United States Patent [19]

Hoofnagle

[11] **3,924,752**

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[54] **CRANE BOOM AND LINE SAFETY LIMIT WARNING ASSEMBLY**

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[52] **U.S. Cl.** ..... **212/39 MS;** 91/1; 91/400; 214/761

[51] **Int. Cl.²** **B66C 13/48**

[58] **Field of Search** 212/39; 214/761; 91/1, 91/400; 60/328, 403

[56] **References Cited**

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Assistant Examiner—Lawrence J. Oresky

[57] **ABSTRACT**

A fluid pressure warning system is provided bleed valves for use on a crane and positioned for actuation in response to the boom of a crane being elevated excessively, the block of a crane approaching its upper limit and the fast line of a crane approaching its upper limit of travel. The fluid pressure system comprises a pneumatic system and includes a pneumatically actuated audible signal developing apparatus disposed in a branch line of the pneumatic system under the control of a pneumatic relay actuatable in response to a drop in air pressure within the system.

10 Claims, 6 Drawing Figures

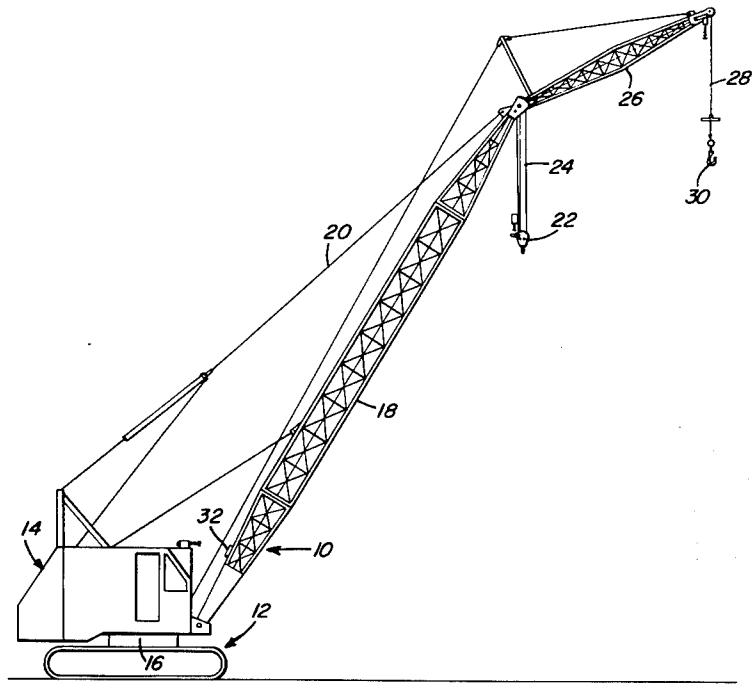


Fig. 1

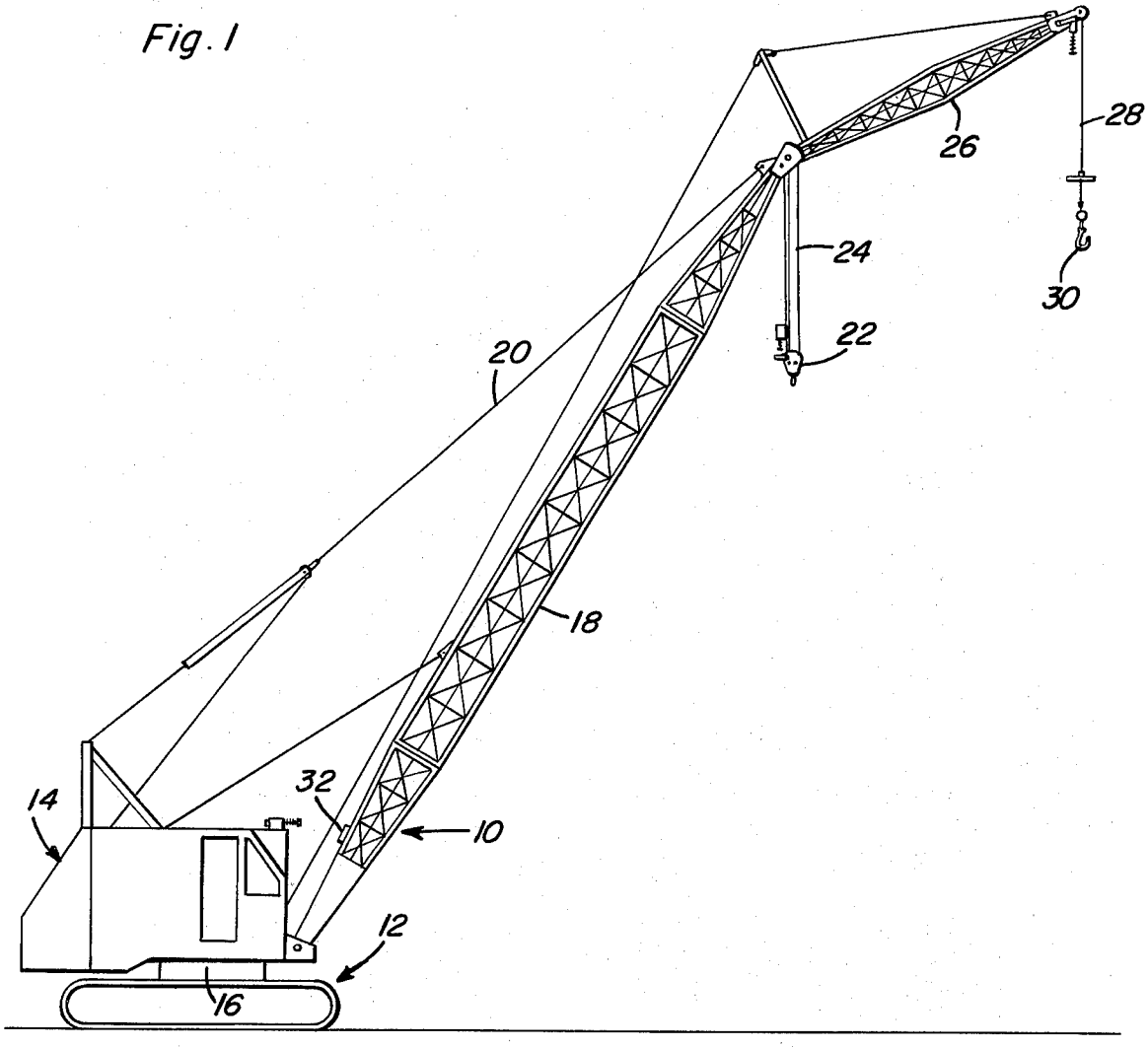

28
26
24
30
22
20
18
14
32
10
12
16

Fig. 6

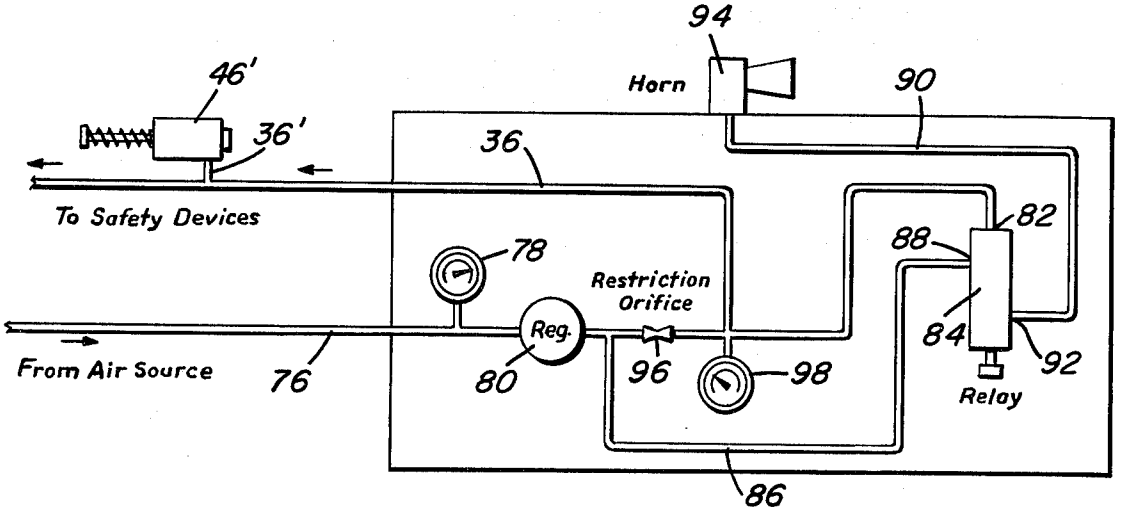

94
Horn
90
46'
36'
36
To Safety Devices
82
88
78
Restriction Orifice
84
Reg.
From Air Source
76
80
96
98
92
Relay
86

Fig. 2

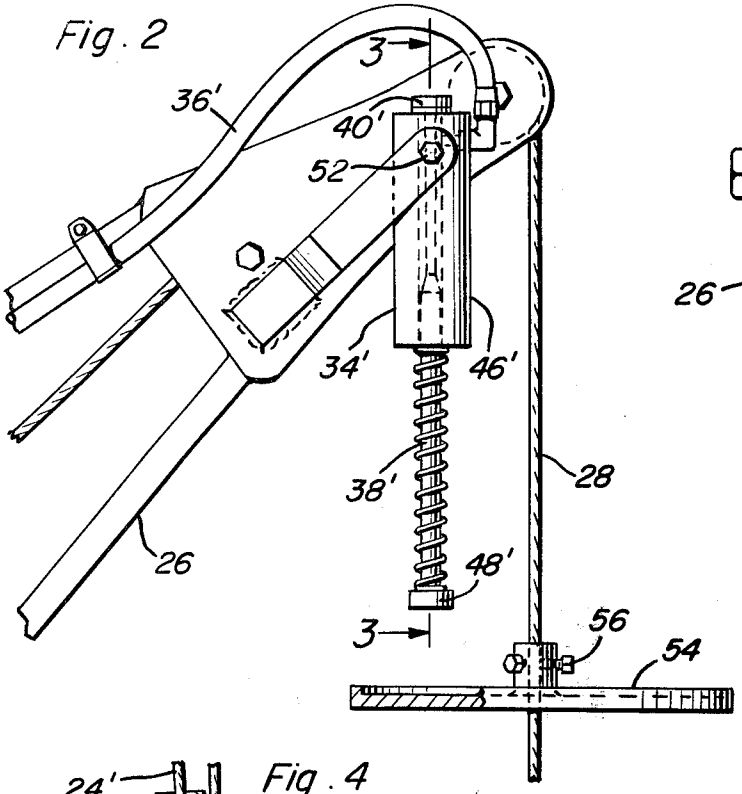


Fig. 3

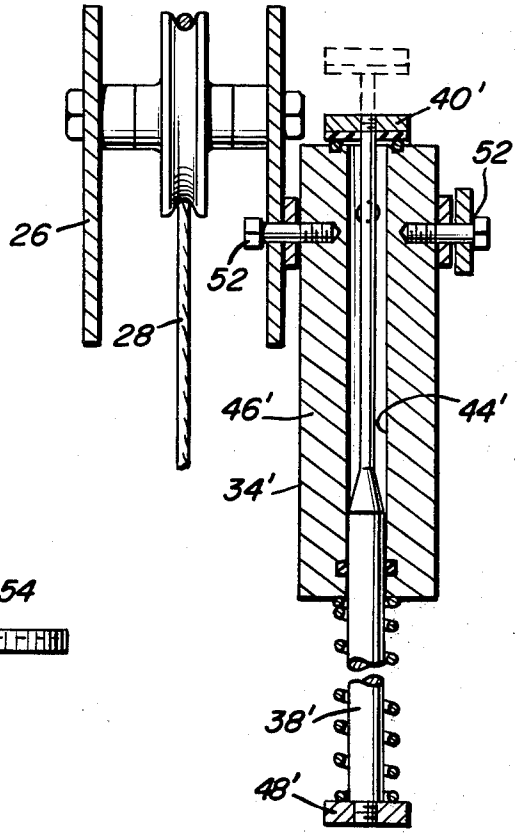


Fig. 4

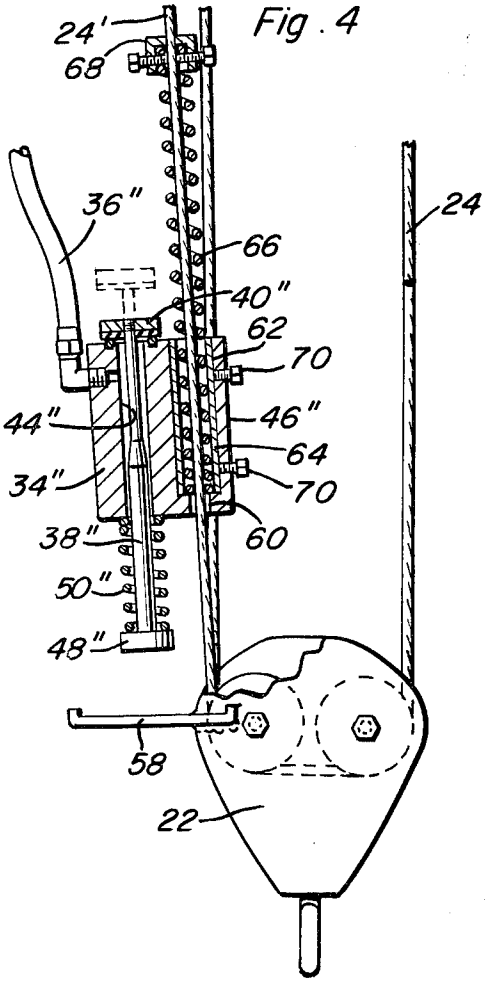
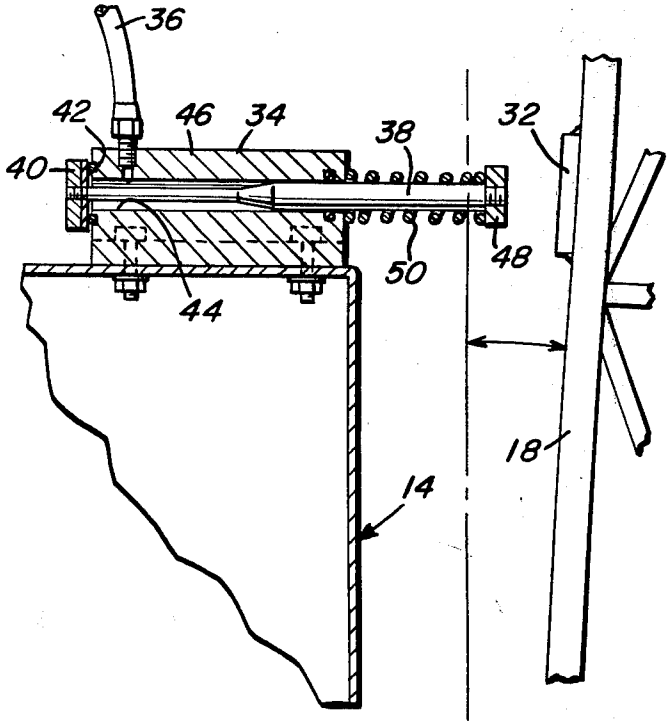


Fig. 5



CRANE BOOM AND LINE SAFETY LIMIT WARNING ASSEMBLY

BACKGROUND OF THE INVENTION

Each year many accidents involving the operation of cranes occur not as a result of mechanical failure but as a result of human error. In most cases an accident occurs because the crane operator is momentarily unaware of a critical position of the crane's fast line, block or boom.

