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REVERSE ACTING PNEUMATIC AMPLIFIER

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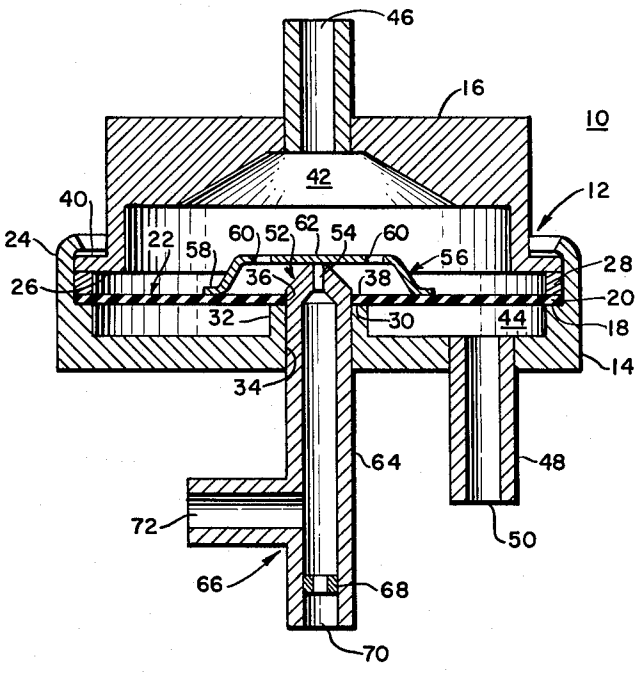


FIG. 1.

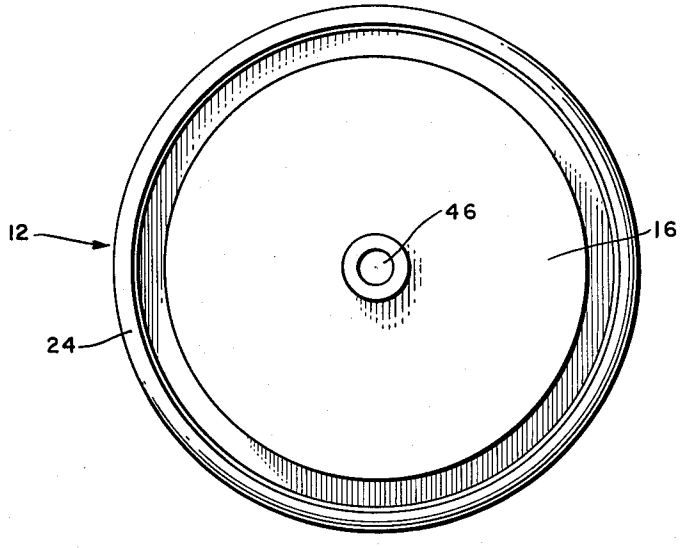


FIG. 2.

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REVERSE ACTING PNEUMATIC AMPLIFIER

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This invention relates to pneumatic amplifiers and more particularly, to a pneumatic amplifier wherein an increase in the input signal results in a decrease of the output signal.

It is an object of this invention to provide a pneumatic amplifier where large changes in output pressure are provided by small changes in input pressure.

Another object of the present invention is to provide a pneumatic amplifier having high gain characteristics wherein the change in output pressure is inversely proportional to a change in input pressure.

Still another object of this invention is to provide a pneumatic amplifier of the reverse acting type wherein a novel single diaphragm and integral flapper combination provides the only active element.

These and other objects of this invention will become apparent with reference to the following specification and drawings which relate to a preferred embodiment of the invention.

In the drawings:

FIGURE 1 is a schematic cross-section of the invention; and

FIGURE 2 is a top plan view of FIGURE 1.

Referring now to the drawings, the pneumatic amplifier **10** is shown to include a hollow cylindrical casing or housing **12** comprising two interlocked housing portions hereinafter referred to as the base **14** and the end cap **16**.

The base portion **14** includes an internal peripheral shoulder **18** on which is mounted the peripheral flange **20** of a flexible diaphragm **22**. The upper end of the base portion **14**, as shown, is open and of a size to internally receive the lower end of the end cap **16**. The upper end of the said base **14** from the shoulder **18** comprises a thin walled extended portion **24**.

