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ACOUSTICALLY OR ELECTRICALLY CONTROLLED FLUID AMPLIFIERS

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FIG. 1

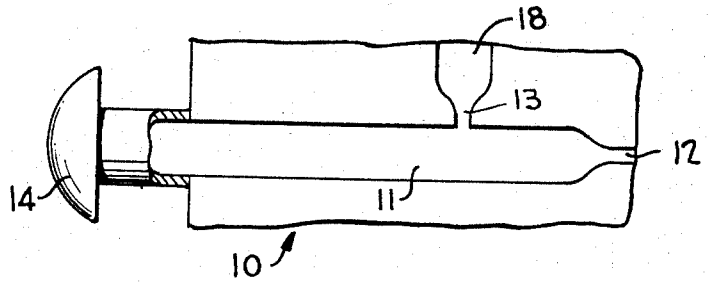


FIG. 2

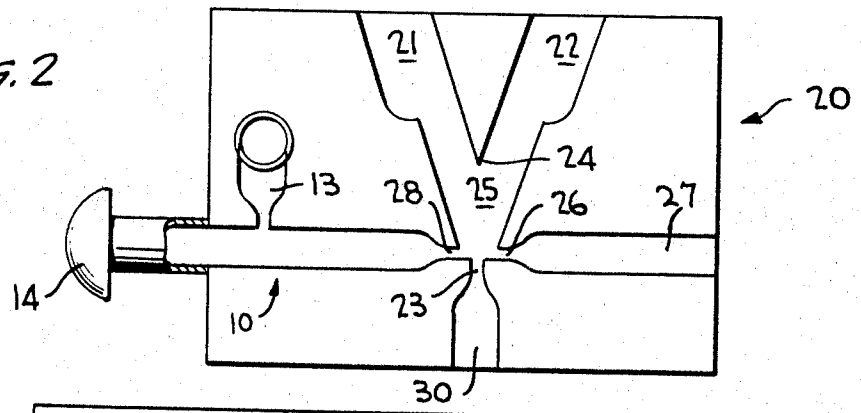
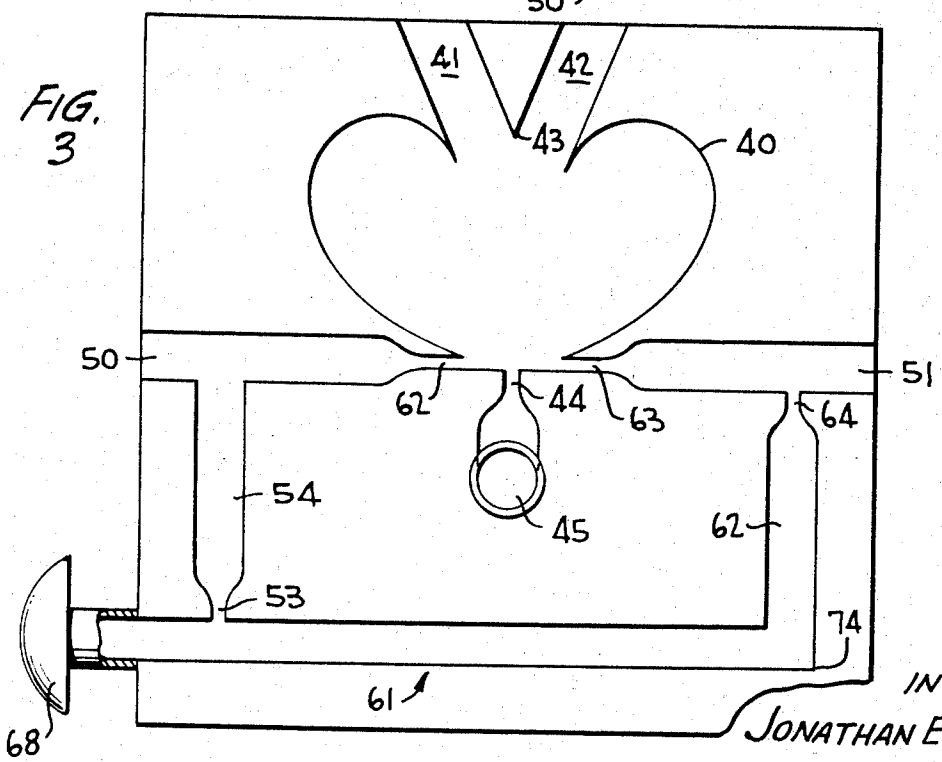


FIG. 3



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ACOUSTICALLY OR ELECTRICALLY CONTROLLED FLUID AMPLIFIERS

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This invention relates to fluid amplifiers and more particularly to means for acoustically or electrically controlling the power stream of a fluid amplifier. The switching of the power stream in accordance with the present invention is provided by a pressure transducer which provides a fluid pulse to act on the power stream of a fluid signal can be greatly amplified.

