J. E. SHEPHERD.

ALARM SIGNALING SYSTEM.

APPLICATION FILED JAN. 13, 1908.

**969,414.**

**Patented Sept. 6, 1910.**

2 SHEETS—SHEET 1.

Fig. 1.

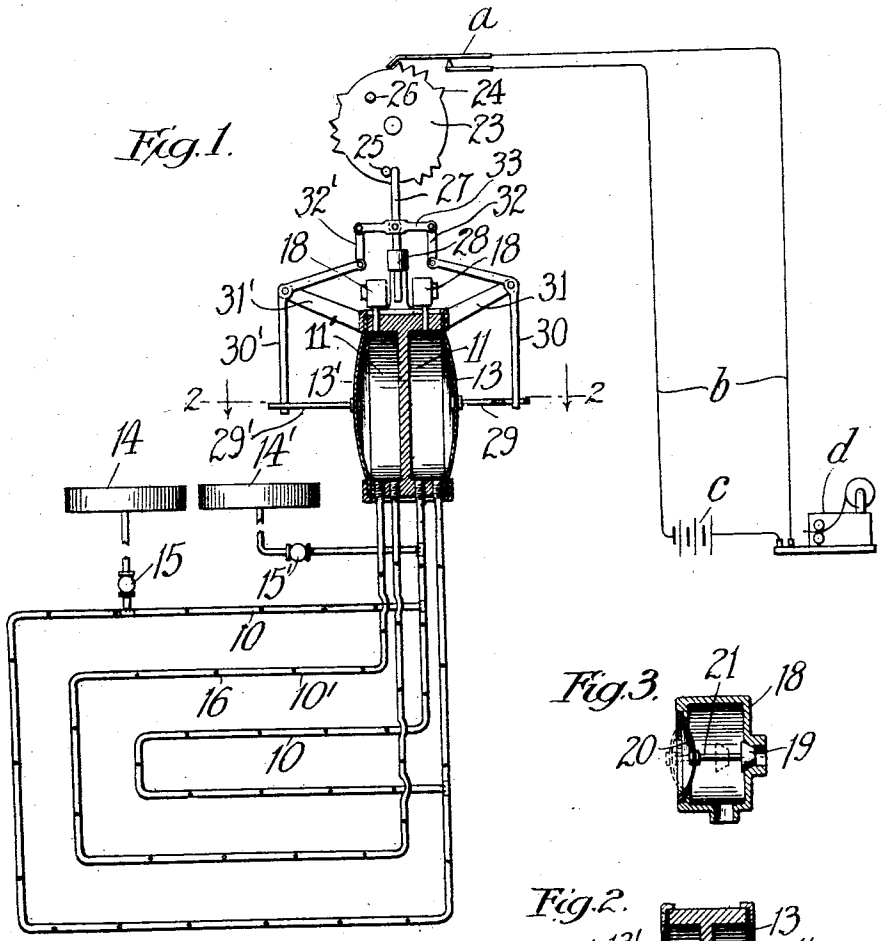



Fig. 3.




Fig. 2.

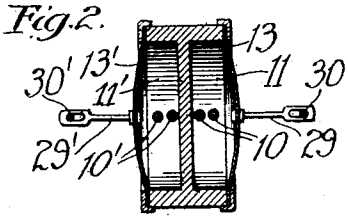



Fig. 4.

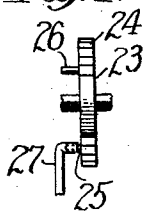



Fig. 5.

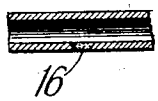



Fig. 7.

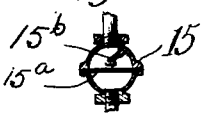
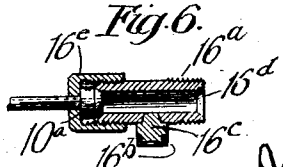



Fig. 6.

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2 SHEETS—SHEET 2.

Fig. 7.

