Feb. 15, 1966 W. M. PIERCE, JR 3,234,739

PNEUMATIC CONTROL APPARATUS

Original Filed April 27, 1960

Fig. 1.

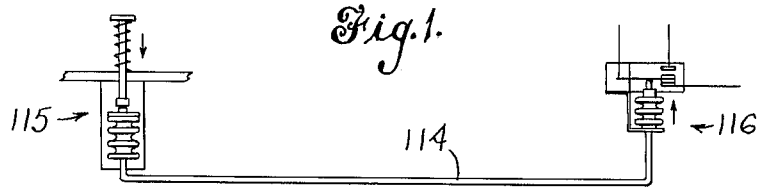


Fig. 2.

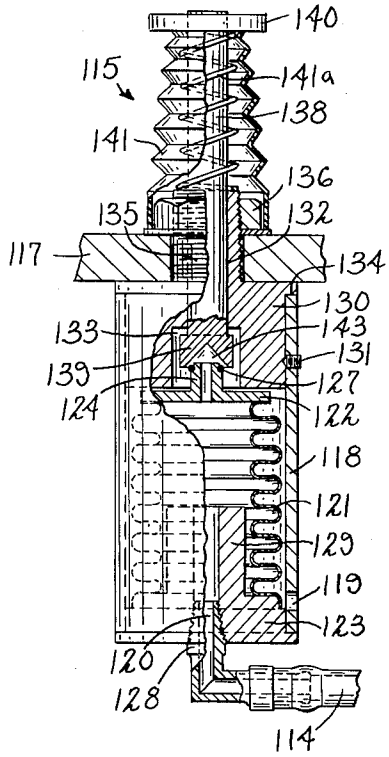


Fig. 3.

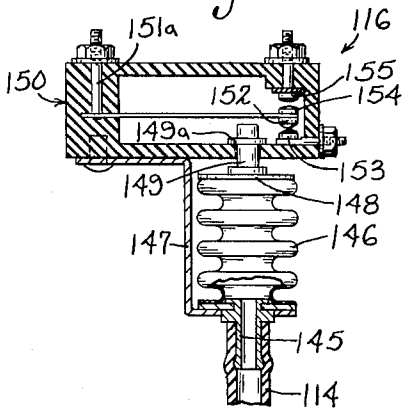
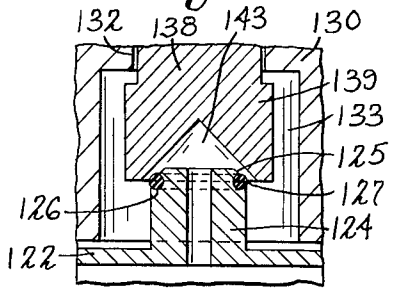


Fig. 4.



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United States Patent Office 3,234,739 Patented Feb. 15, 1966

3,234,739

PNEUMATIC CONTROL APPARATUS

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Original application Apr. 27, 1960, Ser. No. 24,955, now Patent No. 3,132,718, dated May 12, 1964. Divided and this application May 11, 1964, Ser. No. 366,383
10 Claims. (Cl. 60—62.6)

This invention relates to pneumatic control apparatus and relates more particularly to control apparatus particularly useful on power-operated boom structures for lifting a workman aloft such as shown and described in my copending patent application, Serial No. 24,955, filed April 27, 1960, now Patent No. 3,132,718, of which the present application is a division.

Boom structures for lifting a workman aloft are often employed to service overhead lines carrying high voltages which present a hazard to workmen and others near workmen. It is desirable that workmen carried aloft have within easy reach controls for effecting the various movements of the booms. The employment of pneumatic controls for this purpose is highly advantageous in that the pneumatic transmission lines which extend throughout the length of the booms may be constructed entirely of dielectric material, thereby reducing shock hazard. It should be understood, however, that my invention is not restricted to pneumatic control apparatus for controlling the movements of boom structures.

One object of the invention is to provide an improved pneumatic control apparatus.

Another object is to provide apparatus such as characterized above, having an open air system which is self-charging and which permits air to enter and leave the air transmission lines.

Another object is to provide pneumatic apparatus which may be exposed to the elements, which has efficient provisions for preventing water from entering the air system.

Yet another object is to provide apparatus such as characterized above, having a relatively simple construction, which apparatus is very efficient and reliable in use.

In the drawing:

FIG. 1 is a diagrammatic view of pneumatic control apparatus embodying my invention;

FIG. 2 is an elevational view, partially broken away, illustrating the air transmitter of the control apparatus;

FIG. 3 is a sectional view of a slave unit or receiver operated by the mechanism of FIG. 2; and

FIG. 4 is a fragmentary view on a larger scale illustrating in vertical section certain parts of the transmitter shown in FIG. 2.

