

[54] **SNAP ACTION PNEUMATIC RELAY**
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[57] **ABSTRACT**

A miniature pneumatic snap action relay having a bistable snap disc arranged to interconnect first and second sets of two ports when in one stable position and to interconnect third and fourth sets of two ports when in the other stable position.

[56] **References Cited**

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10 Claims, 3 Drawing Figures

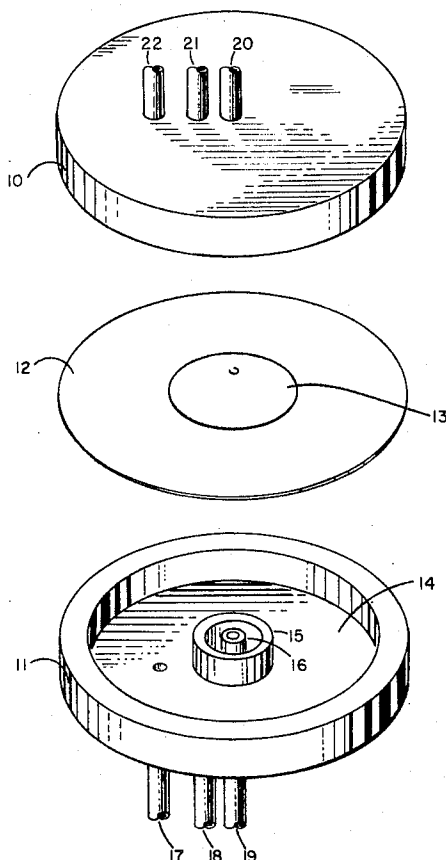
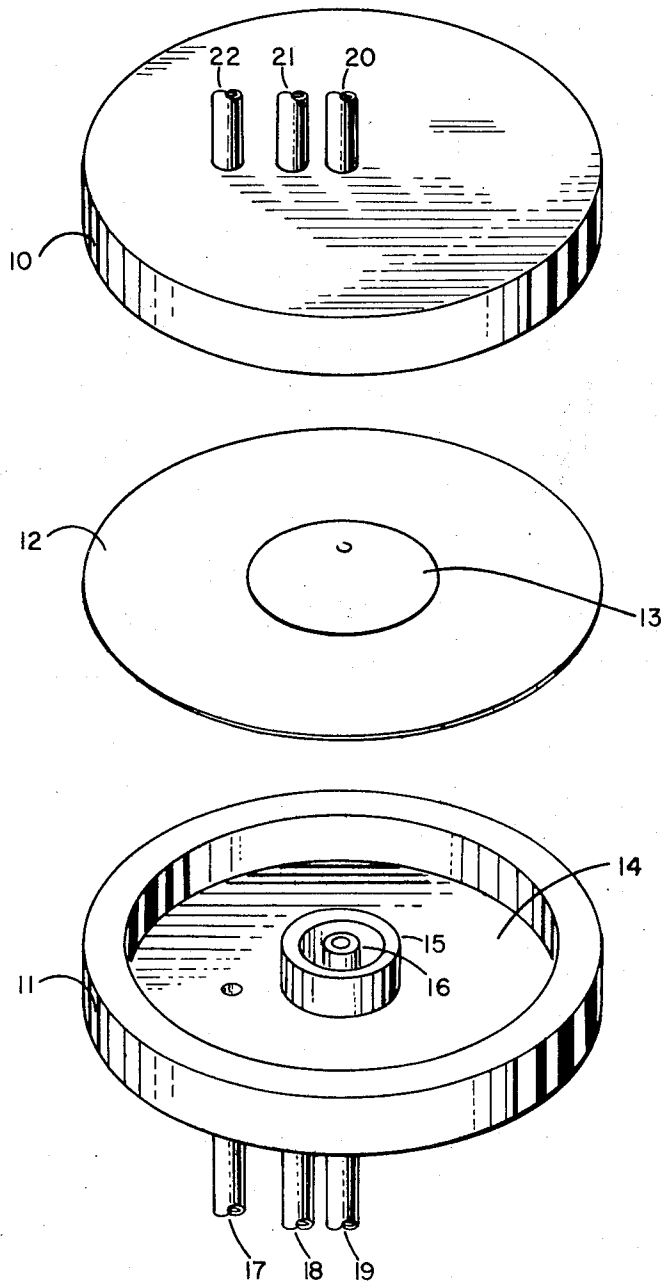
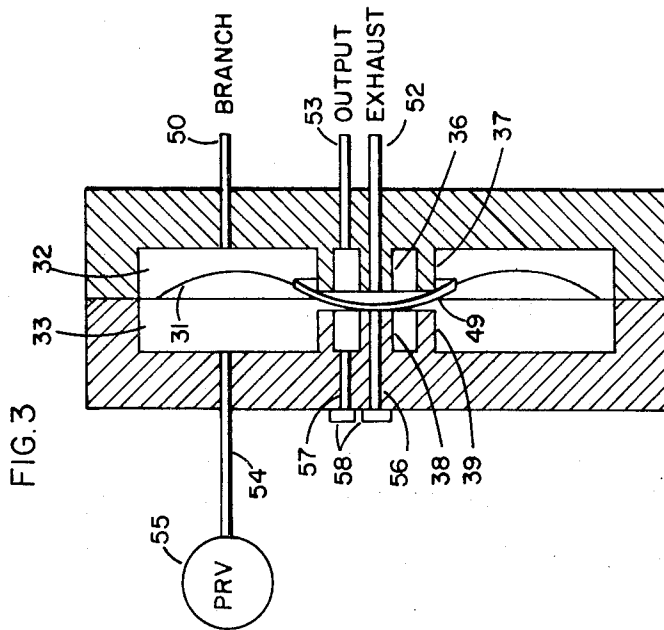
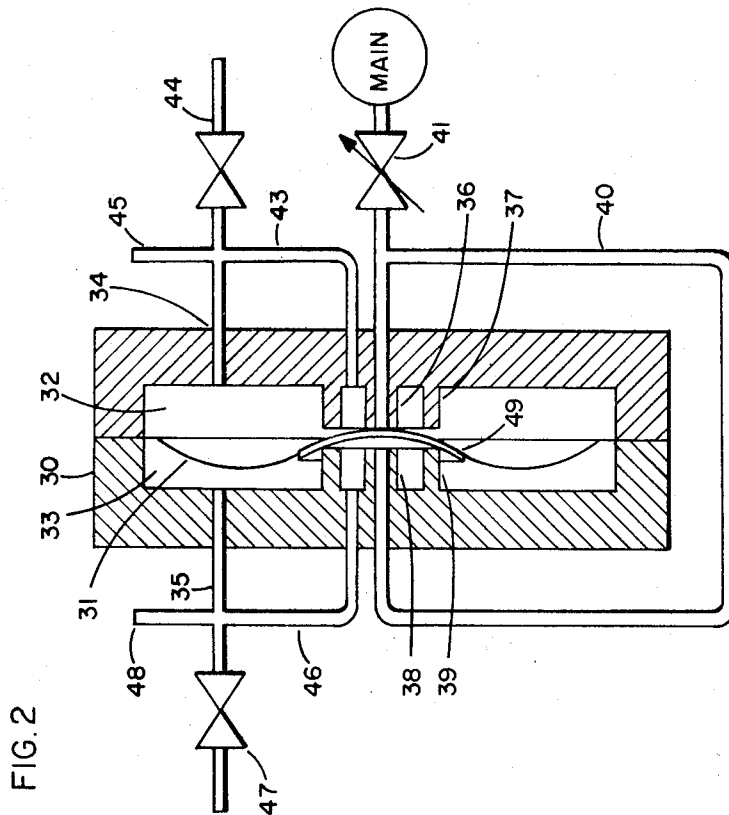