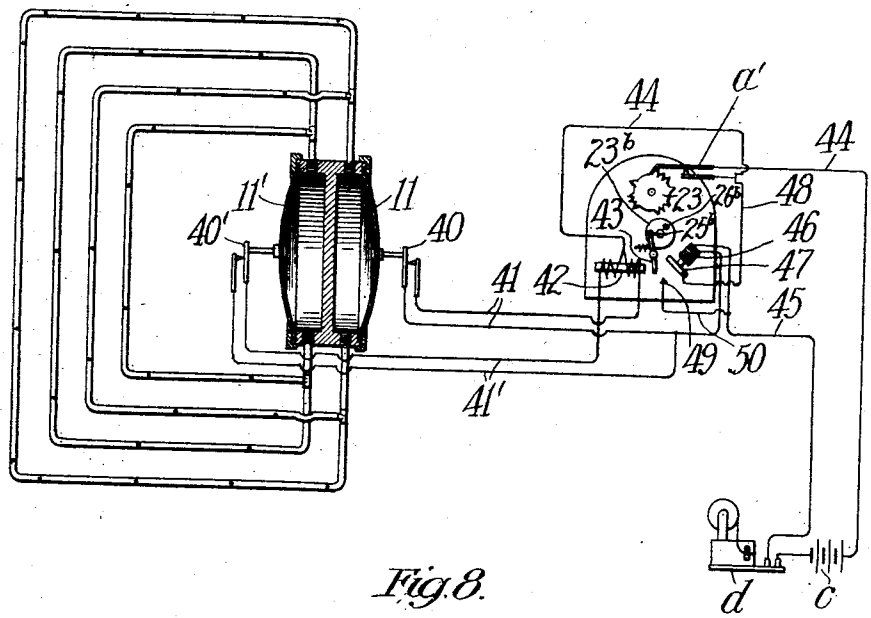
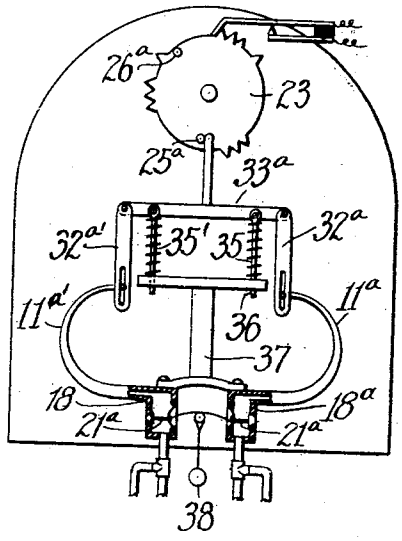



Fig. 8.

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# UNITED STATES PATENT OFFICE.

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## ALARM SIGNALING SYSTEM.

969,414. Specification of Letters Patent. Patented Sept. 6, 1910.

Application filed January 13, 1908. Serial No. 410,640.

*To all whom it may concern:*

Be it known that I, JOHN E. SHEPHERD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Alarm Signaling Systems, of which the following is a specification.

My invention relates to improvements in alarm signaling systems.

One of the objects of this invention is to provide a duplex heat detecting system comprising two independent piping elements extending throughout the same area to be subject to the same fire conditions, and associated with pressure responsive devices arranged to operate signaling means, in such manner that a change of pressure conditions in either one of the two piping elements alone, such as might occur by accident, will cause the transmission of a trouble signal, and the operation of both piping elements in response to fire will occasion the transmission of a different fire alarm signal.

A further object of this invention is to provide a heat detecting system normally under pressure, and signal initiating means responsive to decrease in pressure within the pipe. And a further object of this invention is to provide in connection with a duplex system of the character described, means for electrically or mechanically operating a signal transmitter to show trouble in either piping element or to give a fire signal in the event of operation of both piping elements.