In order to reduce such accidents various types of warning devices and crane clutch deactivating mechanisms have been heretofore designed. Examples of these previous devices may be found in U.S. Pat. Nos. 1,558,635 to W. M. Rutan, dated Oct. 27, 1925, 2,840,244 to W. T. Thomas, Jr., dated June 24, 1958, 3,052,878 to J. E. Berry, dated Sept. 4, 1962, 3,094,221 to C. W. Galuska, dated June 18, 1963 and 3,565,402 to Ernest A. Linke, dated Feb. 23, 1971. However, these previous warning and crane clutch actuating devices have been constructed whereby certain operating conditions may render them inoperative or at least reduced in effectiveness.

BRIEF DESCRIPTION OF THE INVENTION

The warning assembly of the instant invention has been designed primarily for use on cranes including compressed air systems and includes structure whereby the assembly is substantially fail safe. The assembly does not include automatically actuatable crane clutch operating structure which could cause additional accidents if operated suddenly in a manner not anticipated by the operator of the crane or persons beneath a load supported by the crane, but is constructed in a manner whereby an audible signal for both the crane operator and persons who may be disposed beneath a load supported by the crane is actuated in response to the load or fast line approaching its upper limit, the block approaching its upper limit or the boom approaching a vertical position. The warning assembly is designed in a manner such that the audible signal (in addition to any other signals which may be operatively connected to the warning assembly) is rendered in sufficient time for the operator of the crane to correct the impending dangerous situation before a critical extent thereof is reached.

