July 17, 1956 A. F. SPERRY 2,754,793

ALARM SYSTEM AND SIGNALLING APPARATUS THEREFOR

Filed Oct. 1, 1954

2 Sheets-Sheet 1

Fig. 1.

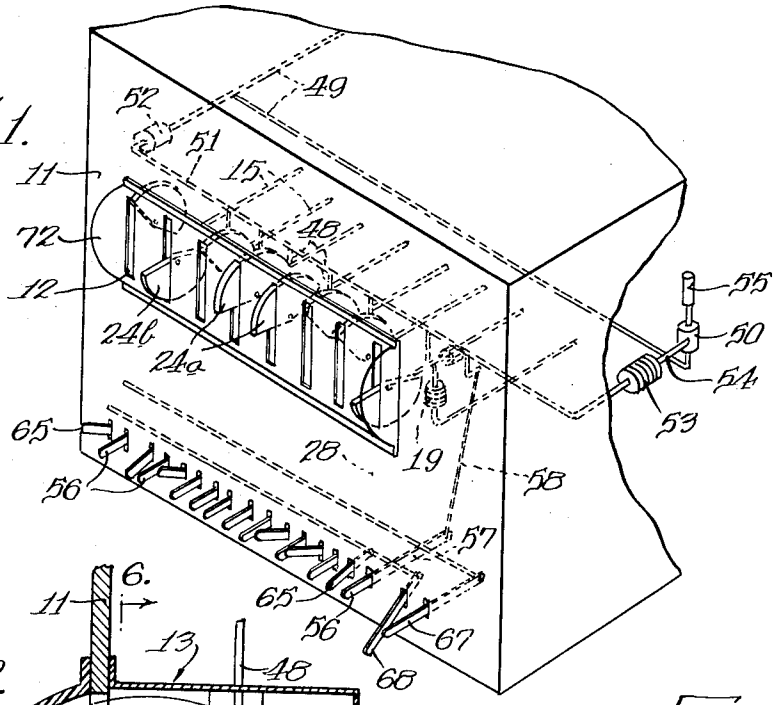


Fig. 2.

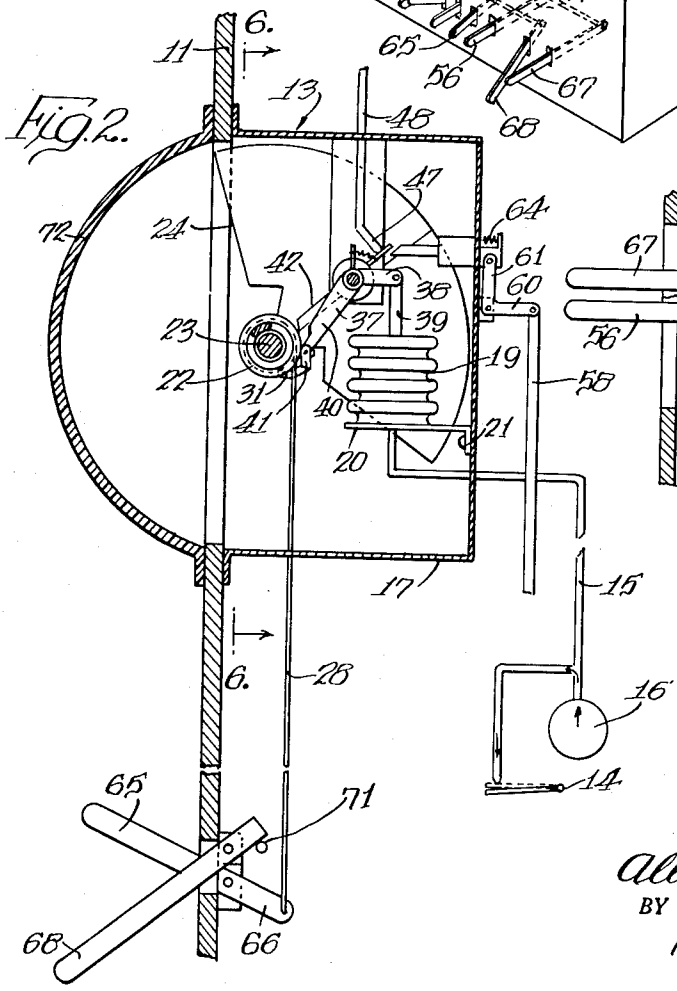
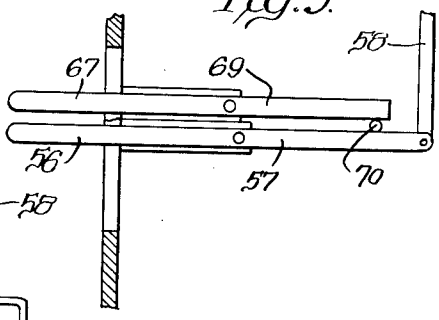


Fig. 3.



