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PNEUMATIC WARNING SYSTEM

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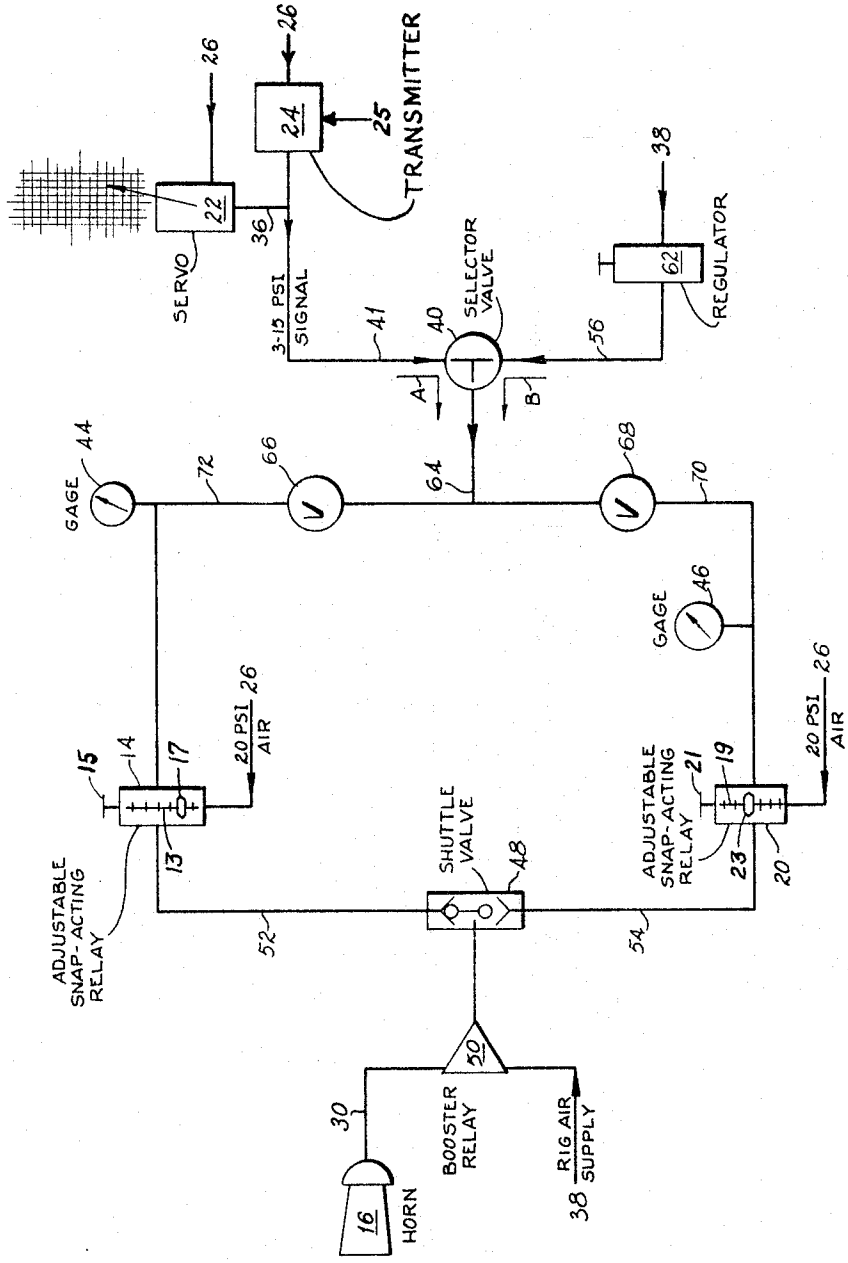

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PNEUMATIC WARNING SYSTEM

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1 Claim. (Cl. 116—65)

This application is a division of my copending application, Serial No. 247,142, filed December 26, 1962, now Patent No. 3,223,068. This invention relates generally to a pneumatic warning system adapted to operate in conjunction with recording or indicating apparatus. More specifically, it relates to an adjustable pneumatic warning system that may be set to provide a warning at desired values of a measured variable.