In the drawing the transmitter is indicated generally at **115**. The transmitter may be supported on a suitable control panel **117**. The slave unit or receiver is indicated at **116**. It may have any suitable support, not shown. The transmitter and receiver are connected by a length of tubing **114** which, as previously indicated, may be constructed entirely of dielectric material.

The transmitting mechanism **115** (FIG. 2) has a cup-like lower part **118** having in the side wall structure thereof and near the bottom an inlet and outlet **119** and having in the center of the bottom an air outlet **120**. A vertically arranged bellows **121** is disposed in the bottom portion of the cup part **118** and has an upper end fitting **122** in fixed relation to the bellows and a lower end fitting **123** also secured to the bellows. The fitting **122** closes the upper end of the bellows except in the central region thereof, and in this region the fitting **122** has an upward extending tubular part **124**, providing an opening communicating with the interior of the bellows **120**.

The upper extremity of the tubular part **124** is tapered, as at **125**, and, as best shown in FIG. 4, this tapered portion is provided with a circumferential groove **126** seating a resilient O-ring gasket **127** forming a valve seat.

The lower fitting **123** closes the lower end of the bellows except in the central region thereof, and in this region is internally threaded to receive a nipple **128** on the air line **114**, the nipple extending into the cup part **118** through the air outlet **120**. The fitting **123** has in communication with the last-named threaded part a tubular part **129** extending upwardly in the bellows and opening into the latter.

As shown in FIG. 2, the lower end of the bellows is rather narrowly confined between the tubular part **129** and the cup part **118**. The upper end of the part **118** is filled by an insert **130** secured to the side wall structure of the part **118** as by a screw **131**. The insert **130**, which has a central bore **132** therethrough enlarged at the lower end by a counterbore **133**, has a peripheral shoulder **134** to abut the upper edge of the cup part **118**. As shown in FIG. 4, the tubular part **124** of the upper bellows fitting may be extended with clearance into the counterbore **133**.

Above the cup part **118**, the insert **130** has a reduced externally threaded portion **135** threaded upwardly through the panel **117** for support by the latter, and the upper end of the portion **135** receives a nut **136** over a washer which bears against the top of the panel **117**. A plunger **138** which extends loosely into the portion **132** so that air may pass lengthwise along the plunger, has an enlargement **139** in the lower end thereof to abut the bottom of the counterbore **133** and thereby prevent separation of the plunger from the insert **130** on upward movement of the plunger. As shown in FIG. 2, the enlargement **139** of the plunger is considerably smaller in diameter than the side wall of the counterbore **133**. The plunger **138** normally extends a distance above the insert **130**, and at the upper end thereof is provided with a disk **140** secured thereto and providing a button to move the plunger downwardly upon hand pressure of an operator thereagainst. A flexible cover **141** of the well-known accordion type embraces the plunger **138**. The cover has one end thereof suitably fixed at the upper part of the plunger below the disk **140** and has the other end disposed over the nut **136**.

The enlargement **139** of the plunger has a conical recess **143** in the bottom thereof approximating the taper of the portion **125** of the tubular part **124**, the last-named recessed part forming a valve for seating engagement with the valve seat **127**. The upper end fitting **122** of the bellows **121** normally occupies the position shown in FIG. 4. Within the cover **141** a compression spring **141a** is provided acting between the nut **136** and the disk **140** and embracing the plunger **138**. The last-named spring, which may be omitted if the cover **141** is sufficiently resilient, normally maintains the plunger **138** in the position of FIG. 4. In this position the plunger is spaced upwardly from the upper end fitting of the bellows **121** to permit air to enter or escape from this bellows and the air line **114**. When the button **140** is depressed through hand pressure, the plunger **138** seats on the upper end fitting of the bellows, cutting off the entry of air to the bellows, and compresses the bellows to transmit, through the line **114**, air under pressure of the air-receiving mechanism **116**, such as that shown in FIG. 3.

The air line **114** has a nipple **145** connecting the line to a fixed end (FIG. 3) of a bellows **146**, forming a part of the air-receiving mechanism or slave unit **116**, the last-named end being fixed by a bracket **147**. The nipple communicates with the interior of the bellows **146**, and the other or movable end of the bellows **146** is closed by a fitting **148** including a plunger **149** extensible into the

switch **150** to engage and move a spring-biased leaf member **151**. The leaf member **151** has a contact **152** and is biased in a direction toward a fixed contact **153** to normally engage the latter with the contact **152**. The leaf member **151**, which is a conductor and has a terminal **151a**, is provided with a contact **154** for cooperation with a fixed contact **155**. When the bellows **146** is extended by air pressure from the air line **114**, the plunger **149** is extended to engage and move the leaf member **151** in a direction to break the electrical connection between the contact **153** and the terminal **151a** and establish an electrical connection between the contact **155** and the terminal **151a** through the contact **154**. It will be understood from the foregoing that when the button **140** is released by the operator, the bellows **121** is permitted to re-expand through movement of the spring-biased plunger **138** upwardly. This results in contraction of the bellows **146** which retracts the plunger **149**, allowing the biased leaf member **151** to disengage the contact **155** and re-establish the electrical connection between the contact **153** and the terminal **151a** through the contact **152**. It may be noted that, as shown in FIG. 3, within the casing of the switch **150** the plunger **149** is provided with an enlargement **149a** forming an abutment for engagement with the casing to prevent separation of the plunger from the switch casing.