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2 Sheets-Sheet 2

Fig. 4.

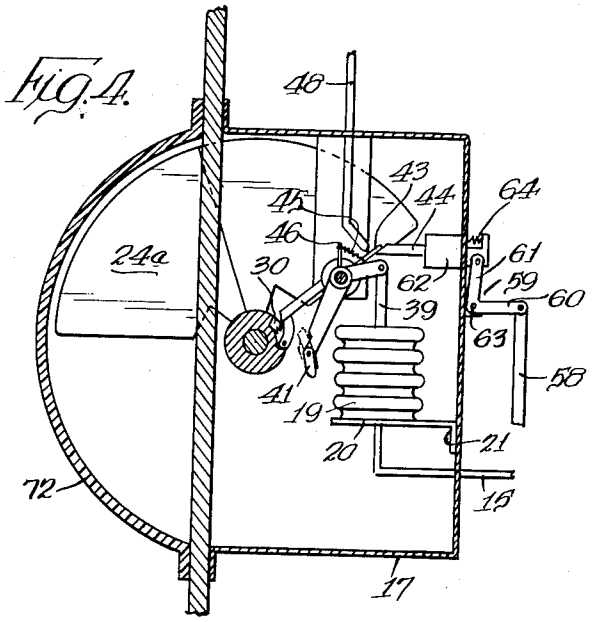
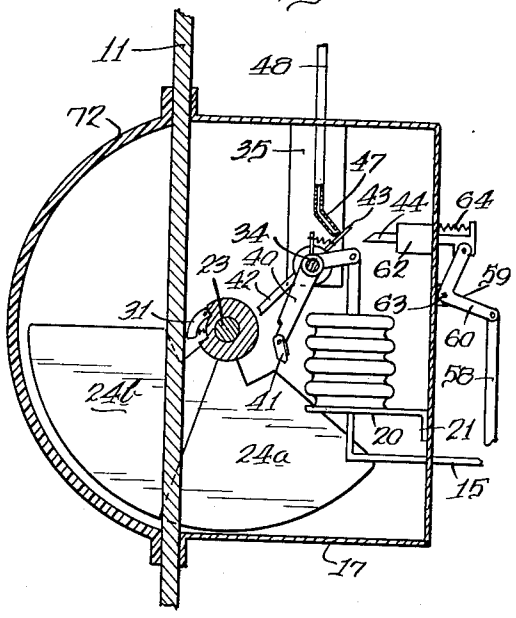


Fig. 5.



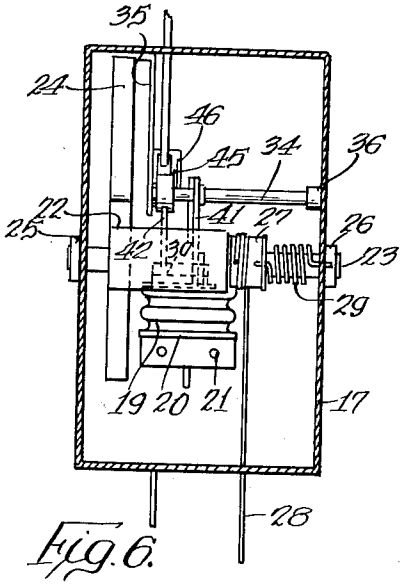


Fig. 6.

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2,754,793

ALARM SYSTEM AND SIGNALLING APPARATUS THEREFOR

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Application October 1, 1954, Serial No. 459,692

9 Claims. (Cl. 116—4)

This invention relates to fluid operated alarm systems for supervising situations wherein the system gives both audible and visual signals indicating the occurrence of an abnormal condition and identifying the supervised apparatus or area. The condition to be supervised may be evidenced by temperature or pressure, liquid level, rate of flow, or innumerable other conditions which must be superintended for reliable indication of an abnormal condition.