FIG. 1



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SNAP ACTION PNEUMATIC RELAY

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a pneumatic relay and more particularly to a snap acting pneumatic relay capable of performing a plurality of functions.

As pneumatic diaphragm logic circuits have become increasingly miniaturized, there has arisen a need for a miniature snap acting relay capable of performing a multitude of logic functions. Such a relay should be inexpensive, highly reliable, and easily manufacturable.

The subject invention fulfills all of these needs. It comprises a housing having a cavity divided by a flexible diaphragm into two pressure chambers. Oppositely disposed in the two pressure chambers are two sets of two concentric nozzles. Forming part of the diaphragm is a bistable snap disc which is disposed between the two sets of two nozzles. The bistable snap disc is arranged so that when it is in one or the other of its two stable positions, it allows communication between the two nozzles in one pressure chamber and at the same time closes off one of the nozzles in the other pressure chamber and allows communication between the other nozzle and the other pressure chamber.

The relay may be used as an oscillator, as a feed and bleed device, or as an element which may serve any number of purposes in pneumatic control circuits. Specific uses and advantages of the snap action pneumatic relay of the subject invention will become apparent upon a reading of the detailed description of the invention in view of the drawing.

DESCRIPTION OF THE DRAWING

FIG. 1 is an exploded view of the snap action pneumatic relay.

FIG. 2 is a cross sectional view of the snap action pneumatic relay arranged to function as an oscillator.