In the past, it has been possible to obtain warning systems for pneumatic apparatus that will provide satisfactory service provided that the system can be pre-set at a given value and provided, further, that it does not require subsequent adjustment or frequent changes of the value at which the warning is to be sounded. Perhaps the greatest difficulty encountered has been the development of a warning system of sufficient simplicity that it can be adjusted to a certain value of a measured variable and then changed, by a relatively unskilled person, to provide a warning at a different, but desired value of the measured variable.

It is, therefore, one object of this invention to provide an improved warning system for use with pneumatic apparatus wherein the system can be easily adjusted to a pre-selected value of a measured variable.

Another object of this invention is to provide an improved warning system that can be easily adjusted and will sound an alarm upon an increase above or decrease below a pre-selected value of a measured variable.

Generally, this invention contemplates a warning system that includes warning means, adjustable means for controlling the value at which the warning means will be actuated, and control means adapted to produce a visual indication of the value at which the adjustable means will actuate.

Other, further, and additional objects and advantages of the invention will become more apparent when the following description is read in conjunction with the accompanying drawing which is a schematic diagram illustrating a warning system, constructed in accordance with the invention, connected with a pneumatic recording apparatus and adapted to provide an alarm above a certain value and below a certain value of a measured variable.

Referring to the drawing in detail, there is shown a pneumatic transmitter **24** connected by a conduit **36** to a recording servo mechanism **22**. The transmitter is also connected by a conduit to a source of air which is regulated to 20 p.s.i. in a conventional manner (not shown per se) as indicated by the reference numeral **26**, the latter numeral also being employed throughout this application to designate a 20 p.s.i. source of air pressure wherever required. The transmitter is also connected by means of element **25** to a variable whose condition is to be measured by the servo **22** and whose maximum or minimum condition is to be indicated by the warning system described herein. For example, the element **25** could be an arm connecting with a float (not shown) resting on the surface of drilling mud (not shown) in a mud pit (not shown). In such an instance, the transmitter **24** would have therein a rotatable element movable in response to the pivoting motion of the element **25** and would be adapted to produce an output

pressure varying between 3 and 15 p.s.i., depending upon the level in the mud pit. (A Foxboro type C.P. Position Transmitter of the type disclosed in Foxboro Catalog 14–132 of June 1958, or a Moore model 70 Motion Transmitter, such as shown on page 28 of the Moore Products Catalog, Eighth Edition, 1962, are suitable as pit level transmitters.)

Various other types of transmitters can be utilized, the exact type depending upon the variable to be measured. One requirement, however, for the transmitter to be used in the warning system disclosed herein is that the transmitter **24** should have an output pneumatic pressure variable between 3 and 15 p.s.i. which is a function of the measured variable.

The recording servo mechanism **22** will, of course, be compatible with the particular type of transmitter **24** employed. Briefly stated, however, a 20 p.s.i. reference pressure is introduced to the servo **22** from the source **26** referred to above. The variable signal between 3 and 15 p.s.i. is also introduced to the servo **22** through the conduit **36**. The internal details of the servo are such that the indicating portion thereof will be moved to a position dependent upon the value of the variable input signal through the conduit **36**. (A suitable servo has been found to be a Taylor Servomatic Motor, 90 J series, as illustrated in catalog 4B201, issue 2, of the Taylor Instrument Company TP–618.)