The switch **150** may be operatively connected (not shown) with any one of a number of apparatuses or devices such as an electrically powered pump, for example, to operate a hydraulic cylinder unit to effect a movement of a boom.

The pneumatic line which may control, for example, a movement of a boom is of the self-charging type due to the construction and arrangement of elements in the air transmitter **115**. Due to the provision of the conically recessed valve **143** of the transmitter and the construction and arrangement of the valve seat which includes the gasket **127** of the transmitter, water is very effectively inhibited from dripping into the apertured upper end fitting **122** of the bellows **121**. The normally open air line permits air to enter or leave it through the port **119** in the air transmitter, which port also serves to permit the escape of moisture from within the transmitter. The normally open air line permits air to escape as when the line is subjected to heat, and permits air to enter the line as when the line is subjected to cold temperatures.

While the air receiver is illustrated and described as having an operative connection with an electric switch, it will be understood that the bellows-equipped plunger of the air receiver may be employed to operate other devices such as valves, for example.

While only one form of the pneumatic control apparatus has been illustrated and described above, it will be apparent to those versed in the art that the control may take other forms and is susceptible of many changes in details without departure from the principles of the invention and the scope of the claims.

What I claim is:

1. In a control mechanism of the pneumatic type, an air transmitter connected to a remotely located air receiver by an air line, the transmitter comprising: a casing; a flexible resilient bellows within the casing having one end thereof connected to the air line, the other end of the bellows being free within the casing and provided with a fitting having an orifice opening into the bellows; and valve means for closing the orifice and compressing the bellows through the end fitting to transmit air through the air line, the last-named means extending within the casing and being operable from without the latter, the valve means being spring biased to a normal position spaced from said fitting to permit ingress and egress of air from the bellows, and the casing having means providing for the admission and exhaust of air.

2. In a control mechanism of the pneumatic type, an air transmitter connected to a remotely located air receiver by an air line, the transmitter comprising: a casing; a flexible resilient bellows within the casing having one end thereof connected to the air line, the other end of the bellows being free within the casing and provided with a fitting having a central tubular part communicating with and extending from the bellows and terminating in a free end, the last-named end having a resilient member thereon to form a valve seat; and valve means for cooperation with said seat and movable to compress the bellows through the end fitting to transmit air through said line, the last-named means extending within the casing and being operable from without the latter, the valve means comprising a valve element having a conically recessed surface for cooperation with the valve seat, said valve element being spring biased to a normal position spaced from said fitting to permit ingress and egress of air from the bellows, and the casing having means providing for the admission and exhaust of air.

3. In a control mechanism of the pneumatic type, an air transmitter connected to a remotely located air receiver by an air line, the transmitter comprising: a casing; a flexible resilient bellows within the casing having one end thereof connected to the air line, the other end of the bellows being free within the casing and provided with a fitting having a central tubular part communicating with and extending from the bellows and terminating in a free end, the last-named end having a generally conical peripheral surface; an O-ring seated in abutting relation to said surface and protruding therefrom to form a valve seat; and valve means for cooperation with said seat and movable to compress the bellows through the end fitting to transmit air through said line, the last-named means extending within the casing and being operable from without the latter, the valve means comprising a valve element having a conically recessed surface for cooperation with the valve seat, said valve element being a manually depressible plunger spring biased to a normal position spaced from said fitting to permit ingress and egress of air from the bellows, and the casing having means providing for the admission and exhaust of air.

4. In a control mechanism of the pneumatic type, an air transmitter connected to a remotely located air receiver by an air line, the transmitter comprising: a casing; a flexible resilient bellows within the casing having one end thereof connected to the air line, the other end of the bellows being free within the casing and provided with a fitting having a central part communicating with and extending from the bellows and terminating in a free end, the last-named end having a generally conical peripheral surface; an O-ring seated in abutting relation to said surface and protruding therefrom to form a valve seat; and valve means for cooperation with said seat and movable to compress the bellows through the end fitting to transmit air through said line, the last-named means extending within the casing and being operable from without the latter, the valve means comprising a valve element having a conically recessed surface for cooperation with the valve seat, said valve element being spring biased to a normal position spaced from said fitting to permit ingress and egress of air from the bellows, and the casing having means providing for the admission and exhaust of air.