The main object of this invention is to provide a warning assembly for a crane which may be actuated in sufficient time in order to prevent the load or fast line or the block or dead line from reaching their upper limits and the boom of the crane from too closely approaching a vertical position.

Another object of this invention, in accordance with the immediately preceding object, is to provide a warning assembly actuatable from a crane's pneumatic system.

Still another object of this invention is to provide an apparatus in accordance with the preceding objects constructed in a manner so as to be substantially fail safe in operation.

A final object of this invention to be specifically enumerated herein is to provide a warning assembly in accordance with the preceding objects and which will conform to conventional forms of manufacture, be of simple construction and automatic in operation so as to provide a device that will be economically feasible, long lasting and trouble free.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevational view of a crane equipped with the warning assembly of the instant invention;

FIG. **2** is an enlarged fragmentary side elevational view of that portion of the warning assembly operatively associated with the fast line of the crane;

FIG. **3** is a fragmentary vertical sectional view taken substantially upon the plane indicated by the section line **3—3** of FIG. **2**;

FIG. **4** is a side elevational view of that portion of the warning assembly operatively associated with the block lift line of the crane and with the related warning assembly components illustrated in vertical section;

FIG. **5** is a fragmentary side elevational view of that portion of the warning assembly operatively associated with the boom of the crane and with the corresponding warning assembly components illustrated in vertical section; and

FIG. **6** is a schematic view of the pneumatic system of the warning assembly.

DETAILED DESCRIPTION OF THE INVENTION

Referring now more specifically to the drawings, the numeral **10** generally designates a conventional form of crane including a crawler carriage referred to in general by the reference numeral **12** from which a cab and boom support structure referred to in general by the reference numeral **14** is supported by means of a turntable **16.**

The crane **10** includes a boom **18** of conventional design which may be raised and lowered by means of a cable or line **20** and a block **22** is supported from the upper end of the boom **18** by means of a block line **24.** Further, the boom **18** includes an extension **26** over whose outer end a fast line **28** provided with a hook **30** is guided. The lines **20, 24** and **28** may be reeled inwardly and paid out by the operator of the crane **10** as is conventional.

Secured to the lower end of the boom **18** is an abutment plate **32** and a pressure relief valve **34** is connected to one end of an air vent line **36** and supported from an upper portion of the cab **14.** The pressure relief valve **34** includes a spring-biased reciprocal piston **38** including a valve head **40** on one end for engagement with a sealing ring **42** disposed about the outlet end of a vent bore **44** formed through the body **46** of the valve **34.** The other end of the piston **38** projects outwardly of the opposite end of the bore **44** and includes an abutment head **48** thereon which may be abutted by the plate **32** when the boom **18** approaches a near vertical position as a result of the line **20** being reeled in too far.

As the plate **32** engages the abutment head **48** and shifts the piston **38** to the left as viewed in FIG. **5** against the biasing action of the compression spring **50,** the head **40** is unseated from the seal **42** and the line **36** is vented through the bore **44.**

In addition, a second pressure relief valve **34'** of substantially the same construction as the pressure relief valve **34** but including a longer piston **38'** has its body portion **46'** pivotally supported from the upper

end of the boom extension **26** as at **52.** The abutment head **48'** carried by the lower end of the piston **38'** is disposed for engagement by an abutment disc **54** secured to the fast line **28** by means of setscrews **56.** The abutment disc **54** is spaced slightly above the free end of the fast line **28** and therefore is disposed for engagement with the abutment head **48'** to upwardly displace the piston **38'** in order to unseat the head **40'** from the upper end of the bore corresponding to the bore **44** through which the piston **38** is slidable. The line **36** includes a branch line **36'** whose end remote from the line **36** is attached to the body **46'** of the pressure relief valve **34'** and opens into the bore thereof corresponding to the bore **44.**

It will of course be appreciated that by suspending the pressure relief valve **34'** at its upper end in a pivotal manner the longitudinal extent of the pressure relief valve **34'** and the piston **38'** will be maintained vertically disposed throughout angular changes of the boom **10** and that the piston **38'** will therefore always parallel the fast line **28** to ensure that the abutment disc **54** will be engageable with the abutment head **48'.**

