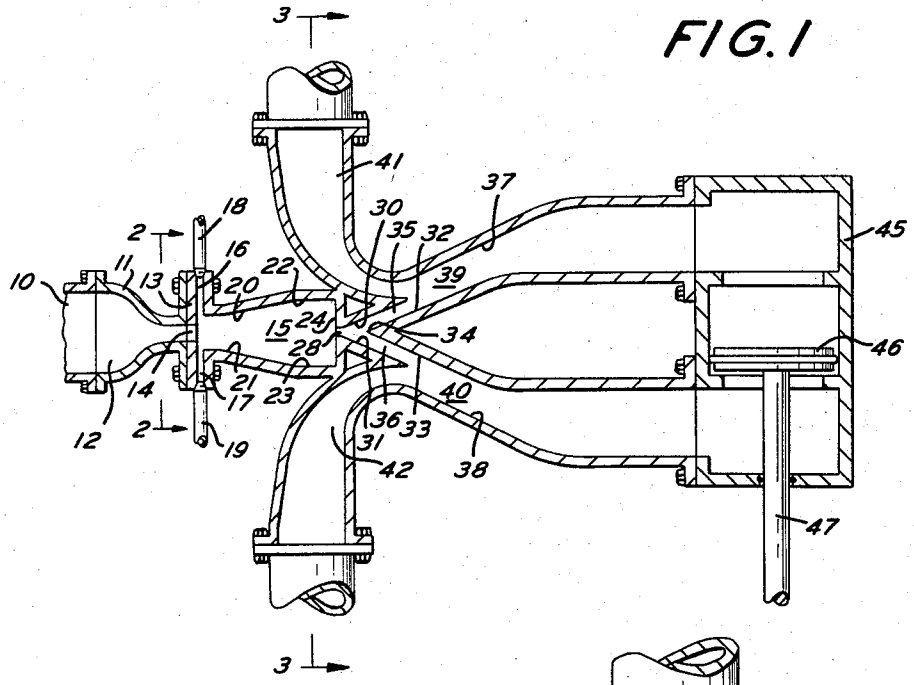
March 19, 1968 R. B. ADAMS ETAL 3,373,760

FLUID CONTROL APPARATUS

Filed Feb. 24, 1965

FIG. 1



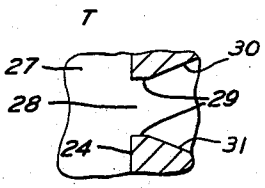


FIG. 4

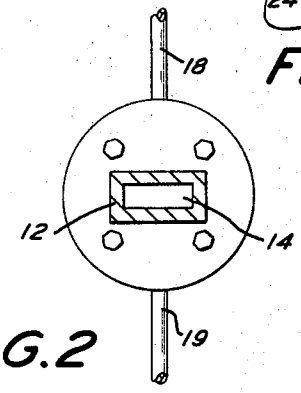


FIG. 2

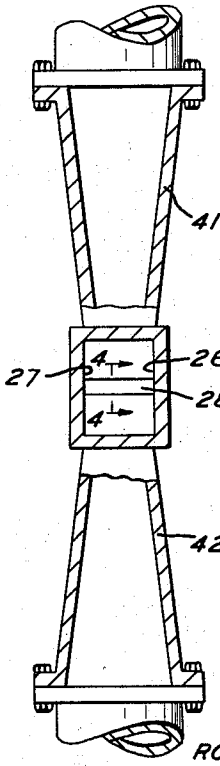


FIG. 3

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FLUID CONTROL APPARATUS

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11 Claims. (Cl. 137—81.5)

ABSTRACT OF THE DISCLOSURE

Fluid flow control apparatus having a fluid interaction chamber with a single outlet smaller than the inlet and with a blunt end at the outlet of the chamber, diverging collecting passageways being provided beyond the chamber with backward vents.

This invention relates to fluid control apparatus and more particularly to a two position diverting valve.

It has heretofore been proposed to provide a fluid control apparatus in which a fluid jet is delivered into a fluid interaction chamber, ports being provided on one or both sides of the jet for steering the jet, the chamber having opposite diverging and converting side walls with a discharge opening to which the converging side walls extend.

The chambers heretofore available were limited as to the deflection possible to be attained.

It is the principal object of the present invention to provide fluid control apparatus having a fluid interaction chamber and entrance nozzle with improved operating qualities in the chamber and particularly reduction of turbulence and attendant energy loss thereby obtaining increased efficiency and pressure recovery.

It is a further object of the present invention to provide fluid control apparatus having a fluid interaction chamber and entrance nozzle in which the chamber is shorter than those heretofore available for a particular discharge deflection.

It is a further object of the present invention to provide fluid control apparatus having a fluid interaction chamber and entrance nozzle in which the chamber, at the delivery end has a transverse delivery end in which the discharge port is located, the chamber permitting a divider therebeyond to be closer to the discharge port.

Other objects and advantageous features of the invention will be apparent from the description and claims.

The nature and characteristic features of the invention will be more readily understood from the following description taken in connection with the accompanying drawings forming part thereof, in which:

FIGURE 1 is a longitudinal sectional view of fluid control apparatus in accordance with the invention;

FIG. 2 is a transverse sectional view taken approximately on the line 2—2 of FIG. 1;

FIG. 3 is a transverse sectional view taken approximately on the line 3—3 of FIG. 1; and

FIG. 4 is an enlarged longitudinal sectional view of the exit opening of the interaction chamber, taken approximately on the line 4—4 of FIG. 3.

It should, of course, be understood that the description and drawings herein are illustrative merely, and that various modifications and changes can be made in the structure disclosed without departing from the spirit of the invention.

Referring now more particularly to the drawings a fluid supply pipe **10** is provided extending to a supply section **11** having a passageway **12** for supplying fluid through a nozzle plate **13** having a nozzle opening **14** into a fluid interaction chamber **15**. The chamber **15**, at opposite sides of the nozzle opening **14** has ports **16** and **17** with fluid connections **18** and **19** for pressure fluid or vacuum

supply to determine the positioning of the jet, preferably rectangular in cross section, from the nozzle opening **14**.

The interaction chamber **15** has opposite diverging side walls **20** and **21** with straight parallel side walls **22** and **23** extending therefrom to a transverse end wall **24** providing an angle of convergence of at least 180°. The chamber **15**, also, has spaced parallel top and bottom walls **26** and **27**,

The end wall **24**, at the center thereof and preferably in longitudinal axial alignment with the center of the nozzle opening **14** has an exit opening **28**.

Assuming uniform height of the nozzle opening **14**, and chamber **15**, if the width of the nozzle opening be taken as w, then the length of the chamber **15** from the nozzle plate **13** to the end wall **24** is of the order of $5\frac{3}{4}w$, and the width of the opening **28** is of the order of $\frac{3}{4}w$.

The opening **28** (see FIG. 4) preferably has parallel sides **29** for about $\frac{1}{10}w$, and therebeyond diverging walls **30** and **31** which, with walls **32** and **33** extending to a divider **34**, provide delivery passageways **35** and **36**.

The delivery passageways **35** and **36** for the uniform height referred to above, are preferably each of a width about 10% less than the width of the opening **28**.

The provision of the end wall **24** and opening **28**, as herein described, permits of a wider angle of disposition of the walls **30** and **31** than would otherwise be feasible.

The walls **30** and **31** therebeyond and offset outwardly therefrom have walls **37** and **38** which, with walls **32** and **33** bound passageways **39** and **40**.

The junctions of the passageways **35** and **39** and of the passageways **36** and **40** have backwardly extending diverging vent passageways **41** and **42** which provide for return of fluid to a reservoir (not shown).

The passageways **39** and **40** can be connected to any desired device, such as a fluid actuator or motor. By way of illustration, the passageways **39** and **40** are shown as connected to opposite ends of a cylinder **45** having a piston **46** movable therein with a piston rod **47** extending through one head of the cylinder **45** for providing an actuating movement.

The mode of operation will now be pointed out.

Fluid under pressure supplied through the pipe **10** and supply section **11** is delivered through the nozzle opening **14** as a rectangular jet into the fluid interaction chamber **15**. The pressure conditions at the ports **16** and **17** determine the extent of deflection of the jet from the opening **14**. The fluid passes through the chamber **15** and through the exit opening **28**, the direction being determined by the pressure conditions at the ports **16** and **17**.