The end cap is also shaped like a hollow cylinder with the inner end **26** thereof dimensioned to abut a peripherally disposed gasket or compression ring **28** in juxtaposition with the peripheral flange **20** of the diaphragm **22** on the side thereof opposite the shoulder **18**.

A second shoulder **30**, centrally located in the base **14**, circular in shape and concentric with the peripheral shoulder **18**, is provided on the end face of a centrally located upstanding cylindrical collar **32** having a bore **34** longitudinally thereof.

The diaphragm **22** has a bore **36** at the center thereof in registry with the bore **34** in the collar **32**. A second or inner peripheral flange **38** about the central bore **36** is provided and is anchored by any suitable means (not shown) to the second shoulder **30** on the collar **32**.

The entire housing **12** is maintained in assembled position by crimping the thin walled extension **24** of the base **14** over a cooperating external flange or shoulder **40** on the lower end of the end cap **16**. This crimping step also secures the outer peripheral flange **20** of the diaphragm **20** between the first shoulder **18** of the base **14** and the compression ring **28**.

The diaphragm **22** forms an upper or reference pressure chamber **42** and a lower or signal chamber **44** with the end cap **16** on one side and base **14** on the other, respectively. A centrally located exhaust port **46** is provided in the end cap **16** for venting the upper chamber to atmosphere. A signal inlet line **48** having an inlet flow port **50** therein is provided in the base **14** to couple the signal input chamber **44** to the said input signal source.

A nozzle **52** is press-fitted in the bore **34** of the central collar **32** in the base **14**. The nozzle **52** extends through the bore **36** in the diaphragm **22** such that the mouth or outlet orifice **54** of the nozzle **52** extends above the diaphragm **22**.

Integral with the diaphragm **22** is a hood-like flapper **56** which is bridged across the nozzle mouth **54** to normally maintain the said mouth closed when the diaphragm **22** is in a natural, non-distorted condition.

The flapper **56** generally comprises an inverted dish-shaped structure which is rigid in comparison to the diaphragm **22**. The diameter of the dish is such that the peripheral flange **58** thereon is affixed to the diaphragm **22** along a line of substantially maximum distortion of the diaphragm in response to pressure differentials between the inlet and reference chambers **44** and **42**, respectively. A plurality of flow ports **60** are provided in the dish bottom or flap valve **62** of the flapper **56**.

The nozzle **52** is fed from a line **64** comprising one leg of a T-connection **66**. The through-connection of the T is a flow restriction **68** in a line **70** which is connected with a source of operating or supply pressure (not shown).

The branch connection of the T comprises an output line or port **72** between the nozzle **52** and the flow restriction **68**.

Operation

With the input line **48** connected to a signal pressure source (not shown), the output line or port **72** connected to a pressure receiver (not shown), and the supply line **70** with the flow restriction **68** therein connected to a pressure supply (not shown), the operation of the pneumatic amplifier **10** will now be described.

In the absence of an input signal pressure in the input signal chamber **44**, there is no pressure differential across the diaphragm **22**. Thus, there is no force tending to distort the diaphragm **22** other than that generated over the small area of contact between the mouth **54** of the nozzle **52** and the valve plate **62** of the flapper **56**. This force is of a negligible magnitude with respect to that required to distort the diaphragm **22** and is distributed to the diaphragm **22** over the entire area of the peripheral flange **58** of the flapper **56**.

Thus, in the pressure line **64** feeding the nozzle, a back pressure is built up, in the absence of a signal input, which is equal to the supply pressure and this pressure is reflected at the output port **72** and conveyed to a suitable pressure receiver. The initial condition of no signal pressure at the input is, therefore, in inverse relationship with the output of the amplifier **10** which is the maximum or supply pressure at the output port **72**.

When an input signal pressure is transmitted to the input chamber **44** via the inlet flow port **50**, the flexible diaphragm **22** will be distorted by a force proportional to the input pressure and will, therefore, displace the valve plate **62** of the flapper **56** away from the mouth **54** of the nozzle **52** a distance directly proportional to the input signal pressure in the input chamber **44**.

The back pressure in the pressure line **64** between the nozzle mouth **54** and the flow restriction **68** varies in inverse proportion to the distance of the valve plate **62** of the flapper **56** from the nozzle mouth **54**. This is the result of a decreasing impedance to flow from the nozzle mouth **54** as the distance of the flapper **56** therefrom is increased. The fluid flow from the nozzle passes through the flapper flow ports **60** into the upper or reference chamber **42** and out through the exhaust port **46** to atmosphere.

