG. 1 form with the exception of the provision of an enlarged orifice 46 which is now lengthened to become merely an extended passageway through the valve body 11 leading to a similarly enlarged bore 47. The slightly enlarged cross bore 48 connects valve bore 47 with groove 38 in valve 23.

Within bore 47 is a rotatable valve 49 which is threaded into bore 47 at 51 and is sealed with respect to said bore by a suitable packing ring 52. Valve 49 extends to the right as viewed in FIG. 3 outwardly of valve body 11 and has secured to the extending end thereof a graduated knob 53, the graduations of which may be designated in terms of gallons per minute or in any other desirable volumetric units. The inner end 50 of valve 49 normally extends across cross bore 48, but is cut off at an angle such as 45° so that when the valve is in an angular position such as that shown in FIG. 3, the cross bore 48 is completely exposed, and when the valve is turned 180° away from the position shown in FIG. 3, cross bore 48 is completely closed. Between these two extreme positions is an infinite variety of settings for restricting the flow of fluid into cross bore 48 from bore 47, thereby providing in effect a variable orifice which in turn provides a means for varying the volume of fluid issuing from the controlled flow passage 40.

I claim:

1. A flow divider valve comprising a valve body having an inlet opening, an excess flow opening and a con-

trolled flow opening, a valve bore communicating with the inlet and excess flow openings, a valve seat intermediate the inlet and excess flow openings, a valve in the valve bore and having an effective radially disposed area exposed to the fluid in the inlet opening, said valve having opposed ends an annular surface on the valve adjacent one of said ends thereof and adapted to seat upon said valve seat to close the inlet opening to the excess flow opening, a passage in the valve body connecting the inlet opening to the exterior of the said valve and having an orifice therein, said valve having an axially disposed recess therein opening upon the end of the valve opposite the valve seat and a cross bore connecting the passage with the recess in the valve, a fixed abutment adjacent the recess end of the valve, a passage communicating the controlled flow opening with the space between the recess end of the valve and the abutment adjacent thereto, and resilient means urging the valve against its seat, said valve sliding axially in the bore and reducing the said space in proportion to the pressure differential exerted against the valve by the fluid in the inlet passage in one direction and by the fluid in the recess in the opposite direction, whereby to modulate the flow through the controlled flow outlet.

2. A flow divider valve comprising a valve body having parallel bores therein, an inlet bore disposed transversely of the said parallel bores and connected to one of the parallel bores through an orifice and intersecting the other of said bores, a valve seat substantially at the said intersection of the inlet and the other of said bores, an annular groove in the valve body in the other of the bores adjacent the seat, an excess flow outlet in the valve having opposed ends and body connected with said groove, a valve slidable in said other bore, said valve being adapted to have one end thereof engage the seat to close the annular groove to the excess flow outlet, said valve having a recess extending inwardly from the other end thereof, means closing the said other bore, an opening in the valve body adjacent the recess end of the valve in communication with the recess and variably closed by the valve as it reciprocates in its bore, a controlled flow outlet and a passage connecting the last mentioned opening with the controlled flow outlet, said valve having a cross bore therein communicating the recess with the exterior of the valve, and a passage in the valve body communicating the cross bore of the valve with the said one of the said parallel bores.

3. A flow divider valve comprising a valve body having an inlet opening, an excess flow opening and a controlled flow opening, a valve bore communicating with the inlet and excess flow openings, a valve seat on the valve body intermediate the inlet and excess flow openings, a valve in the valve bore and having an effective area exposed to the inlet opening, said valve having opposed ends, an annular surface on the valve adjacent one of said ends and adapted to seat upon said valve seat to close the inlet opening to the excess flow opening, spring means acting upon the valve in opposition to the pressure of the fluid in the inlet opening to seat the valve on its said seat, said valve having a recess therein opening upon the other of said ends thereof, a passageway connecting the inlet opening to the controlled flow opening through the recess in the valve, said valve being interposed in a portion of said passageway and exposed to the pressure of the fluid in the controlled flow passageway in opposition to the pressure of the fluid upon said one of said ends of the valve exposed to the inlet opening, said valve modulating the effective flow capacity of the passageway in accordance with the pressure differential between the inlet opening on the one hand and the spring pressure and the pressure in the controlled flow on the other hand, and means for variably restricting the flow of fluid from the inlet opening in the valve body to the said portion of said passageway.

4. A flow divider as described in claim 3, said passageway connecting the inlet opening with the controlled flow

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opening including a second bore extending from the exterior of the valve body to the inlet opening and a cross bore, and said variable restricting means comprising a cylinder extending into the said second bore and having a chamfered end overlying the cross bore and closing said bore as a function of the angular position of the chamfered end in the second bore.

5. A flow divider as described in claim 3, said passage-way connecting the inlet opening with the controlled flow opening including a second bore substantially parallel with the valve bore and a first cross bore, said recess extending axially of said valve and communicating with the exterior of the valve around the end thereof opposite said one of said ends, cross bores in the valve communicating with the first cross bore, an abutment in the valve bore in proximity to the valve and adapted to restrict the axially extending recess in the valve to produce a modulation of the flow through the controlled flow opening as aforesaid, and said means for variably restricting the flow of fluid from the inlet opening comprising a second valve disposed

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in proximity to the first cross bore and movable to vary the effective opening of said first cross bore.

6. A flow divider as described in claim 5, said second valve being rotatable and having a chamfered end in proximity to the first cross bore such that rotation of the second valve causes a variation in the effective size of the first cross bore, and graduated means exterior to the valve body and secured to the second valve for indicating the rate of flow through the controlled flow opening.

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**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 3,024,798

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Oscar H. Banker

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 3, line 22, for "16D" read -- 16 --; column 4, lines 32 and 33, strike out "having opposed ends and" and insert the same after "valve", first occurrence, in line 34, same column 4.

Signed and sealed this 10th day of July 1962.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents