Jan. 5, 1960 M. MOLLICK 2,919,713

INSTRUMENTS

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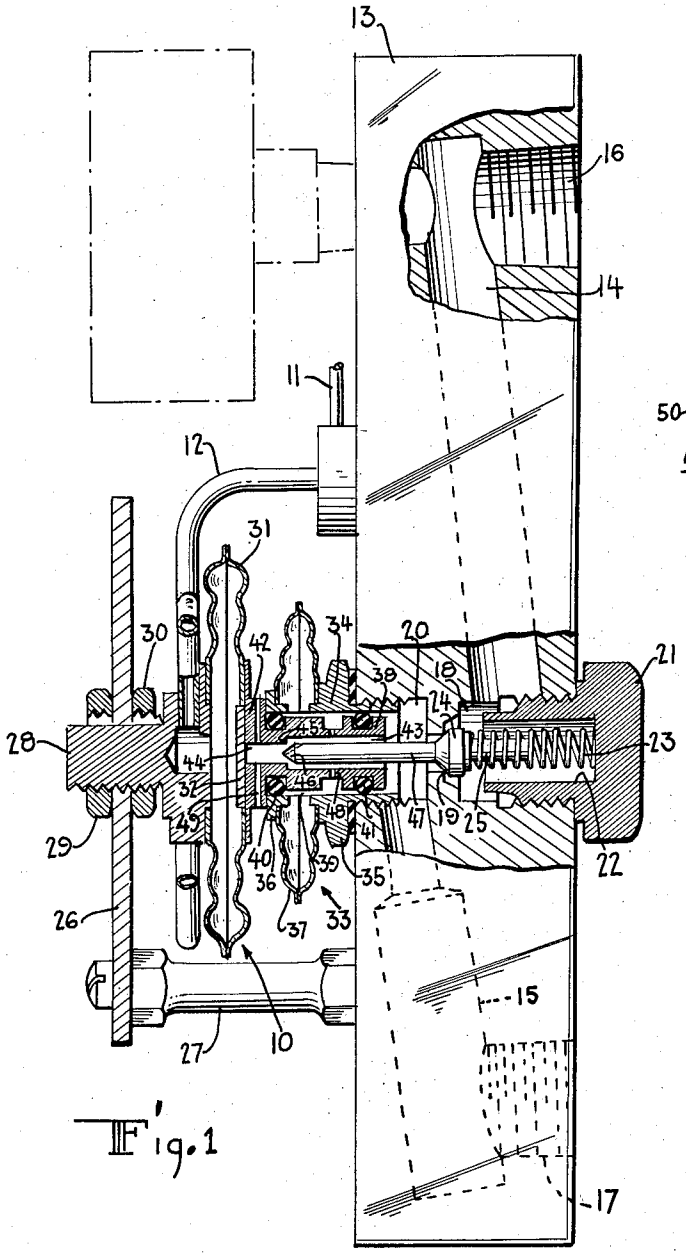


Fig. 1

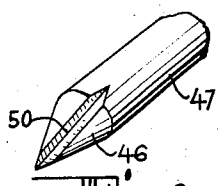


Fig. 2

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INSTRUMENTS

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This invention relates to pneumatically operated instruments and particularly to a non-bleed relay for use therein.

A variable condition, such as temperature, pressure, flow or the like, can be used to position a valve or a flapper and nozzle relative to each other so as to vary the air pressure in the nozzle in response to variations in the variable condition.

The nozzle may be connected to a supply of air through a restriction so that, for example, as the valve or flapper is moved to closed position relative to the nozzle by a change in the variable condition, air pressure in the nozzle will rise and as the valve or flapper is moved away from the nozzle by the variable condition, air pressure in the nozzle will decrease. In order to utilize the nozzle air pressure and produce an amplified controlling pressure proportional to the nozzle air pressure, a device known as a pressure relay is normally utilized.

In order to keep the air consumption of the relay at a minimum and reduce the cost of operating the instrument, a relay known as a "non-bleed" relay is desirable for some purposes since it does not consume air when the pressure in the nozzle is low.

One of the objects of this invention is to provide an improved non-bleed pressure relay which has a high speed of response and is quiet in operation.

A further object of this invention is to provide a non-bleed pressure relay which consumes very little air. A further object of this invention is to provide a non-bleed relay having a rigid base which can be economically made.

A still further object is to provide a non-bleed relay in which equilibrium is reached without any vibration by utilizing dampening means.

In a preferred aspect, the non-bleed pressure relay includes an expansible and contractible condition responsive element. An air supply line is connected to an air outlet, and the flow of air from the supply to the outlet is controlled by a valve. A valve stem is connected to the valve. A bellows having an exhaust passage is provided and the valve stem controls the flow of air through this exhaust passage. The bellows also includes a plunger with slidable friction sealing means. This plunger is movable in response to the movement of the condition responsive element. The plunger has a restricted aperture therein leading from the downstream side of the valve means to the bellows, so that air will enter the bellows to expand the same. This expansion urges the plunger in a downstream direction beyond the free end of the valve stem.

The base of the non-bleed pressure relay involved herein is rigid and can be removably mounted in a casing in which the various measuring and control elements with which it is used are mounted. Suitable connections are made to the supply and output lines and to the various elements of the instrument.

These and other objects, advantages and features of the invention will become apparent from the following

detailed description and drawings, which are merely exemplary.

In the drawings:

Fig. 1 is a sectional view of a preferred form of the non-bleed pressure relay of the invention; and

Fig. 2 is an enlarged view of the preferred form of needle point for the free end of the valve stem.

As the flapper or valve and nozzle (these elements are not shown) are moved relative to each other by a change in the variable condition or measured variable, there will be a change in pressure in the nozzle passage. The nozzle passage is connected to the pressure responsive means of the pressure relay, shown as capsule or diaphragm **10** in Fig. 1, through passages **11** and **12**. As the pressure changes in the pressure responsive means of the relay, the output pressure passage will be connected to the supply pressure or to the atmosphere as determined by the nozzle pressure.

The relay is preferably mounted on a rigid base **13** formed from bar stock having a uniform transverse cross section. The bar stock may be formed by any suitable metal forming operation and cut to the desired length.

Air passages and chambers can be formed in base **13** by suitable cutting machines or drills. For example, a supply pressure passage **14** and an output passage **15** may be drilled in any suitable manner. In the form shown, these passages are drilled from opposite ends of the base **13** and are skewed relative to each other, so as to permit use of a minimum thickness bar stock. The threaded connecting apertures **16** and **17** must be of a predetermined length to provide a suitable connection.

Also formed in base **13** is the valve chamber **18** valve seat **19** and bellows unit receiving chamber **20**. Chambers **18** and **20** are axially aligned and are internally threaded at their outer ends. Screw plug means **21** is threaded in the outer end of valve chamber **18** and has a well **22** therein carrying valve spring **23**, said valve spring bearing against the valve **24**. Valve **24** has an extension **25** which is within the coils of spring **23** so as to ensure linear movement of valve **24**.

The pressure responsive means **10** can have its outer end connected to pressure responsive means mounting plate **26**, said mounting plate being spaced from base **13** by spacer posts **27** (only one of which is shown). Diaphragm stud **28** can be adjustably mounted on plate **26** by means of nuts **29**, **30**. Capsule or wafer **31** has its interior connected through passages **11** and **12** to the nozzle passage or to the control air source. Button or plate **32** is secured to the opposite side of capsule **31** from stud **28**.

Threadingly mounted in chamber **20** is a bellows unit, designated generally at **33**, which includes a hollow casing **34** having flanges **35** and **36** on the outside between which is secured a wafer or capsule **37**. A plunger **38** is slidably mounted within passage **39** in casing **34** and frictionally engages said passage through O-rings **40** and **41** which prevent the leakage of air between the passage **39** and post plunger **38**. The construction using O-rings also serves to dampen the motion of plunger **38**. Plunger **38** has a flange **42** which engages flange **36** when the plunger moves in an upstream direction toward the valve. The downstream side flange **42** rests against or is in contact with plate **32** on capsule **31**. A longitudinal passageway **43** having a reduced portion **44** is formed in the plunger **38**. Reduced portion **44** forms a needle valve seat **45** for needle point **46** on valve stem **47**. Restricted apertures **48** connect passage **39** with passageway **43**.

When there is no pressure exerted on diaphragm **31**, valve **24** will be in contact with valve seat **19** so as to close the connection between supply pressure passage **14** and output pressure passage **15**. At the same time needle point **46** will be spaced from valve seat **45** to permit

output passage 15 to be in communication with the atmosphere through passages 49 in plunger 38, thereby venting the pressure in passage 15.

As the pressure in passages 11 and 12 increases, capsule 31 expands forcing plunger 38 in an upstream direction. Valve seat 43 engages needle point 46 and forces valve stem 47 and valve 24 to open position against the action of spring 23, thereby connecting the supply pressure passage 14 with the output pressure passage 15. This also results in air entering the interior of capsule 37 through restricted passages 48 causing capsule 37 to expand until the pressure in capsules 37 and 31 is equalized.

It has been found desirable to form a notch 50 in the needle point, so as to provide a very small exhaust of air so as to get equilibrium without any "dead spot".

The above described construction results in a non-bleed relay having a rapid speed of response which is economical to manufacture and which is not subject to constant breakdowns. Also it is quiet in operation and will not "flutter."

It should be apparent that details of the invention can be varied without departing from the spirit of the invention, except as set forth in the appended claims.

What is claimed is:

1. In a non-bleed pressure relay, the combination including an expansible and contractible condition responsive element, a source of air supply, an air outlet, valve means connecting said source and said outlet for controlling the passage of air therethrough, an exhaust valve connected to said valve means, and a bellows arrangement having an exhaust passage controlled by said exhaust valve, said bellows arrangement including a plunger with slidable friction sealing means, said bellows arrangement also including expansible and contractible means, said plunger having a restricted aperture leading from the downstream side of said valve means to said expansible and contractible means.

2. In a non-bleed pressure relay, the combination including an expansible and contractible condition responsive element, a source of air supply, an air outlet, valve means connecting said source and said outlet for controlling the passage of air therethrough, a valve stem connected to said valve means, and a bellows arrangement having an exhaust passage controlled by said stem, said bellows arrangement having a plunger with slidable friction sealing means which is movable in response to movement of said condition responsive means to control said exhaust passage in cooperation with said stem and also to cause said valve stem to move in an upstream direction to open said valve means and allow the air to flow from said supply to said outlet, said bellows arrangement also including a bellows, said plunger having a restricted aperture leading from the downstream side of said valve means to said bellows.

3. In a non-bleed pressure relay, the combination including an expansible and contractible condition responsive element, a source of air supply, an air outlet, a valve chamber connecting said source and said outlet, a valve biased to closed position, a valve stem connected to said valve, and a bellows arrangement having an exhaust passage controlled by said stem, said bellows arrangement including a plunger with slidable friction sealing means, said plunger being movable in response to movement of said condition responsive means to control said exhaust passage in cooperation with said stem, and also to cause said valve stem to move in an upstream direction to open said valve and allow the air to flow from said supply to said outlet, said bellows arrangement also including a bellows, said plunger having a restricted aperture leading from the downstream side of said valve means to said bellows.

4. In a non-bleed pressure relay, the combination including an expansible and contractible condition responsive element, a source of air supply, an air outlet, a bar stock body having an air supply and an air outlet passage therein, a valve chamber in said body connecting said air supply passage and said air outlet passage, valve means in said valve chamber for controlling the passage of air through said chamber, a valve stem connected to the downstream side of said valve means, and a bellows arrangement having an exhaust passage controlled by said stem, said bellows arrangement including a plunger with slidable friction sealing means, said plunger being movable in response to movement of said condition responsive elements to control said exhaust passage in cooperation with said stem, and also to cause said valve stem to move in an upstream direction to open said valve means and allow the air to flow from said supply to said outlet, said slidable friction sealing means including a pair of spaced O-rings on the outer peripheral surface of said plunger, said bellows arrangement also including an expansible and contractible bellows, and said plunger having a restricted aperture leading from the downstream side of said valve means to the interior of said bellows.

5. In a non-bleed pressure relay, the combination including a diaphragm which is expansible and contractible in response to change in the condition being controlled, a source of air supply, an air outlet, valve means connecting said source and said outlet for controlling the passage of air therethrough, spring means biasing said valve means to closed position, a valve stem connected to said valve means, and a bellows arrangement having an exhaust passage controlled by said stem, said bellows arrangement including a plunger with slidable friction sealing means which is movable in response to movement of said condition responsive means to control said exhaust passage in cooperation with said stem, and also to cause said valve stem to move in an upstream direction to open said valve means against the action of said spring means and allow the air to flow from said supply to said outlet, said bellows arrangement also including a bellows, said plunger having a restricted aperture leading from the downstream side of said valve means to said bellows.

6. In a non-bleed pressure relay, the combination including an expansible and contractible condition responsive element, a source of air supply, an air outlet, valve means connecting said source and said outlet for controlling the passage of air therethrough, a valve stem connected to said valve means, and a bellows arrangement having an exhaust passage controlled by said stem, said bellows arrangement including a plunger with slidable friction sealing means which is movable in response to movement of said condition responsive means, said plunger including an internal valve seat adapted to engage the downstream end of said stem so as to control said exhaust passage in cooperation with said stem, and also to cause said valve stem to move in an upstream direction to open said valve means and allow the air to flow from said supply to said outlet, said bellows arrangement also including a bellows, said plunger having a restricted aperture leading from the downstream side of said valve means to said bellows.

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