FIG. 3 is a cross section of the snap action pneumatic relay arranged to provide a feed-bleed function.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1 there is shown an exploded view of the snap action pneumatic relay which includes two halves, 10 and 11, of a housing and a flexible diaphragm 12 interposed between the halves of the housing. The diaphragm means 12 is preferably two thin layers of a rubber material or the like between which is sandwiched a force responsive means or snap disc 13. The housing halves 10 and 11 are substantially identical, each having a cavity 14 in which are disposed two annular concentric partitions 15 and 16. The housing half 11 is provided with ports 19, 18, and 17 which communicate respectively with the interiors of the annular partition 16, annular partition 15, and the cavity 14. Housing half 10 is provided with ports 20, 21, and 22 which communicate with like portions of housing half 10. The snap disc 13 is arranged within the layers of the diaphragm means 12 so as to be centrally located and is further sized so as to cover the larger partition means 15. The housing halves 10 and 11 and the diaphragms 12 may be fastened together by any suitable means such as an adhesive, bolts, etc.

In FIG. 2 a snap action pneumatic relay is illustrated with connections for providing an oscillator. Again the

housing means 30 has a cavity therein which is divided by the diaphragm means 31 into a first pressure chamber 32 and a second pressure chamber 33. In communication with the first pressure chamber 32 is a first port 34; in communication with the second pressure chamber 33 is a second port 35. The annular partitions disposed within the first pressure chamber 32 define first and second nozzles 36 and 37. The oppositely disposed annular partitions in the second pressure chamber 33 define the third and fourth nozzles 38 and 39. The first and third nozzles 36 and 38 are connected via conduit 40 through a variable restriction 41 to a source of main pressure 42. The second nozzle 37 is connected via conduit 43 to the first port 34 and also to a restricted bleed 44 and an outlet 45. The fourth nozzle 39 is connected via conduit 46 to the second port 35 and also to a restricted bleed 47 and another outlet 48.

The diaphragm means 31 preferably comprises two thin layers of rubber-like material between which is disposed a force responsive means 49. This force responsive means 49 comprises a bistable snap disc having over center action. The snap disc is preferably sized so as to have a diameter greater than the diameter of the second and fourth nozzles 37 and 39. In addition the snap disc 49 is sufficiently cup shaped so that when it is in its second stable position as shown in FIG. 2 it simultaneously closes off the first nozzle 36 from the second nozzle 37 and allows the third nozzle 38 and the fourth nozzle 39 to communicate with each other but not with the second pressure chamber 33. When the snap disc 49 is in its first stable position, it closes off the third nozzle 38 while allowing the fourth nozzle 39 to communicate with the second pressure chamber 33; simultaneously the force responsive means, or snap disc 49, closes off the second nozzle 37 from the first pressure chamber 32 while allowing the first and second nozzles 36 and 37 to communicate with each other.

The oscillator of FIG. 2 operates as follows:

When the force responsive means 49 is in its second position as shown in FIG. 2, the source of main air pressure 42 provides air through restriction 41, through conduit 40, to the third nozzle 38. The air pressure is transmitted from the third nozzle 38 into the fourth nozzle 39 and then through conduit 46 into the second port 35 and the second pressure chamber 33. Assuming the outlet 48 is connected to substantially deadended device, such as a pressure gage, the pressure in the second pressure chamber 33 will build up until the pressure on the diaphragm 31 will cause the force responsive means or snap disc 49 to snap into its first stable position. The pressure required for snapping the force responsive means 49 from one stable position to the other is a function of the operative area of the diaphragm 31 and of the inherent differential or resiliency of the snap disc 49. When the snap disc is caused to move from its second stable position to its first stable position, the pressure in the second pressure chamber will bleed down through the restricted bleed 47. At the same time, pressure from the main pressure source will be fed through the variable restriction 41, through the first nozzle 36, through the second nozzle 37, the conduit 43, and the first port 34 into the first pressure chamber 32. When the pressure has suffi-

ciently built up in the first pressure chamber 32, the snap disc will be caused to snap into its second position as shown in FIG. 2 and one cycle of oscillation will have been completed. The pressure in the first pressure chamber will thereafter bleed down through restricted bleed 44, and the cycle will repeat itself. The frequency of this oscillation may be varied by varying the restricted bleed 41.

The snap action pneumatic relay illustrated in FIG. 3 is arranged to provide a feed and bleed function. Fewer than all of the available ports or nozzles in the relay are utilized in performing this function. A first pressure port 50 in communication with the first pressure chamber 32 is connected to a branch pressure source which may be provided by a pneumatic thermostat or the like. A second pressure port 52, in communication with the interior of the first nozzle means 36, provides an exhaust port to atmosphere. A third port 53 is in communication with the interior of the second nozzle means 37 exterior to the first nozzle 36. This port 53 provides an outlet which may be connected to a valve or the like not shown. A fourth port 54 is in communication with the interior of the second pressure chamber 33 and is connected to a pressure regulating valve 55. Fifth and sixth ports 56 and 57 which are in communication with the interiors of the third and fourth nozzles 38 and 39 respectively are blocked off by suitable means 58.

