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BISTABLE FLUID DEVICE

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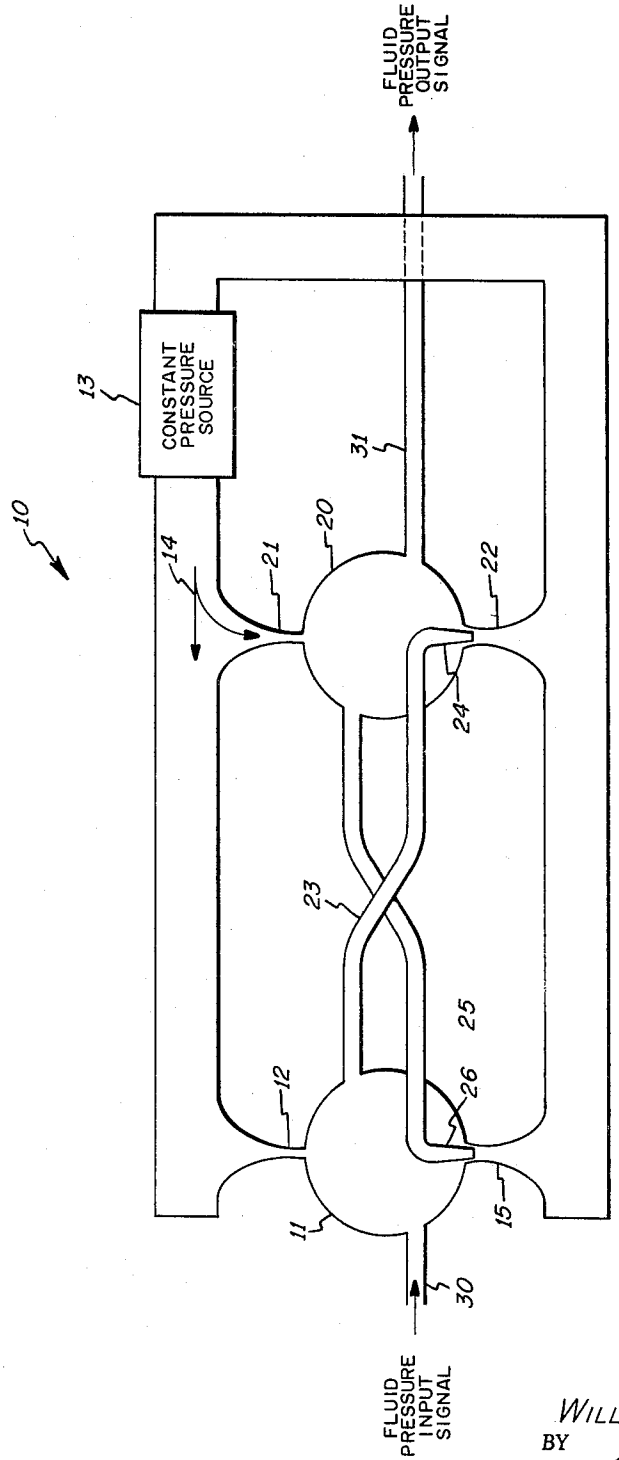

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BISTABLE FLUID DEVICE

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This invention relates to a fluid operated device which is stable in two modes of operation without requiring moving parts.

The present invention utilizes fluid flow to perform functions analogous to electrical bistable multivibrators without requiring delicate electrical apparatus or a source of electrical energy. Further the present invention operates without moving parts and switches from one stable state of operation to another without requiring any moving elements other than a fluid pulse. The present invention is therefore extremely reliable and suitable for operation over a wide range of environmental conditions.

It is an object of the present invention to provide a bistable fluid device that requires no moving parts.

It is another object of the present invention to provide a bistable fluid device that performs functions analogous to functions performed by known electrical apparatus.

It is a further object of the present invention to provide a bistable fluid device that remains reliable in operation although subjected to a wide variation in environmental conditions.

The above objects are accomplished by utilizing the energy of a pressure fluid to switch from one stable state of operation to another by means of a cooperative pair of aspirating-type devices.

The drawing is a schematic diagram of a bistable fluid device incorporating the present invention. The bistable fluid device **10** includes a hollow spherical chamber **11** having a restricting inlet **12** that is connected to a constant pressure fluid source **13** which provides a pressure fluid **14** at a pressure of P_1. The chamber **11** also has a restricting outlet **15** which may be connected to the inlet of the source **13** or may exhaust to the atmosphere at a pressure P_2 which is less than P_1.

Similarly, another hollow spherical chamber **20** has its restricting inlet **21** connected to the pressure fluid source **13** and its restricting outlet **22** connected to the inlet of the source **13** or to exhaust to atmosphere at the pressure P_2.

An aspirating conduit **23** has one end connected to the chamber **11** while its other end terminates in a nozzle **24** disposed in the outlet **22** in a manner to aid in exhausting the fluid from the chamber **20**. Similarly an aspirating conduit **25** has one end connected to the chamber **20** while its other end terminates in a nozzle **26** which is disposed in the outlet **11** to aid in exhausting the fluid from the chamber **11**. An input conduit **30** may be connected to the chamber **11** and is adapted to receive a fluid pressure input signal as indicated by the legend. An output conduit **31** may have one end connected to the chamber **20** while its other end provides a fluid pressure output signal as indicated by the legend.