With the exit opening **28** narrower than the nozzle opening **14** there is a relatively lower pressure drop across the nozzle opening **14** and a lower velocity inside the chamber **15** is utilized. This lower velocity inside the chamber **15** results in less turbulent flow with higher total energy of the fluid as it leaves the chamber **15**.

With lower inlet pressure drop at the nozzle opening **14** there is a higher outlet pressure drop at the opening **28** at which point the fluid stream receives additional acceleration for movement along the passageways **35** and **36**. The acceleration is in direction parallel to the axis rather than in a direction of the stream flow, that is at an angle to the axis, and hence this accelerating force tends to straighten out the stream.

It is desired that the stream have the greatest possible deflection in its extreme positions. This permits bringing the divider **34** closer to the exit opening **28** thereby reducing the free travel distance of the unconfined jet with consequent improvement of the efficiency and pressure recovery.

The blunt shaping of the outlet end of the chamber **15** aids in reducing the unbalanced pressures across the

stream at the exit opening 28 of the chamber 15 which tend to straighten the jet.

The blunt shaping of the outlet end of the chamber 15 causes any fluid caught against the opposite side to veer off at a more gentle angle with less build up of back pressure in this region.

With the structure as herein disclosed full flow in passageways 35 and 39 or in passageways 36 and 40 can be effected with a back pressure up to 70% of the supply pressure.

When the passageways 39 and 40 are connected to a motor cylinder 45 up to 70% of the supply pressure can be delivered to either end of the cylinder 45 in the locked condition of the piston rod 47 while the pressure at the opposite end is atmospheric.

It will thus be seen that apparatus has been provided for carrying out the objects of the invention.

We claim:

1. Fluid flow control apparatus comprising
a fluid interaction chamber having an inlet for directing a jet of fluid into said chamber, and
members for controlling the direction of said jet in said chamber,
said chamber having a single outlet spaced from said inlet of smaller size than said inlet,
said chamber having jet controlling diverging walls and having jet controlling converging walls at the outlet end of said chamber with straight wall portions extending outwardly from opposite sides of said outlet with an angle of convergence of at least 180°.

2. Fluid flow control apparatus as defined in claim 1 in which
divergent collecting passageways are provided beyond said outlet with a divider separating said passageways.

3. Fluid flow control apparatus as defined in claim 2 in which
said collecting passageways each has a backward vent.

4. Fluid flow control apparatus as defined in claim 3 in which
a fluid pressure responsive member is provided, and
said collecting pasageways are connected to opposite sides of said fluid pressure responsive member.

5. Fluid flow control apparatus as defined in claim 2 in which
a fluid pressure responsive member is provided, and
said collecting passageways are connected to opposite sides of said fluid pressure responsive member.

6. Fluid flow control apparatus comprising
a fluid interaction chamber having an inlet for directing a jet of fluid into said chamber,
member for controlling the direction of said jet in said chamber,

said chamber having a discharge end in which a single discharge opening is located with straight wall portions extending outwardly from said discharge opening at said discharge end and having an angle of convergence of at least 180°.

7. Fluid flow control apparatus is defined in claim 6 in which
divergent collecting passageways are provided beyond said outlet with a divider separating said passageways.

8. Fluid flow control apparatus as defined in claim 6 in which
said collecting passageways each has a backward vent.

9. Fluid flow control apparatus as defined in claim 8 in which
a fluid pressure responsive member is provided, and
said collecting passageways are connected to opposite sides of said fluid pressure responsive member.

10. Fluid flow control apparatus as defined in claim 6 in which
a fluid pressure responsive member is provided, and
said collecting passageways are connected to opposite sides of said fluid pressure responsive member.

11. Fluid flow control apparatus comprising
a fluid interaction chamber having an inlet for directing a jet of fluid into said chamber, and
members for controlling the direction of said jet in said chamber,
said chamber having a single outlet spaced from said inlet of smaller size than said inlet,
said chamber having jet controlling diverging walls and having jet controlling converging walls at the outlet end of said chamber with straight wall portions extending outwardly from opposite sides of said outlet with an angle of convergence of at least 180°,
the width of the outlet being of the order of three fourths of the width of the inlet.

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