The invention comprises broadly a fluid operated system combined with instruments responsive to changes in pressure in the system. Upon the actuation of the fluid system by the occurrence of an abnormal condition in the apparatus or area being supervised, warning signals, both visual and audible, are brought into operation. While the audible signal may be silenced, the visual signal remains operative until normal conditions are again established in that which is being supervised.

Alarm systems commonly comprise a plurality of individual alarm units on an instrument panel board, each unit having a visual indicator which responds to changes in the condition supervised. When an abnormal condition occurs, the individual alarm unit connected to the apparatus or area supervised responds to the condition and visually signals the occurrence of such condition. In addition, the alarm unit causes an audible alarm to operate in order to draw attention to the visual signal. Complications arise, however, in the use of such systems in areas where the atmosphere is likely to be filled with gas or dust, or where other hazardous conditions exist. In such locations, electrical systems may be prohibited, or only conditionally allowed. Even under the latter condition, the requirement of suitably protecting against accident, fire and explosion may make the use of electrical systems unfeasible. The design of such electrical protection means as metallic enclosures and hermetic seals makes the equipment large, cumbersome and inflexible, besides being expensive. Therefore, under such conditions, the use of a fluid operated system becomes both practical and economical.

In an alarm system, upon actuation of an alarm unit, it is desirable to have the audible alarm continue to signal until notice has been taken of the visual signal. Thereafter, it is best to silence the audible alarm while leaving a visual indicator showing on the alarm unit. Thus, there is no annoyance from a continually sounding alarm while the abnormal condition is being corrected. For simplicity of construction, it further is desirable to have a common audible alarm device which becomes actuated whenever any one of a group of alarm units indicates the occurrence of an abnormal condition. Silencing of the actuated common audible alarm should not, however, affect the other alarm units, whether signalling or in normal operating position, in any manner. The visual indicators of other actuated alarm units should remain in evidence while the audible alarm is silenced and prepared to sound attention to any newly activated alarm unit.

In carrying out this invention, one of the objects is to provide an extremely compact instrument panel which serves to supervise a plurality of apparatuses or areas, gives visual warning of an abnormal condition, and, in addition, sounds an audible alarm to draw attention to the instrument panel.

An important object of this invention is to supply an alarm unit which visually indicates the existence of an abnormal condition while simultaneously sounding an audible alarm, and including means whereby the audible alarm may be silenced while leaving a visual indicator on the instrument panel to show where the fault exists.

A further object of this invention is to provide an alarm system which will permit restoration of an activated alarm unit to normal operating position only after correction of the abnormal condition which caused the alarm.

Another object of this invention is to provide a highly sensitive, reliable and accurate, and at the same time economical and simple fluid operated alarm system which may be used in hazardous areas where the use of electrical systems is prohibited or highly unsafe. The fluid alarm system used should further provide the full equivalent protection of an electrical alarm system.

Still another object is to provide an alarm unit which is readily adaptable to either pneumatic or hydraulic pressure activation, and which is applicable to all alarm purposes.

It is also an important feature of this invention to provide an alarm unit which visually distinguishes between acknowledged and unacknowledged signals, having an audible signal to attract the attention of an attendant to any existing unacknowledged signal.

Since many areas or apparatuses may be supervised on one instrument panel, it is accordingly another object of this invention to provide an entire alarm system which permits resetting of the individual alarm units for the corrected supervised areas or apparatus while not exinguishing other alarms which also may be existing.

The foregoing and other objects of the invention are fully met by an alarm system having individual alarm units forming a series of instruments, with a small spring biased and rotatable alarm indicator disc in each unit. A pressure actuated bellows is further provided in each unit, acting to release the disc upon the occurrence of an abnormal condition, thus exposing the disc over part of its area. Between the disc and bellows a simple linkage is provided, comprising a fixed shaft having two movable fingers attached thereto, and a disc actuating shaft with a segment cooperating with the two fingers. A third finger, attached to one of the other fingers, actuates an audible alarm which is silenced by a manually operated acknowledgment toggle switch. Acknowledgment of the alarm also releases the disc, enabling it to expose another portion of its area. Reset mechanism on the disc actuating shaft, and mechanically actuated by a reset toggle switch, returns the disc to its normal position upon correction of the abnormal condition.

Other objects will become apparent from the following detailed description, it being understood that the alarm system may be applied in a variety of modifications without departing from the scope of the invention.