The chambers **11** and **20** as well as the unrelated elements are substantially identical in size. The restricting inlets **12** and **21** restrict the amount of fluid entering the respective chambers **11** and **20** in a manner to be explained while the restricting outlets **15** and **22** provide a venturi effect which in conjunction with the nozzles **26** and **24** respectively causes an aspirating effect in a manner to be explained.

In operation, a constant pressure fluid **14** is supplied by the source **13** at a pressure P_1 and passes through the restrictions **12** and **21** into chambers **11** and **20** respectively to exhaust through outlets **15** and **22** at a pressure P_2.

The fluid from the chamber **11** passes through the conduit **23** and issues from the nozzle **24** at a high velocity thereby tending to lower the pressure in the chamber **20** in accordance with Bernoulli's theorem thus inducing an aspirating action. Similarly, the fluid issuing through the nozzle **26** from the chamber **20** tends to lower the pressure in the chamber **11**. Due to a slight difference in pressure in one of the chambers, the fluid pressure in one chamber will be approximately equal to P_1 while that of the other chamber will be approximately equal to P_2.

Assuming chamber **20** is at P_1 and chamber **11** is at P_2, the apparatus **10** will remain stable because the higher pressure P_1 in the chamber **20** provides a high velocity fluid stream from the nozzle **26** thereby lowering the pressure in the chamber **11** by creating a suction through the venturi restricting outlet **15**. The low fluid pressure in the chamber **11** creates a relatively low velocity stream to issue from the nozzle **24** thereby creating very little suction from the venturi restricting outlet **22** and retaining the relatively high pressure P_1 in the chamber **20**.

To cause the device **10** to switch to its other bistable state, an input signal, for example, in the form of an input pulse of pressure P_1 is applied to the input conduit **30**. This causes an increase in pressure in the chamber **11** thereby increasing the velocity of the fluid issuing from the nozzle **24** to a higher velocity than that issuing from the nozzle **26** which reduces the pressure in the chamber **20** to less than that in the chamber **11**. With the pressure decreased in the conduit **25** less fluid passes through the nozzle **26** thereby decreasing the suction through the outlet **15** while aiding the pressure increase in chamber **11** and the fluid flow from nozzle **24**.

To switch back again to the original condition explained above, an input signal of pressure P_2 is applied to the input conduit **30**. In either event, a fluid pressure output signal may be taken, for example, from the chamber **20** through the output conduit **31** thereby providing a bistable fluid device.

While the invention has been described in its preferred embodiments, it is understood that the words which have been used are words of description rather than of limitation and that changes within the purview of the appended claims may be made without departing from the true scope and spirit of the invention in its broader aspects.

What is claimed is:

1. A bistable fluid device comprising
   (1) a first chamber having a first restricting inlet adapted to receive a fluid under pressure and a first restricting outlet,
   (2) a second chamber having a second restricting inlet adapted to receive said fluid under pressure and a second restricting outlet,
   (3) a first nozzle responsive to the pressure of the fluid in said second chamber and disposed in said first outlet for aiding in exhausting the fluid from said first chamber,
   (4) a second nozzle responsive to the pressure of the fluid in said first chamber and disposed in said second outlet for aiding in exhausting the fluid from said second chamber,
   (5) an input conduit connected to one of said chambers for providing a fluid pressure input signal, and
   (6) an output conduit connected to one of said chambers for providing a fluid pressure output signal.

2. A bistable fluid device comprising
   (1) means for providing a fluid under constant pressure,
   (2) a first chamber having a first restricting inlet con-

nected to receive said fluid and a first restricting outlet,

(3) a second chamber having a second restricting inlet connected to receive said fluid and a second restricting outlet,

(4) a first aspirating conduit having one end connected to said first chamber and the other end disposed in said second outlet for aiding in exhausting the fluid from said second chamber,

(5) a second aspirating conduit having one end connected to said second chamber and the other end disposed in said first outlet for aiding in exhausting the fluid from said first chamber,

(6) said first and second chambers, inlets, outlets, aspirating conduits and nozzles being substantially identical,

(7) an input conduit connected to one of said chambers for providing a fluid pressure input signal, and

(8) an output conduit connected to one of said chambers for providing a fluid pressure output signal.

3. A bistable fluid device comprising

(1) means for providing a fluid under constant pressure,

(2) a first chamber having a first restricting inlet connected to receive said fluid and a first restricting outlet,

(3) a second chamber having a second restricting inlet connected to receive said fluid and a second restricting outlet,

(4) a first aspirating conduit having one end connected to said first chamber and the other end terminating in a first nozzle disposed in said second outlet for creating a venturi effect tending to exhaust said second chamber,

(5) a second aspirating conduit having one end connected to said second chamber and the other end terminating in a second nozzle disposed in said first outlet for creating a venturi effect tending to exhaust said first chamber,

(6) said first and second chambers, inlets, outlets, aspirating conduits and nozzles being substantially identical,

(7) an input conduit connected to said first chamber for providing a fluid pressure input signal, and

(8) an output conduit connected to said second chamber for providing a fluid pressure output signal.

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