With attention now invited more specifically to FIG. **4** of the drawings there may be seen a third pressure relief valve **34''** to which one end of a second branch line **36''** is connected. The block **22** includes an outwardly projecting plate **58** supported therefrom for engagement with the abutment head **48''** carried by the piston **38''** of the pressure relief valve **34''.** Of course, the piston **38''** includes a head **40''** at its end remote from the abutment head **48''** and corresponding to the head **40** and continued upward movement of the block **22** after initial engagement of the plate **58** with the abutment head **48''** will cause the piston **38''** to be displaced upwardly to the phantom line position thereof illustrated in FIG. **4** in order to vent the branch line **36''** through the bore **44''** corresponding to the bores **44** and **44'.**

However, rather than the pressure relief valve **34''** being stationarily supported from the upper end of the boom **18** adjacent the block line **24** the body **46''** of the valve **34''** includes a vertical bore **60** extending therethrough including an upper end counterbore **62.** The dead line **24'** extends through the bore **60** whereby the body **46''** is slidingly disposed on the dead line **24'** and a slightly deformable sleeve **64** is seated within the counterbore **62** and snugly receives the lower end of a compression spring **66** whose upper end is anchored in position on an upper portion of the dead line **24'** by means of a clamp assembly **68.** The body **46''** includes setscrews **70** for slightly inwardly deflecting and deforming the sleeve **62** in order that the latter may clampingly engage the lower end of the compression spring **66** disposed about the dead line **24.** Accordingly, the body **46''** is supported on the dead line **24'** against downward sliding therealong by resistance of the spring **66** to expansion and yet may be moved upwardly along the dead line **24** in the event upward movement of the block **22** and the plate **58** is sufficient to fully collapse the compression spring **50''** corresponding to the compression spring **50** and apply direct upward force on the body **46''** of the valve **34''.** Accordingly, even though the block **22** may be elevated sufficiently to fully upwardly displace the piston **38''** (and in the process vent the branch line **36''** through the bore **44''**) further upward movement of the block **22** is possible as a result of upward sliding of the body **46''** along the dead line **24'.**

With attention now invited more specifically to FIG. **6** of the drawings it may be seen that the crane **10** includes an air pressure line **76** extending from a suitable source of air under pressure. The line **76** includes a pressure gauge **78** and a pressure regulator **80** is serially connected in the line **76.** The line **76** extends to a first port **82** in a pneumatic relay **84** and a branch or bypass line **86** extends from the line **76** downstream from the regulator **80** to a second port **88** in the pneumatic relay **80.** The inlet end of a discharge line **90** is connected to a third port **92** in the relay **84** and the outlet end of the discharge line **90** is connected to a pneumatically operated audible signalling device **94.** Further, the line **76** has a restriction orifice **96** disposed therein intermediate the inlet end of the bypass line **86** and the port **82** and a second pressure gauge **98** is communicated with the line **76** intermediate the restriction orifice **96** and the port **82.** Further, the inlet end of the line **36** opens into the line **76** intermediate the restriction orifice and the port **82.** In operation, if any of the pistons **40, 40'** and **40''** are unseated from the adjacent ends of the corresponding bores **44, 44'** and **44''** the line **36** is vented and pressure to the port **82** of the relay **84** is reduced and maintained reduced by the restriction orifice **96.** However, higher air pressure is maintained in the bypass line **86** extending to the port **88** and thus the relay **84** is actuated. Upon actuation of the relay **84** the port **92** is communicated with the port **88** whereby the pneumatically actuated audible signalling device **94** is placed in direct communication with the full pressure of the line **86** as regulated by the regulator **80.** Of course, actuation of the audible signalling device **94** is sufficient to warn the operator of the crane **10** of a dangerous operating condition and the operator may take corrective steps.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. In combination with a crane including first and second components with the first component movable relative to the second component in opposite directions toward and away from the second component and in one of said directions toward a predetermined limit position, an abutment portion on one of said components, a normally closed pressure relief valve on the other of said components and including an actuator engageable by said abutment portion upon movement of said first component in said one direction to a position adjacent said limit position to open said pressure relief valve, a fluid pressure system including a fluid pressure line having an inlet end adapted for connection to a source of gas under pressure and an outlet end, an air pressure operated relay including a normally closed air passage extending therethrough and a pressure inlet port to which gas pressure must be supplied to maintain said air passage closed, said relay being operative to automatically open said passage in response to a drop in air pressure at said port below a predetermined value, said outlet end being communicated with said port and said pressure line including air flow restricting means intermediate said inlet and outlet ends, a first branch line including an inlet end open-