In the drawings:

Figure 1 is a fragmentary perspective view of an instrument panel containing a plurality of individual alarm units;

Figure 2 is a sectional view of an individual alarm unit and showing the alarm indicator disc in normal operating position, and further showing the field sensing valve and reset toggle switches;

Figure 3 is an enlarged sectional view of the alarm acknowledge toggles;

Figure 4 is a sectional view similar to Figure 2 with the alarm indicator disc signalling the existence of an abnormal condition;

Figure 5 is a view similar to Figures 2 and 4, and showing the alarm indicator disc in alarm-acknowledged position; and

Figure 6 is a sectional view taken along lines 6—6 in Figure 2.

Referring to Figures 1 and 2, the invention includes an alarm instrument panel 11 in which individual annunciator alarm windows 12 are placed for each alarm unit 13 housed within the panel. Each alarm unit 13 is interconnected with its own normally open field valve 14 by its corresponding pressure line 15. Each field valve 14 is interconnected to a pressure header source 16, and under normal operating conditions valve 14 remains open. The occurrence of an abnormal field condition causes valve 14 to close whereupon a signal is given in alarm unit 13. Valve 14 may be any of the usual types of valves which are used to respond to abnormal conditions. For example, it may be a float valve or the like operated by high or low liquid levels.

The individual alarm units 13 are each provided with a housing 17 which is attached to panel 11 by suitable means such as bolting. At the rear of housing 17 an aperture 18 is provided, permitting pressure line 15 to lead into housing 17 where it ends in bellows 19. A bracket 20, connected to the housing 17 by rivet 21, provides a mounting means for bellows 19. As best shown in Figure 2, bellows 19 when subject to atmospheric pressure remains in a contracted position. When field valve 14 senses an abnormal condition, however, it closes, and pressure is directed to bellows 19 which becomes extended.

Referring to Figures 2 and 6, housing 17 contains a principal operating shaft 23 having sleeve 22 and alarm disc 24 non-rotatably secured thereto. Under normal operating conditions disc 24 is maintained entirely within panel 11. Bearings 25 and 26, secured to the sides of housing 17, rotatably support shaft 23. A drum 27, also fixed to shaft 23, is provided for reset cable 28 to wind upon as shaft 23 is rotated. Spring 29 furnishes a turning movement to the shaft 23, tending to rotate shaft 23 counterclockwise as viewed in Figure 2.

Sleeve 22 is recessed at 30 to hold detent 31 therein by means of pin 32, thus providing a stop means for shaft 23. Spring 33 supplies a slight outwardly directed bias to detent 31 to assure that it will be engaged by stops as shaft 23 rotates counterclockwise, as will be explained more fully hereinafter. As shaft 23 is returned to its starting position, however, spring 33 permits detent 31 to be urged to within recess 30.

A fixed shaft 34, supported at its ends by standard 35 and support 36, is provided within the alarm unit 13, supplying a mounting means for stops which control the movement of shaft 23 and disc 24. Bellcrank 37, rotatively mounted upon shaft 34, is pivotally connected at the outer end of one arm 38 to lifting rod 39 carried by bellows 19. The other bellcrank arm 40 carries an escapement lever 41. Upon expansion of bellows 19, rod 39 moves upwardly, rocking bellcrank 37, thereby slipping escapement lever 41 from engagement with detent 31. The release of detent 31 from engagement with lever 41 permits spring 29 to rotate shaft 23 counterclockwise.

As seen in Figure 4, a second escapement lever 42, also rotatively mounted upon shaft 34 and adapted to engage detent 31, provides a means to stop the rotation of shaft 23 after it has travelled approximately ninety degrees. Since spring 29 continuously tends to rotate shaft 23, lever 42 is rotated slightly by detent 31 until its end 43 engages slide 44 mounted in housing 17, thereby stopping both shaft 23 and lever 42. Spring 45, attached to post 46 and at its other end to lever end 43, provides a means to return lever end 43 to its original position. In such position, end 43 engages the open

bleeder end 47 of pressure duct 48. The position of disc 24 shown in Figure 4 indicates an alarm position which is the result of the occurrence of an abnormal condition in the field. In this position, that portion 24*a* of disc 24 which is showing may be painted red.