The force responsive means or snap disc 49 is again arranged to allow the second and third ports 52 and 53 to communicate when in its first stable position as illustrated in FIG. 3. When in its second stable position, the snap disc 49 closes off the second port 52.

In operation, when the branch pressure is somewhat greater than the output of the pressure regulating valve 55, the snap disc 49 is forced into its second stable position thereby closing off the exhaust port 52 and allowing branch pressure to be communicated through the first pressure chamber 32, through the second nozzle 37 and out through port 53. When the branch pressure falls below the output of the pressure regulating valve 55, the snap disc 49 is forced by the diaphragm means 31 into its first stable position as illustrated in FIG. 3 thereby preventing communication between the branch port 50 and the output or third port 53. At the same time port 53 is allowed to communicate with port 52 thereby allowing the pressure in the conduit connected to the port 53 to exhaust through port 52. Thus a feed-bleed function is provided by the embodiment of the snap action pneumatic relay illustrated in FIG. 3. This feed-bleed function obviates the use of a restricted bleed in a conduit leading to a controlled device such as a valve or the like. A bleed is thus eliminated, there being an exhausting of the pressure to the control device only when the branch pressure thereto is cut off.

While only one of the many possible embodiments of the subject invention have been described and only within the context of specific uses, it is intended that the scope of the invention described herein be limited only by the scope of the intended claims.

The embodiments of the invention in which an exclusive property or right is claimed are defined as follows:

1. Fluid switching apparatus comprising:
housing means having a cavity therein;
diaphragm means dividing the cavity into first and second pressure chambers;

force responsive means associated with the diaphragm means, the force responsive means having an over center snap action and having first and second stable positions;

first and second ports in communication with the first and second pressure chambers respectively;
first and second nozzle means disposed within the first pressure chamber;

the force responsive means arranged to allow the first and second nozzle means to communicate when in its first stable position, and to allow the first port and second nozzle means to communicate when in its second stable position.

2. The invention according to claim 1 wherein the force responsive means if further arranged to close off the first nozzle means when in its second stable position.

3. The invention according to claim 1 additionally comprising third and fourth nozzle means disposed within the second pressure chamber means oppositely of the first and second nozzle means in the first pressure chamber, the force responsive means further arranged to allow the second port and the fourth nozzle means to communicate when in its first stable position, and to allow third and fourth nozzle means to communicate when in its second stable position.

4. The invention according to claim 3 wherein the force responsive means if further arranged to close off the first nozzle means when in its second stable position and to close off the third nozzle means when in its first stable position.

5. The invention according to claim 4 wherein the force responsive means comprises bistable snap disc means, the first and second nozzle means are concentric, and the third and fourth nozzle means are concentric.

6. A snap action pneumatic relay comprising:
housing means having a cavity therein;

diaphragm means dividing the cavity into first and second pressure chambers;

bistable force responsive means having an over center snap action with first and second stable positions, the bistable force responsive means associated with the diaphragm means;

first and second concentric annular partitions means disposed within the first pressure chamber, the first partition means being interior to the second partition means;

a first port in the housing in communication with the interior of the first partition means;

a third port in the housing in communication with the interior of the second partition means, exterior of the first partition means;

a fourth port in the housing in communication with the second pressure chamber;

the bistable force responsive means arranged to allow the second and third ports to communicate when in its first stable position, and to allow the first and third ports to communicate when in its second stable position.

7. The invention according to claim 6 wherein the force responsive means is further arranged to cut off communication between the second and third ports when in its second stable position.

8. The invention according to claim 6 additionally comprising:

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third and fourth concentric annular partition means disposed within the second pressure chamber oppositely of the first and second concentric annular partition means within the first pressure chamber, the third partition means being interior to the fourth partition means;
a fifth port in the housing in communication with the interior of the third partition means;
a sixth port in the housing in communication with the interior of the fourth partition means, exterior to the third partition means;
the bistable force responsive means further arranged to allow the fourth and sixth ports to communicate

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when in its first stable position, and to allow the fifth and sixth ports to communicate when in its second stable position.

9. The invention according to claim 8 wherein the bistable force responsive means is further arranged to cut off communication between the second and third ports when in its second stable position and to cut off communication between the fifth and sixth ports when in its first stable position.

10. The invention according to claim 9 wherein the bistable force responsive means comprises snap disc means.

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