The transmitter **24** is also connected by means of a conduit **41** to a selector valve **40** which, as will hereinafter appear, is used for calibration purposes. The conduit **41** is in communication with a conduit **64** through the selector valve **40** when the latter provides a flow path as indicated by the arrow "A." Conduit **64** connects upwardly to an on/off valve **66** and through a conduit **72** to a relay **14**. Conduit **64** connects downwardly to an on/off valve **68** and through a conduit **70** to a relay **20**. Gages **44** and **46** are connected to the conduits **72** and **70** respectively. Relay **14** is connected by means of conduit **52** to the upper end of a shuttle valve **48**, the latter being essentially a two-way check valve. Relay **20** connects by means of conduit **54** to the opposite end of the shuttle valve **48**. The output of the shuttle valve **48** is connected to a booster relay **50** which, in turn, is connected by a conduit **30** to an alarm **16** (indicated as a horn). The rig air supply **38** also connects with the booster relay **50**.

The selector valve **40** is connected to an adjustable regulator **62** by means of a conduit **56**.

Relay **14** is an adjustable snap-acting relay of the type disclosed in Minneapolis-Honeywell Regulator Company bulletin 95–2554, published June 7, 1960. Relay **14** is a direct-acting relay as will hereinafter appear. Relay **14** is provided with an integral calibrated indicating portion **13** and an external adjusting knob **15**. A pointer **17** which is slidable along the indicating portion **13** is moved by rotation of the adjusting knob **15**.

Relay **20** is another snap-acting relay which is essentially the same as the relay **14**, but is reverse-acting as will hereinafter appear. Relay **20** has an integral calibrated indicating portion **19**, an external adjusting knob **21** and a pointer **23** which is movable across the calibrated portion **19** in response to rotation of the knob **21**.

As indicated above, the relay **14** is a direct-acting relay, which means that this relay will be energized or opened when the pressure in the conduit **72** exceeds a predetermined value; below this pressure, the relay **14** will remain closed. Contrariwise, the relay **20** is a reverse-acting relay in that it will not be energized or opened until the pressure in the conduit **70** drops below a predetermined value; above this predetermined value, the relay **20** will remain closed. It will be now assumed that the element **25** on the transmitter **24** is a float arm connect-

ing with a float (not shown) resting on the surface of the drilling mud in a mud pit (not shown). With the system being connected in the manner shown, if the level in the mud pit drops below a predetermined value, the signal in the conduit **72** will increase so as to open or energize the relay **14**. When the relay **14** is energized, pressure will be transmitted through this relay into conduit **52** to the shuttle valve **48**. The pressure in the conduit will move the shuttle valve in such a manner as to prevent pressure being transmitted through the shuttle valve into the conduit **54**. Thus, the pressure transmitted to the shuttle valve will pass through the booster relay into conduit **30** to the alarm **16** or, more precisely, actuation of the booster relay as the result of the pressure transmitted to it from the shuttle valve, will permit passage of air from the rig air supply **38** through the booster relay **50** to the conduit **30** and to the alarm **16**.

Conversely if the level in the mud pit rises above a predetermined value, the signal in the conduit **70** will decrease so as to open or energize the relay **20**. Resulting pressure in the conduit **54** will move the internal mechanism (not shown) of the shuttle valve in the opposite direction to prevent communication with the conduit **52**. Thus, pressure passes from the shuttle valve **48** in the same manner as described above to the booster relay so as to actuate the alarm **16**.

The selector valve **40**, gages **44** and **46**, valves **66** and **68**, and adjustable regulator **62** are provided for the purpose of calibrating the relays **14** and **20**. The dials on the gages **44** and **46** are calibrated in advance to correspond with the units of measurement of the measured variable (not shown) which operates the transmitter **24**. Thus, if transmitter **24** is used in a mud pumping system, for example, then gages **44** and **46** will be calibrated in units of liquid level. Valve **40**, for example, is movable into two positions to permit flow in two directions indicated by the right-angled arrows designated by the reference characters A and B, of course, at separate periods of time.

