

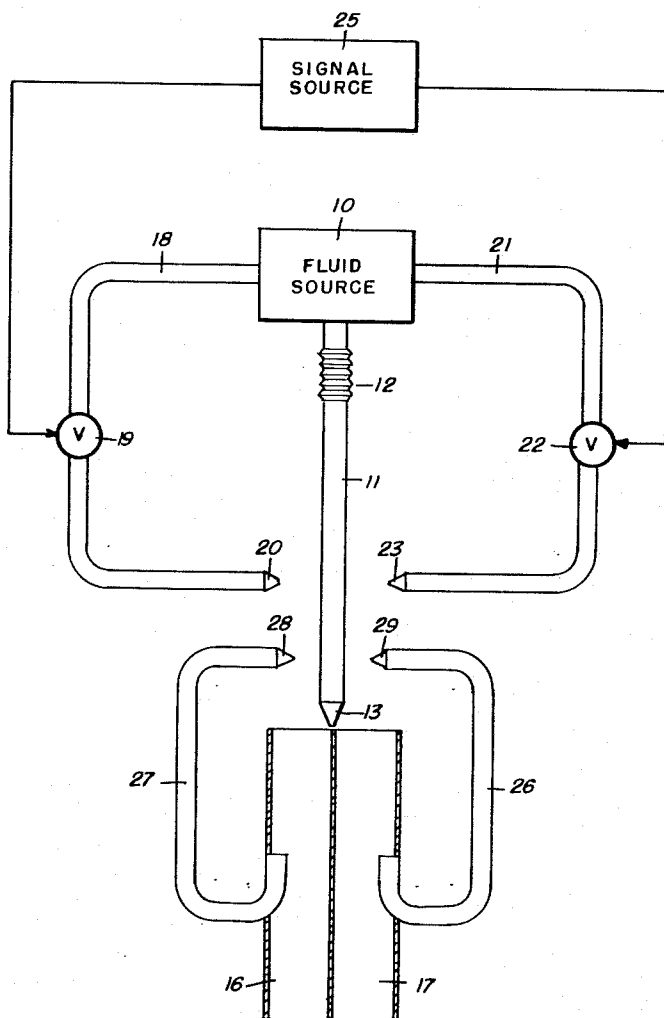
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H. HURVITZ

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BOUNDED JET FLUID AMPLIFIERS

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INVENTOR

HYMAN HURVITZ

BY *Hurvitz + Rose*

ATTORNEYS

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BOUNDED JET FLUID AMPLIFIERS

Hyman Hurvitz, 1313 Juniper St. NW., Washington, D.C.

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5 Claims. (Cl. 137—83)

The present invention relates to fluid amplifier and more particularly to fluid amplifiers utilizing confined or bounded power jets, in distinction to the free, unbounded or unconfined power jets heretofore known.

Fluid amplifiers are known which utilize no mechanically moving parts except the fluid. In such amplifiers an unbounded or unconfined power jet of fluid is directed toward two channels, so that the fluid divides equally therebetween. Control jets of fluid are then applied directly to the power jet, to deflect the latter transversely, so that more fluid flows into one or the other of the channels. The change in fluid flow in either channel is essentially an output signal, and amplification is provided in that a small mass flow of control fluid can deflect a large mass flow in the power jet, or a low pressure control jet can control a high pressure power jet. Systems of the type described have rapid responses, because only fluid is moved, and no mechanically moving parts are involved.

For many purposes extremely high speed movement of the power jets of fluid amplifiers is not essential for any one of many reasons, or high speed overall response of a system may in any event be unattainable because a utilization device, i.e. a device moved by the controlled power jet, has considerable inertia, or because the control jets are themselves controlled by slowly acting mechanical valves.

In such cases the fact that the power jet is free and unbounded after leaving the jet forming nozzle may be a disadvantage because the free power jet diverges slightly on leaving the power nozzle and therefore it is necessary to effect a considerable jet deflection to accomplish complete transfer of the power jet from one to another of the output channels.

According to one aspect of the present invention the power jet is confined or bounded in a very light weight, readily deflectable tube until it reaches the output channels. The tube may be made of highly flexible plastic, cloth, fabric, or rubber or very thin metal, as convenient, and may have a relatively small or large output orifice, or one of any desired shape or size. Relatively little mass is added to the power jet by the tube, so that neither the power required in the control jets to deflect the power jet, nor the speed of transverse motion of the power jet, are appreciably increased, especially in the case of liquid jets, but the extent of deflection of the power jet required to effect complete transfer of the power jet from one channel to another is reduced sharply.

Negative feed-back may be optionally employed, in the fluid circuit, to maintain the power jet precisely balanced in response to zero input signal, so that if a mechanical element is differentially moved by the pressures in the two channels, it will maintain a balanced or zero position in response to zero input signal. Oscillation of the system is thereby prevented.