Pure fluid amplifiers are a relatively new addition to the control art and are characterized by their ability to amplify fluid signals, and perform related operations, without the need for moving mechanical parts.

A typical pure fluid amplifier includes a power jet nozzle from which a power stream emanates. A short distance from the center of the power jet nozzle is a divider which defines two output channels through either of which the power stream can discharge to provide a fluid output. Various schemes are available for controlling the power stream of which the most popular is a pair of fluid control nozzles adjacent, and at right angles, to the power jet nozzle. The fluid control nozzles will receive the signal to be amplified and by directing fluid against the power stream can control the movements of the latter. Only a small amount of energy in the control nozzle is necessary to control the mainstream's direction and thus a small fluid signal can be greatly amplifiied.

The present invention is concerned with providing means to use an electric or acoustic signal to control the power stream of a fluid amplifier. In many control applications it is desirable to use an acoustic or electric signal to provide a control signal for a control device, such as a fluid amplifier, without the need for complex devices to adapt the signal for the amplifier. Applicant has provided a simple, yet efficient, system for employing an acoustic or electric signal to control a fluid amplifier.

It is therefore an object of the present invention to provide for the switching of a fluid amplifier by means of an acoustic or electric signal.

Another object of the invention is to provide means for converting an acoustic or electric signal into a fluid pulse.

A further object of the present invention is to provide for the simultaneous increase and decrease of pressure at the control nozzles of a fluid amplifier.

Further objects, features and advantages of the present invention will become apparent upon consideration of the following specification and drawing, wherein:

FIG. 1 is a schematic representation of a pressure driver for converting an acoustic or electric signal into a pressure signal.

FIG. 2 is a schematic representation of a fluid amplifier adapted to be controlled by an acoustic or electric signal in accordance with the invention.

FIG. 3 is a schematic illustration of an acoustic or electric signal controlling proportional amplifier.

In FIG. 1 pressure generator **10** includes transmission pipe **11**. The pipe at its right end opens into discharge nozzle **12** which is a converging nozzle. An inlet nozzle **13**, which is placed along the length of pipe **11**, is similarly a converging nozzle but is inverted with respect to the interior of pipe **11**. Inlet nozzle **13** communicates with a source of fluid **18** while discharge nozzle **12** delivers positive pressure to the device to be activated. At the left end of pipe **11** is a pressure driver **14** which is simply

a device for sensing an acoustic or electric signal and producing a pressure pulse in response to the sensed signal. A typical pressure driver could be a loud speaker, an electrically vibrated diaphragm, or a piezo-electric device for converting electric signals into mechanical movement which would create a pressure pulse. A pressure driven diaphragm could similarly be used.

When pressure driver **14** receives a signal it will produce a series of pressure waves as the pressure driver includes a vibrating element; for a speaker the cone will vibrate, for a piezo-electric device the crystal will vibrate and for an electrically or pressure vibrated diaphragm the diaphragm will vibrate. As the moving element of pressure driver **14** moves into pipe **11** it will decrease the volume of the pipe **11** and correspondingly increase the pressure in the pipe. The increased pressure in pipe will discharge from nozzle **12** and not nozzle **13** because of their symmetry with respect to the interior of pipe **11**. Nozzle **13** is inverted with respect to the interior of pipe **11** while nozzle **12** provides a smooth discharge from the interior of the pipe. Thus, for any increase in pressure in the interior of pipe **11**, the fluid will discharge from nozzle **12** as it will provide the path of least resistance from the fluid in pipe **11**. As the vibrating device of pressure driver **14** moves to the left of transmisison pipe **11** the volume inside the pipe will increase and the pressure will decrease inside the pipe. Fluid from source **18** will flow into pipe **11** via nozzle **13** since the interior of the pipe will be at a low pressure. Very little fluid will flow into the pipe from nozzle **12** as this nozzle is inverted with respect to flow from the outside of the pipe to the interior presenting a path of high impedance for flow into the pipe. Thus it can be readily seen that as the vibrating device of pressure driver **14** is moved fluid will alternately be sucked into pipe **11** by inlet nozzle **13** and discharged through discharge nozzle **12** thus providing for a positive pressure output.

In FIG. 2 a bistable fluid amplifier **20** is shown having outlets **21** and **22** separated by splitter **24**. Power fluid issues from power nozzle **23** which is supplied with fluid from a source of pressure **30**. Adjacent power nozzle **23** are control nozzles **28** and **26**. Each control nozzle is positioned with respect to power nozzle **23** so as to be able to control the direction of fluid issuing from power nozzle **23**. Control nozzle **26** receives the signal to be amplified by conduit **27** while control nozzle **28** coincides with the discharge nozzle **12** of a pressure generator **10**.