5. In a control mechanism of the pneumatic type, an air transmitter connected to a remotely located air receiver by an air line, the transmitter comprising: a casing; a flexible resilient bellows within the casing having one end thereof connected to the air line, the other end of the bellows being free within the casing and provided with a fitting having a central part communicating with and extending from the bellows and terminating in a free end, the last-named end having a generally conical peripheral surface; an O-ring seated in abutting relation to said surface and protruding therefrom to form a valve seat; and valve means for cooperation with said seat and

movable to compress the bellows through the end fitting to transmit air through said line, the last-named means extendings within the casing and being operable from without the latter, the valve means comprising a valve element having a conically recessed surface for cooperation with the valve seat, said valve element being a manually depressible plunger spring biased to a normal position spaced from said fitting to permit ingress and egress of air from the bellows, and the casing having means providing for the admission and exhaust of air.

6. In a control mechanism of the pneumatic type, an air transmitter connected to a remotely located air receiver by an air line, the transmitter comprising: a casing; a flexible resilient bellows within the casing having one end thereof connected to the air line, the other end of the bellows being free within the casing and provided with a fitting having a central tubular part communicating with and extending from the bellows and terminating in a free end, the last-named end having a generally conical peripheral surface having a valve seat provided thereon; and valve means for cooperation with said seat and movable to compress the bellows through the end fitting to transmit air through said line, the last-named means extending within the casing and being operable from without the latter, the valve means comprising a valve element having a conically recessed surface for cooperation with the valve seat, said valve element being spring biased to a normal position spaced from said fitting to permit ingress and egress of air from the bellows, and the casing having means providing for the admission and exhaust of air.

7. In a control mechanism of the pneumatic type, an air transmitter connected to a remotely located air receiver by an air line, the transmitter comprising: a casing; a flexible resilient bellows within the casing having one end thereof connected to the air line, the other end of the bellows being free within the casing and provided with a fitting having a central tubular part communicating with and extending from the bellows and terminating in a free end, the last-named end having a generally conical peripheral surface having a valve seat provided thereon, said valve seat being provided by a surface protruding from said conical peripheral surface; and valve means for cooperation with said seat and movable to compress the bellows through the end fitting to transmit air through said line, the last-named means extending within the casing and being operable from without the latter, the valve means comprising a valve element having a conically recessed surface for cooperation with the valve seat, said valve element being spring biased to a normal position spaced from said fitting to permit ingress and egress of air from the bellows, and the casing having means providing for the admission and exhaust of air.

8. In a control mechanism of the pneumatic type, an air transmitter connected to a remotely located air receiver by an air line, the transmitter comprising: a casing; a flexible resilient bellows within the casing having one end thereof connected to the air line, the other end of the bellows being free within the casing and provided with a fitting having a central tubular part communicating with and extending from the bellows and terminating in a free end, the last-named end having a generally conical peripheral surface having a valve seat provided thereon, said valve seat being provided by a

surface protruding from said conical peripheral surface; and valve means for cooperation with said seat and movable to compress the bellows through the end fitting to transmit air through said line, the last-named means extending within the casing and being operable from without the latter, the valve means comprising a valve element having a conically recessed surface for cooperation with the valve seat, said valve element being a manually depressible plunger spring biased to a normal position spaced from said fitting to permit ingress and egress of air from the bellows, and the casing having means providing for the admission and exhaust of air.

9. In a control mechanism of the pneumatic type, an air transmitter connected to a remotely located air receiver by an air line, the transmitter comprising: a casing; a flexible resilient bellows within the casing having one end thereof connected to the air line, the other end of the bellows being free within the casing and provided with a fitting having an orifice opening into the bellows; and valve means for closing the orifice and compressing the bellows through the end fitting to transmit air through the air line, the last-named means extending within the casing and being operable from without the latter, the valve means being spring biased to a normal position spaced from said fitting to permit ingress and egress of air from the bellows, and the casing having means providing for the admission and exhaust of air.

10. In a control mechanism of the pneumatic type, an air transmitter connected to a remotely located air receiver by an air line, the transmitter comprising: a casing; a flexible resilient bellows within the casing having one end thereof connected to the air line, the other end of the bellows being free within the casing and provided with a fitting having a central tubular part communicating with and extending from the bellows and terminating in a free end, the last-named end having a generally conical peripheral surface; an O-ring seated in abutting relation to said surface and protruding therefrom to form a valve seat; and valve means for cooperation with said seat and movable to compress the bellows through the end fitting to transmit air through said line, the last-named means extending within the casing and being operable from without the latter, the valve means comprising a valve element having a conically recessed surface for cooperation with the valve seat, said valve element being spring biased to a normal position spaced from said fitting to permit ingress and egress of air from the bellows, and the casing having means providing for the admission and exhaust of air.

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