An audible alarm also is provided, drawing attention to the instrument panel 11 whenever an abnormal condition occurs. Constant pressure is supplied through line 49 to a normally closed needle valve 50. As shown in Figure 1, branch header 51 and orifice 52 direct pressure to take-off lines 48 in the individual alarm units. A drop in pressure in header 51 causes normally expanded bellows 53 to collapse, moving rod 54, and opening needle valve 50. In its normal operating position, lever end 43 also acts as a bleeder valve, closing the open bleeder end 47 of duct 48. In the position shown in Figure 4, however, lever end 43 is moved sufficiently to permit bleeding off of pressure in line 48 and header 51, thereby collapsing bellows 53 to open needle valve 50. Opening of valve 50 permits pressure from line 49 to sound whistle alarm 55.

To effect acknowledgment of both the visual and audible alarms, the acknowledgment toggle 56 is flipped upwardly, thereby moving acknowledgment arm 57 and lever 58 downwardly. Lever 58, pivotally connected to arm 60 of acknowledgment bellcrank 59, rocks bellcrank arm 61 to move slide 44 held in guide 62. Bellcrank 59 is pivotally mounted at 63 to the rear of alarm housing 17. As slide 44 moves outwardly, it slips from contact with end 43 of lever 42, permitting detent 31 to ride free from lever 42 as spring 29 rotates shaft 23 and disc 24 approximately 180 degrees to the position shown in Figure 5. In acknowledgment position, that portion 24*b* of disc 24 which is showing may be of some other color, such as blue, in order to distinguish from the unacknowledged alarm position. Another spring 64 aids in returning slide 44 to its original position.

As detent 31 rides free from lever 42, spring 45 returns lever end 43 to its original position in contact with the bleeder end 47 of line 48. With normal pressure restored in header 51, bellows 53 expands, moving rod 54 to close needle valve 50. The closing of valve 50, in turn cuts off the flow of air to whistle 55, thereby silencing the audible alarm.

After the alarm has been acknowledged and the abnormal field condition has been corrected, reset of alarm unit 13 to its normal operating position is accomplished by moving reset toggle 65 upwardly, thereby moving reset arm 66 down and pulling upon cable 28. This counteracts spring 29 to rotate shaft 23 clockwise and back to its normal position.

It is evident that as long as a normal condition exists in the area or apparatus being supervised, bellows 19 remains collapsed. This feature safeguards against non-signaling units being actuated by operation of their corresponding acknowledgment toggle switches 56. With bellows 19 collapsed, lever 41 is retained in engagement with detent 31, thereby stopping rotation of shaft 23.

A second safety operational characteristic frees the alarm units from the hazard of losing a signalling alarm. As a consequence of the occurrence of an abnormal field condition, line 15 experiences a pressure increase which causes bellows 19 to expand. Bellows 19 remains expanded as long as the abnormal condition exists, thereby preventing escapement lever 41 from engaging detent 31. Thus, if reset toggle 65 is flipped on an unacknowledged signalling alarm unit 13, the expanded bellows 19 causes lever 41 to slip from the detent 31, and shaft 23 rotates until stopped by lever 42 engaging detent 31. In this position, disc portion 24*a* reappears in panel 11, as shown in Figure 4, and continues to signal that an abnormal condition exists.

As shown in Figures 1, 2, and 3, a gang acknowledgment toggle 67 and a gang reset toggle 68 also are provided. When gang acknowledgment toggle 67 is flipped up, gang acknowledgement arm 69 moves downwardly

causing gang crossbar **70** also to move down. The downward movement of crossbar **70** forces the individual acknowledgment arms **57** to move downwardly, and, in turn, acknowledges the individual alarm units which have signaled the occurrence of an abnormal field condition. Non-signalling units keep their normal operating position, since bellows **19** remains unextended, retaining lever **41** in engagement with detent **31** and stopping shaft **23** from rotating.

Gang reset toggle **68** resets all signalling alarm units which have previously been acknowledged and whose field condition is again normal. Raising of gang reset toggle **68** causes gang reset crossbar **71** to move down, forcing the individual reset arms **66** also to move down. This counteracts the individual springs **29**, resetting those alarm units **13** that have previously been acknowledged. If an alarm unit has not been acknowledged, it will continue to signal the existence of an abnormal condition as long as such condition continues, since its bellows **19** remains extended as long as greater than atmospheric pressure is directed into the alarm unit **13**. Under such a condition, escapement **41** is prevented from engaging detent **31**, permitting spring **29** to rotate shaft **23** until detent **31** abuts escapement lever **42** and disc portion **24***a* again is showing on the instrument panel.