If fluid from power nozzle **23** is discharging from outlet **21** no signal from control nozzle **26** is necessary to maintain this discharge as the system is a bistable one. If signal is received by the pressure driver **14** and translated into a pressure signal to left control nozzle **28**, the fluid from the nozzle will switch the fluid from outlet **22** in a manner well-known in the art. Thus it can be seen that I have provided for means to switch a bistable fluid amplifier by means of an electrical or acoustical energy signal.

In FIG. 3 a proportional amplifier **40** is shown having outlets **41** and **42** separated by splitter **43**. A main power stream supplied by a suitable source **45** issues from nozzle **44**. Adjacent nozzle **44** are control nozzles **62** and **63**. Control nozzles **62** and **63** are connected with a signaling pressure by conduits **50** and **51** respectively in their operative state and in their quiescent state are merely closed from ambient or connected with the ambient through a restricted means. Communicating with conduit **50** by conduit **54** and inlet nozzle **53** is transmission pipe **61** having a pressure driver **68** at one end. The pipe **61** has a bend **74** in it which leads to section **62** of the pipe which terminates in discharge nozzle **64** which leads to conduit **51**.

In the normal operation of the proportional amplifier fluid issuing from nozzle **44** will issue from outlets **41** and **42** depending on the signals received by control nozzles

62 and 63 in a manner well-known in the art. If it is desired to deflect more of the output from nozzle 44 to outlet 41 a signal, either electrical or acoustical, will be sent and detected by pressure driver 68. If the signal is electrical in nature the driver could be a loudspeaker, a piezo-electric device, an electrically vibrated element or any other well-known device. A diaphragm could also be used if a pressure signal were applied thereto. When the pressure driver 68 is activated fluid is driven from transmission pipe 61 and discharge nozzle 64 to conduit 51. Since conduit 51 is blocked off or restricted when it is not receiving a fluid signal the flow from pipe 61 flows out control nozzle 63 directing more flow from nozzle 44 to outlet 41 and less flow to outlet 42. It is also noted that during the active state of pressure driver 68 fluid is being sucked from left control nozzle 62 into transmission pipe 61 because of the low pressure created in the pipe when fluid is discharged out nozzle 64. The suction created by the pipe when coupled with the positive pressure output is extremely effective to control a proportional amplifier. Thus, it can be seen, I have shown a simple way to use an acoustic or electric signal to control a fluid amplifier.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction and arrangement within the scope of the invention as defined in the appended claims.

I claim as my invention:

1. A proportional fluid amplifier comprising: an interaction chamber, power nozzle means to direct fluid into said interaction chamber, plural outlets communicating with said interaction chamber, one control nozzle adjacent one side of said power nozzle, a second control nozzle adjacent the other side of said power nozzle, means to simultaneously create a suction pulse on said one control nozzle and a pressure pulse on said second control nozzle, said means to simultaneously create a suction pulse on said one control nozzle and a pressure pulse on said second control nozzle including a transmission pipe having two ends and interconnecting said control nozzles, and a pressure transducer located at one end of said transmission pipe and a discharge nozzle at said other end being communicated to said second control nozzle, an inlet nozzle for said transmission pipe, said inlet nozzle being inverted with respect to the interior of said transmission pipe and communicating with said one control nozzle.

2. A device according to claim 1 wherein said pressure transducer is a loudspeaker.

3. A device according to claim 1 wherein said pressure transducer includes means to transform electrical signals into pressure waves in said transmission pipe.

4. A device according to claim 1 wherein said pressure transducer is a pressure operated diaphragm.

5. In a fluid amplifier having a power nozzle, two control nozzles positioned opposite each other and perpendicular to said power nozzle, a splitter downstream of said power nozzle defining two outlets, the improvement comprising: a transmission pipe having two ends and communicating with one of said control nozzles, said transmission pipe having pressure transducer means at one end and a discharge nozzle at the other end to communicate with said one control nozzle, an inlet converging nozzle placed along the length of said pipe and positioned with respect to the interior of the pipe to provide low impedance to flow to said interior of said pipe and high impedance to flow from said interior of said pipe.

6. A device according to claim 4 wherein said pressure transducer is a loudspeaker.

7. A device according to claim 4 wherein said pressure transducers includes means to transform electric signals into pressure waves in said pipe.

8. A device according to claim 4 wherein said transducer is a pressure driven diaphragm.

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