ing into said pressure line between said flow restricting means and said outlet end and an outlet end communicated with one end of said flow passage, a second branch line including an inlet end communicated with the interior of said pressure line intermediate said flow restricting means and the outlet end of said pressure line and an outlet end under the control of said pressure relief valve, and a signal supply line having an inlet end communicated with the other end of said passage and an outlet end adapted to be communicated with a pneumatically actuatable signalling device.

2. In combination with a crane including first and second components with the first component movable relative to the second component in opposite directions toward and away from the second component and in one of said directions toward a predetermined limit position, an abutment portion on one of said components, a normally closed pressure relief valve on the other of said components and including an acutator engageable by said abutment portion upon movement of said first component in said one direction to a position adjacent said limit position to open said pressure relief valve, a source of pressurized gas, a fluid pressure system including a fluid pressure line having an inlet end adapted for connection to said source of gas under pressure and an outlet end, a branch line including an inlet end communicated with said pressure line and an outlet end, a pneumatically actuatable signalling device connected to the outlet end of said branch line, said branch line including a normally closed valve serially connected therein and to which the outlet end of said pressure line is connected and operable to open said valve in response to a drop in pressure at said inlet port caused by the opening of said pressure relief valve, air flow restricting means in said pressure line between the inlet end of said branch line and the outlet end of said pressure line, and a pressure relief line including an inlet end opening into said pressure line between its outlet end and said flow restricting means and an outlet end under the control of said pressure relief valve, further said source of pressurized gas operates said pneumatically actuactable signalling device.

3. The combination of claim **1** wherein said pressure relief valve includes a valve body having a bore formed therethrough, a piston extending through said bore including a first end portion of reduced diameter provided with an enlarged head disposed outwardly of the corresponding end of said bore and shiftable toward said body to sealingly close said bore, the other end of said piston being snugly slidable through the other end portion of said bore and projecting outwardly of said body, spring means operatively connected between said piston and said body yieldingly biasing said piston toward a position with said head sealingly closing said corresponding end of said bore, said body including a pressure inlet port opening into said bore out of registry with said other end of said piston, the outlet end of said pressure relief line being connected to said inlet port.

4. The combination of claim **3** wherein said crane includes a boom mounting structure and a boom pivotally supported from said structure for oscillation about a generally horizontal axis, said mounting structure and boom comprising said components.

5. The combination of claim **4** wherein said abutment portion is carried by said boom and said pressure relief valve is carried by said mounting structure.

6. The combination of claim **3** wherein said crane includes a boom structure having a free end portion and a fast line received over the free end portion of said boom structure, said boom structure and fast line comprising said components.

7. The combination of claim **6** wherein said abutment portion is carried by said fast line and said relief valve is dependingly supported from said boom structure with said other end of said piston disposed lowermost and alongside the downwardly extending free end portion of said fast line, the upper portion of said relief valve body being pivotally supported from said boom structure for oscillation about a horizontal transverse axis.

8. The combination of claim **3** wherein said crane includes a boom structure having a free end portion and a block line received over said free end portion as well as a dead line anchored at its upper end to said structure, the lower ends of said block and dead lines being joined and supporting a block therefrom, said abutment being carried by said block and support means supporting said valve from said dead line with said other end of said piston lowermost and extending along said dead line.

9. The combination of claim **8** wherein said support means includes means supporting said valve body from said dead line for limited shifting along the latter and yieldingly biasing said body toward its lowermost limit position on said dead line.

10. The combination of claim **9** wherein said valve body includes a through bore generally paralleling the first-mentioned bore and said through bore includes an enlarged counterbore at its end corresponding to said corresponding end of first-mentioned body bore, said support means comprising a coiled combined expansion and compression spring disposed about and slidable on said dead line above said valve body, the lower end of said spring being anchored in said counterbore and the upper end of said spring being anchored to said dead line.

* * * * *