Although the acknowledgment and reset of the alarm units **13** have been shown at the instrument panel **11**, this invention is not limited to such structure. The alarm units **13** are adaptable to solenoid actuation of slide **44** and to the provision of either a mechanical or electrical rewind construction for shaft **23**.

The operation of the alarm system thus described is as follows:

As normally open field valve **14** senses an abnormal condition, it closes and pressure is directed to alarm unit **13** whose bellows **19** immediately becomes expanded. Expansion of bellows **19** turns bellcrank **37** sufficiently to allow escapement **41** to slip from engagement with detent **31**. This brings about the indicator alarm position shown in Figure 4, wherein shaft **23** has been rotated about ninety degrees by spring **29**, and a portion **24***a* of disc **24** visually indicates the existence of the abnormal condition.

Rotation of shaft **23** and disc **24** in the unacknowledged signalling alarm unit **13** is stopped by detent **31** engaging escapement lever **42**, rotating escapement lever **42** slightly until the lever end **43** abuts slide **44**. The movement of lever end **43** from the open bleeder end **47** of duct **48** causes the pressure to drop in header **51**, collapsing bellows **53**. As bellows **53** collapses, it moves rod **54** to open needle valve **50**, permitting air from line **49** to actuate whistle **55**.

To acknowledge the alarm, either acknowledgment toggle **56** or gang acknowledgment toggle **67** is flipped upwardly, pulling slide **44** from engagement with lever end **43**, and allowing shaft **23** to rotate to the position shown in Figure 5. In the meantime, spring **45** urges lever end **43** back against the bleeder end **47** of duct **48**, returning the pressure in header **51** to normal, and thus expanding bellows **53**. Expansion of bellows **53** closes valve **50**, shutting off air to whistle **55**, and silencing the audible alarm.

After the abnormal condition has been corrected, either reset toggle **65** or gang reset toggle **68** is flipped upwardly, pulling upon cable **28** and rotating shaft **23** clockwise to normal position, as shown in Figure 2. In normal position, detent **31** and escapement **41** again abut one another.

By placing the toggle switches at a convenient point near the alarm windows **12**, the attendant, when called by the audible alarm whistle **55**, is brought in front of the instrument panel **11** and his attention should be caught by the visual alarm disc **24** of the actuated alarm unit **13**. If the attendant does not notice the visual sign, however, the indicator disc **24** persists as long as the abnormal condition survives and the alarm unit has not been reset.

With many alarm units at one instrument panel, it may happen that sounding of the alarm whistle **55** is caused by one alarm unit **13** while the condition in another supervised area or apparatus which previously actuated another unit **13** at an earlier time has not been brought back to normal. Then, visual discs **24** belonging to both units appear in their respective windows **12**. However, the attendant still is able to identify the newly actuated alarm by noticing the particular color in each window **12** and the position of the respective discs **24**.

To protect the discs **24**, and to prevent the entrance of dirt into the individual units **13** by way of the windows **12**, a clear Lucite shield **72** is provided on panel **11**.

While the structure described described forms a satisfactory alarm system, it is to be understood that other forms may be utilized, and that the embodiment herein enumerated is for the purpose of illustration only and not intended to limit and define the invention. One such form suggests itself, namely, the alarm units are adaptable to respond to electrical sensing devices, or the units may respond to pressure systems wherein there is a pressure drop upon the occurrence of an abnormal condition.

I claim:

1. A fluid actuated alarm system, comprising: a pressure source, a plurality of sensing devices, each capable of creating a pressure change upon the occurrence of an abnormal condition; a plurality of visual units, one for each of said sensing devices; an audible alarm; a valve for controlling said audible alarm; a pressure connection from said pressure source to each of said sensing devices; a pressure connection between each sensing device and its corresponding visual unit; a pressure header operatively connected with said valve for effecting the operation thereof; a plurality of conduits, one leading from said header into each of said units; each of said units including a visual alarm indicator, means responsive to pressure changes caused by the sensing device connected therewith to actuate its visual indicator to an alarm position and contemporaneously effect a pressure change in the corresponding conduit leading thereto for opening said valve and sounding said audible alarm, means to actuate its visual indicator to a modified alarm position and contemporaneously restore normal pressure in the conduit leading thereto for closing said valve and silencing said audible alarm; and means to return its visual indicator to normal position.