Now, if it is desired to calibrate relay **14**, the valve **66** is left open, valve **68** is closed, and selector valve **40** is placed in a flow condition corresponding to arrow B. Thereafter, the control on adjustable regulator **62** is adjusted until the pressure reading on the gage **44** corresponds to the first desired value (or level) of the variable whose condition is sensed by the transmitter **24**. When the gage **44** is brought to the correct or desired value, the adjustment knob on the relay **14** is moved until the alarm **16** is sounded. The relay **14** is now adjusted to operate for the condition corresponding to the reading on the gage **44**. Thereafter, the valve **66** is closed and valve **68** is opened. Now, the control on the adjustable regulator **62** is adjusted until the pressure reading on the gage **46** corresponds to the second desired value (or level) of the variable. The relay **20** is then adjusted in the same manner as described above with respect to relay **14**.

Although the invention set forth herein has been described in terms of changes in liquid level, the condition being sensed by the transmitter **24** need not necessarily be a liquid level. Indeed, it can be a variable pressure, hydraulic or pneumatic or it can be a variable mechanical movement, either rotary or translational. It can be a change in weight or volume. Practically no limitations should be placed upon the type of variable to which the present invention can be adapted. Just so long as the transmitter **24** is capable of producing an output pressure variable between 3 and 15 p.s.i., the systems described herein will be completely operable. It is well known in the art that there are many different types of transmitters or converters which are adapted to change a variable pneumatic pressure, liquid pressure or mechanical movement into a corresponding variable pneumatic pressure. Thus, the selection of a particular

transmitter depends upon the type of variable being measured.

Whereas the present invention has been described in particular relation to the drawing attached hereto, it should be understood that other and further modifications, apart from those shown or suggested herein, may be made within the spirit and scope of this invention. For example, the pressure range of the pneumatic signal has been described as being between 3 and 15 p.s.i. and the input operating pressure range of the servos has been described as being between 3 and 15 p.s.i. It should be understood that the applicant does not intend to limit this invention to any particular range, the above being disclosed merely for the sake of preference and in the interest of completeness of disclosure. Actually, any predetermined range can be employed just so long as the same predetermined range is used in a uniform manner. Likewise, the specific operating pressures, such as 20 p.s.i., are not at all critical, but obviously depend upon the requirements and versatility of the units which these pressures operate.

What is claimed is:

A warning system for indicating when the value of a given variable falls below a first predetermined value and exceeds a second predetermined value comprising a sensing means adapted to sense the instantaneous value of said variable and to transform the same into a corresponding output pneumatic pressure falling within a predetermined range of pneumatic pressures, a recording device connected to the output of said sensing device for recording the instantaneous value of said variable, a selector valve having two inlets and a single outlet, one inlet being connected to the output of said sensing device and the other inlet of said selector valve being connected to the outlet of a regulator valve, said regulator valve having an inlet connected to a source of air pressure, said selector valve being adjustable to place said first and said second inlets alternately in communication with the outlet of said selector valve, a pair of on/off valves each having an inlet and an outlet, the outlet of said selector valve being connected in common to the inlets of said on/off valves, the first on/off valve having its outlet connected to a first pneumatic gage, a first pneumatic relay having its inlet connected to the outlet of said first on/off valve, said first pneumatic relay having an outlet and being normally closed but being adapted to open to provide communication between its inlet and outlet when the pneumatic pressure transmitted to said first relay from said sensing means falls below said first predetermined value, the second on/off valve having its outlet connected to a second pneumatic gage, a second pneumatic relay having its inlet connected to the outlet of said second on/off valve and having an outlet which will be placed in communication with said inlet when said second relay is opened, said second pneumatic relay being normally closed but being opened when the pressure transmitted to said second relay from said sensing means indicates that the instantaneous value of said variable exceeds said second predetermined value, a two-way check valve having two inlets and a single outlet with its inlets being connected to the outlets of said pneumatic relays, respectively, an alarm device connected to the outlet of said two-way check valve, said first relay having means adjusting the same to change the pressure required to open said relay, and said second relay having means adjusting the same to change the pressure required to open said relay.

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