In the drawings, wherein is illustrated an embodiment of my invention; Figure 1 is a diagrammatic illustration of an installation. Fig. 2 is a section of the pressure responsive apparatus on line 2—2 of Fig. 1. Fig. 3 is a vertical section of a pop valve. Fig. 4 is a detail of a transmitter wheel shown in Fig. 1. Figs. 5 and 6 are details of fusible members of the piping. Fig. 7 shows a detail of a valve. Fig. 8 shows a modified embodiment of the invention, and; Fig. 9 shows another modified embodiment of the invention.

In general this invention provides piping elements, preferably two in number and independent of each other, extending throughout the same area for protection, preferably in interlaced or alternating relation, that is to say, with piping branches of one element interposed between piping branches of the other element for most uniform distribution of the piping of the two elements, and most efficient supervision by each element of the entire area.

Each piping element in accordance with the invention, is preferably filled with a fluid under pressure, which may be and preferably is, a liquid subject to rapid expansion under the influence of heat to produce a pressure. Associated with the piping elements, or each such piping element, is a pressure responsive appliance, which under the influence of the pressure existing in the system stands potentially active or ready for operation upon decrease of pressure within the system, and the piping element is preferably provided with fusible closures or thermostats at intervals, so that the impingement of the heat or fire upon the piping will cause the blowing of fusible closures and consequent decrease of pressure within the system.

In the drawings, 10 and 10′ indicate two piping elements arranged with their leads in interlaced or alternating arrangement extending throughout the same area to be protected, and subject to the same exposure to conflagration, each such piping element having its two ends extending into communication with the pressure responsive devices, whereof two, 11 and 11′ are provided. Each pressure responsive device may be of any suitable construction, and as herein shown in Figs. 1 and 2 comprises a shell (a single shell with a dividing wall being sufficient for some of the purposes of the invention) the shells being closed on one side by diaphragms 13, 13′. The piping element may be filled with any fluid above atmospheric pressure, but it is preferable that the piping be filled or substantially filled, with an expansive fluid of non-inflammable qualities, suitably supplied and maintained under pressure.

In the specific embodiment shown 14 and 14′ indicate two reservoirs mounted at suitable elevation above the piping elements 10, 10′, and respectively connected through suitable automatic valves 15 and 15′ with said piping elements, so that the piping elements are always maintained under the pressure afforded by the head of the liquid in the reservoirs, but increase of pressure is not vented through the reservoir. Such valves 15, 15′ as shown in Fig. 7, may comprise a perforated diaphragm 15ª the

aperture whereof is closed against a stop $15^b$ when pressure within the piping bulges the diaphragm toward the reservoir. Throughout the piping 10, 10′ fusible closures or thermostats are provided at intervals, preferably in staggered relation to corresponding parts of an adjacent piping line. In the diagrammatic views such fusible closures for the piping are indicated at 16, and in the detail Figs. 5 and 6 two forms of such closures are shown. In Fig. 5 the closure 16 comprises a fusible mass, set in the wall of the pipe in a hole expanding inwardly, so that the internal pressure serves to increase the bond between the wall of the piping and the fusible material. In Fig. 6 a fusible member is shown comprising a shell $16^a$, preferably of metal, threaded at its end and provided with a boss $16^b$, vertically drilled through to the interior of the pipe and laterally drilled to form a cross-shaped aperture. Such aperture is filled with a cross-shaped body of fusible material $16^c$, which as long as it retains a solid condition is held against displacement by the engagement of its laterally extending wings in the cross channel of the apertured lug. The ends of the shell $16^a$ are suitably connected with the piping communicating therewith, in the construction shown the piping end being expanded into a head $10^a$, having a tapered extremity tightly engaging a tapered seat $16^d$ in the end of the shell $16^a$, and retained by the clamping cap $16^e$, screw-threaded on the exterior of the shell. It will be understood that these forms are suggestive only and that others may be used in lieu thereof.

It will be observed that the system heretofore described constitutes when actuated substantially a closed heat detecting system, wherein the application of undue heat results in the opening of the piping and permits a signal-initiating reduction of pressure.