The system of the invention is particularly desirable where a large cross section of flow is involved, at low pressures. In such case there is or need be no leakage as between channels, regardless of the size of the channels and the transverse dimensions of the power jet, or the slow velocity of fluid flow therein.

It is, accordingly, a broad object of the present invention, to provide a novel fluid amplifier, employing a confined or bounded power jet.

The above and still further objects, features and ad-

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vantages of the present invention will become apparent upon consideration of the following detailed description of one specific embodiment thereof, especially when taken in conjunction with the accompanying drawings, wherein:

5 The single figure is a functional diagram of a system according to the invention.

In the drawings, 10 is a source of fluid under pressure. The fluid passes from source 10 through a confining or boundary tube 11, which may include a bellows 12 to impart deflectability to tube 11, if the tube itself has insufficient resilience for this purpose. In the alternative the tube 10 may be fabricated of resilient flexible material such as thin rubber or suitable plastic, or cloth or fabric. The tube 11 terminates in a nozzle 13. The latter may converge to a very small opening, for egress of fluid, or for some purposes the tube 11 including its exit opening may be of uniform size throughout, or it may flare at its exit. The cross-section of tube 11 may be of any desired shape or configuration.

20 The egress end of tube 11 terminates at the input ends of a pair of channels 16, 17, and may precisely straddle the boundary between the channels so as to project fluid equally into both channels. Fluid from source 10 is conveyed via line 18 and electrical control valve 19 to a transverse control nozzle 20, which projects fluid against tube 11, tending to deflect it to the right. Fluid from source 10 is also conveyed via line 21 and electrical control valve 22 to a transverse control nozzle 23, which projects fluid against tube 11, tending to deflect it to the left.

The valves 19, 22 are controlled in push-pull relation in response to electrical signals deriving from signal source 25.

35 Fluid from channel 17 may be diverted in negative feed-back loop 26, which leads to nozzle 29, which projects fluid against tube 11 tending to move it to the left. A right deflecting negative feed-back loop 27, abstracts fluid from channel 16, and applies the fluid via nozzle 28 to tend to deflect tube 11 to the right.

40 In operation, an increase of electrical signal applied to valve 19, accompanied by a corresponding decrease in electrical signal applied to valve 22, both from signal source 25, causes an increase in fluid flow from nozzle 20 and a decrease from nozzle 23. The tube 11 is then deflected to the right, increasing fluid flow in channel 17 and decreasing fluid flow in channel 16. The feed-back loop 17 then acquires a greater flow, and feed-back loop 27a smaller flow. The nozzle 29 projects fluid against 45 11, tending to overcome the impact against tube 11 of fluid from nozzle 20. The nozzle 28 tends to move tube 11 to the right, tending to overcome the impact against tube 11 of fluid from nozzle 23.

50 The feed-back loops 26, 27 tend to center the tube with respect to channels 16, 17, and assure equal flow in these channels in response to zero input signal from signal source 25.

55 While I have described and illustrated one specific embodiment of the present invention, it will become apparent that variations of the specific details of construction may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

What I claim is:

65 1. A fluid amplifier, comprising a power jet, a deflectable elongated enclosure for said power jet, said elongated enclosure being arranged to confine said power jet within predetermined boundaries, said elongated enclosure having an egress aperture for said power jet, at least one fluid control jet, said at least one fluid control jet being arranged to project fluid against said elongated enclosure in a direction having a component perpendicular

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to the direction of flow of fluid in said elongated enclosure, and means for controlling flow of said fluid from said at least one fluid control jet.

2. The combination according to claim 1 wherein is provided two channels having entrances facing said egress aperture and so located as to accept equal flows of fluid from said power jet in one position of said enclosure, said enclosure being arranged to be deflected in response to fluid flow from said at least one fluid control jet so as to modify the proportions of fluid flow from said egress aperture to said entrances.

3. The combination according to claim 2 wherein is provided at least one feed-back path from said channels to said at least one control jet.

4. In a fluid amplifier, a source of fluid flow, a first channel confining said fluid flow, a second channel communicating with said first channel, a third channel com-

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municating with said first channel, a deflectable tube connected to said first channel and positioned to proportion the flow of said fluid from said first channel to said second and third channels, respectively, according to the deflected position of said deflectable tube, at least one source of control fluid flow, means for directing control fluid flow deriving from said last mentioned source against said tube in deflecting relation, and means for controlling said control fluid flow.

5. The combination against claim 4 wherein is provided means for directing fluid flow from said second and third channels to control the deflected position of said tube as a function of the relative flows of fluid in said second and third channels.

No references cited.