Since the back pressure in the pressure line **64** is reflected at the output port **72**, the output pressure is inversely proportional to the signal input.

Because of the relatively small area on the flapper **56** against which fluid flow from the nozzle **52** acts and because of the relatively very large area of the diaphragm

22 acted on by the input signal pressure in the input chamber 44, the operating or supply pressure may be made very high with respect to the signal pressure, whereby a very high gain is made possible with the pneumatic amplifier 10.

By using different size flow restrictions 68 and/or different size nozzle orifices 54, the operating characteristics such as sensitivity and speed of response may be selectively varied. Thus, the nozzles 52 may be removably mounted in the bore 34 of the collar 32 rather than press-fitted, to facilitate the ready removal and selective replacement thereof.

As can be seen from the foregoing specification and drawings, this invention provides a reverse acting pneumatic amplifier having only a single novel active element therein and is capable of high gain and selectively adjustable operating characteristics. In addition, the low mass of the active part therein substantially eliminates sensitivity to the physical position of the amplifier.

It is to be understood that the embodiment shown and described herein is for the purpose of example only and is not intended to limit the scope of the appended claims.

What is claimed is:

1. Reverse acting pneumatic amplifier means comprising a housing, a flexible diaphragm centrally and peripherally anchored on said housing and forming a chamber therewith, signal pressure input means for said chamber, a nozzle in said housing, flap valve means integral with said diaphragm intermediate the anchored portions thereof in flow preventing juxtaposition with said nozzle when said diaphragm is in a natural undistorted condition, a source of supply pressure, a pressure line connecting said nozzle with said source of supply pressure, and an output port in said pressure line, said flap valve normally acting to create a back pressure in said pressure line substantially equal to the supply pressure in the absence of a signal pressure input and said diaphragm, upon the reception of a signal pressure input to said chamber, acting to distort and move said integral flap valve means away from said nozzle a distance proportional to the increase in said input signal pressure to permit increased flow from said nozzle and thereby cause a proportionate decrease in back pressure in said pressure line, whereby the pressure at said output port is inversely proportional to the input signal pressure.

2. The invention defined in claim 1, wherein said nozzle extends through said chamber and out through said diaphragm at the centrally anchored portion thereof and is sealed from said chamber and wherein said flap valve means comprises an inverted dish-shaped plate enclosing the mouth of said nozzle, a flange on the said plate integral with said diaphragm along a line through the flexible portion of said diaphragm, and a plurality of flow ports in said plate.

3. The invention defined in claim 1, wherein said amplifier further includes a flow restriction located in said pressure line between said output port and said source of supply pressure.

4. The invention defined in claim 1, wherein said housing includes a peripherally disposed internal shoulder for securing the outer periphery of said diaphragm, a centrally located collar, a bore in said collar extending through said housing, a central aperture in said diaphragm in registry with said bore, and a shoulder on said collar for securing the central portion of said diaphragm about the periphery of said aperture.

5. The invention defined in claim 4, wherein said nozzle is mounted in the said bore in said collar and extends through said aperture in said diaphragm and wherein said flap valve means comprises an inverted dish-shaped plate enclosing the mouth of said nozzle, a flange on the said plate integral with said diaphragm along a line in the region between said shoulders, and a plurality of flow ports in said plate.

6. The invention defined in claim 4, wherein said amplifier further includes a flow restriction located in said pressure line between said output port and said source of supply pressure.

7. In a pneumatic amplifier, in combination, a flexible diaphragm anchored at the peripheral and central portions thereof, an aperture in the central anchored portion of said diaphragm, a nozzle extending through said aperture, and a flap valve means integral with said diaphragm enclosing said nozzle and normally juxtaposed with the mouth thereof to prevent flow therefrom, said flap valve means being mounted on said diaphragm between said central and peripheral anchored portions.

8. The invention defined in claim 7, wherein said flap valve means comprises an inverted dish-shaped plate enclosing the mouth of said nozzle, a flange on said plate integral with said diaphragm along a line through the flexible portion of said diaphragm, and a plurality of flow ports in said plate.

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