2. A fluid actuated alarm unit, comprising: a bellows responsive to a pressure change upon the occurrence of an abnormal condition; a latch operated by said bellows, a visual alarm indicator normally held in cocked position by said latch; biasing means acting on said indicator, whereby response by said bellows to a pressure change trips said latch to allow the biasing means to move said indicator to alarm position; a second latch whereby said indicator is retained in alarm position; means to trip said second latch and permit said biasing means to move said indicator to modified alarm position; and means to return the indicator to cocked position.

3. A fluid operated alarm unit for operative connection by a pressure line to a sensing device and pressure source, comprising: a bellows responsive to first pressure changes in said line caused by said sensing device; a rotatable shaft; a visual indicator mounted on said shaft and normally held in cocked position by said bellows; biasing means on said shaft to rotate said indicator to alarm position; an audible alarm; a bleeder line operatively connecting said audible alarm with said unit; a lever engageable with said shaft to stop the rotation thereof; a bleeder valve on the bleeder line, said bleeder valve being carried by said lever; means connecting said audible alarm to said pressure source; an audible alarm control valve in said pressure source connecting means; and means responsive to pressure changes in said bleeder line and connected to said audible alarm control valve, where-

by response by said bellows to said first pressure changes trips said indicator for rotation thereof to alarm position, and engagement by said lever with said shaft contemporaneously ends said rotation and opens said bleeder valve to allow said pressure responsive means to open said audible alarm control valve, thereby sounding said audible alarm.

4. Apparatus as described in claim 3 and additionally including means to trip said lever and permit said biasing means to rotate said indicator to alarm-acknowledged position, and means anchored to said bleeder valve and operative upon the tripping of said lever to close said bleeder valve, thereby closing said audible alarm control valve and silencing said audible alarm.

5. Apparatus as described in claim 4 and additionally comprising apparatus to reset said indicator, comprising a cable anchored to and wound about said shaft, and means to pull said cable and counteract said shaft biasing means, thereby returning said indicator to normal cocked position.

6. A fluid operated alarm system for the protection of a plurality of field stations, comprising a plurality of sensing devices, one for each station, and each device being capable of creating a pressure change upon the occurrence of an abnormal condition; a pressure source; a plurality of alarm units, each operatively connected to at least one of said devices; an audible alarm responsive to said pressure change and operatively associated with said alarm units; a bellows in each unit, responsive to said pressure change caused by the respective device connected thereto; a rotatable shaft in each unit; biasing means anchored on said shaft; a visual indicator mounted on said shaft; retaining means in each unit, connected to said bellows, to engage said shaft and hold said indicator in cocked position, and operable by said bellows to release said shaft upon said pressure change, permitting said indicator to assume an alarm position; second retaining means to hold said indicator in alarm position; a pressure header; individual bleeder take-offs from said header to each of said units for the actuation of said audible alarm; a bleeder stop valve carried by said second retaining means to normally close the bleeder associated therewith, said bleeder valve being opened upon the release of said shaft by said retaining means; pressure responsive means connected to said header; an audible alarm control valve, operable by said pressure responsive means, whereby actuation of said bleeder valve to open said bleeder causes said pressure responsive means to open said audible alarm valve; means to trip said second retaining means and permit said shaft to rotate said indicator to a modified alarm position; and means to close said bleeder valve and silence said audible alarm.

7. Apparatus as described in claim 6 and additionally comprising apparatus to reset said indicator, including a cable anchored to and wound about said shaft, and means to pull said cable and counteract said shaft biasing means, thereby returning the indicator to cocked position.

8. In a fluid actuated alarm unit having a pressure responsive bellows and an alarm indicator, the combination of an alarm indicator and actuating assembly, including a rotatable shaft to carry said indicator; stop means on said shaft; biasing means anchored to said shaft and operating thereon; a finger normally engaging said stop means to retain said indicator in a cocked position, said finger being connected to said bellows and tripable thereby to displace said indicator to announce a first condition, comprising an alarm; a second finger adapted to engage said stop and retain said indicator in alarm position; means to pivotally support said fingers; means to trip said second finger to permit said indicator to rotate and announce a second condition, comprising an acknowledged alarm; a cable anchored to and adapted to wind about said shaft as said indicator announces said first and second conditions; and means to pull said cable and counteract said biasing means to move said indicator to cocked position, comprising normal condition.

9. Apparatus as described in claim 8 and additionally comprising an audible alarm control valve including a third finger carried by said second finger, said third finger being normally engaged with an open bleeder line and adapted to be movable therefrom to actuate an audible alarm; and means to close said bleeder and silence said audible alarm.

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