For the practice of the invention it may sometimes be desirable to provide means in connection with the system for relieving pressure therein in the event the pressure shall rise to an undesirable critical point without the fusing of any of the fusible bodies 16. To this end provision may be made, where necessary, of pop valves 18, shown as connected to the respective chambers 11, 11′, and each comprising a valve chamber, open at one side to the receptacle 11, or 11′, and provided with a valve member 19, normally closing an orifice opening to the air, such valve member being normally positively held in closed position by a peened, inwardly bulging diaphragm 20, connected thereto by a stem 21. The diaphragm 20 is free to move outwardly when sufficient pressure is applied to its inner surface to overcome its mechanical resistance to such movement and will obviously open with a snap action. Consequently the pop-valve 18 affords a mechanical relief mechanism governing the system to which it is applied at some predetermined pressure.

It is obvious that the pressure responsive devices of the two elements may be made to actuate said separate alarm apparatus, but it is preferable that the two separate elements shall be operated in connection with a single signal transmitter arranged in such manner that the operation of either branch of the duplex system alone shall occasion the transmission of a trouble signal, while the operation of both simultaneously, or in quick succession shall initiate the quick transmission of distinguishable fire alarm signal.

Referring to Fig. 1, a mechanical construction is shown, whereby a fire alarm transmitting apparatus is operatively associated with the two pressure responsive devices 11, 11′ to respond to the initiation of either alone by the transmission of a trouble signal, and to respond to the actuation of both of such pressure responsive devices by the transmission of a fire alarm signal.

In the particular disclosure of Figs. 1 and 2, 23 indicates the signaling wheel of a potentially active or normally wound signal transmitter, said wheel being peripherally provided with signaling teeth 24 arranged in suitable number series and having mounted on its face at different radial distances from its axis of rotation two pins 25 and 26, the former pin normally contacting with and being restrained by a controlling bar 27 arranged to slide in a bearing 28. For manipulation of the controlling bar 27 by either diaphragm, said diaphragms 13, 13′ are respectively provided with stems 29, 29′ having slotted ends engaging the extremities of bell crank levers 30, 30′ pivotally mounted on suitable supports 31, 31′ and having their inwardly extending ends connected to links 32, 32′, which in turn are pivotally connected to a cross-bar 33, having slot and pin engagement with the stem 27. It will now be seen that if either diaphragm is freed from internal pressure so that it springs back to vertical position it exerts a pull upon the end of its bell crank which communicates an upward movement to the connected end of cross bar 33, so moving said cross bar or lever, which is fulcrumed at its point of connection with the opposite bell crank lever arrangement, and so lifting to a certain extent the connected stem 27, which disengages pin 25 and takes the position in the path of pin 26, so that the signal wheel is freed for a partial rotation during which one number series of its teeth pass beneath a circuit breaking switch *a* associated with the wheel. Furthermore if now the other diaphragm of the duplex pair is collapsed, or returned to

vertical position, the end of the cross-bar 33, which formerly had been stationary is now lifted to a plane even with the first lifted end, thereby elevating the middle portion and causing the stem 27 to move inwardly beyond the pin 26 to free the transmitter wheel 23 for the balance of its suitable signaling movement, for which the transmitter is wound.

In the system shown the switch $a$ is included in a closed signaling circuit $b$ energized by a suitable source of current supply $c$, and including a register $d$, of well known type, so that the signaling action of the wheel 23 is recorded at a suitable supervisory station.

It may be desirable to provide for manual release of the transmitter by simultaneous release of pressure in both branches of the duplex system, and this may readily be accomplished by arranging normally closed valves controlling the pressure in both systems and manual means for opening said valves. In Fig. 8 a modified embodiment of the invention is shown, in which each branch of the duplex piping system is connected with a Bourdon pressure gage, $11^a$ and $11^{a'}$ respectively, the extremities of such gages being respectively connected by pin and slot connections with links $32^a$, $32^{a'}$, which at their opposite extremities are connected to the opposite ends of cross-bar $33^a$, the latter being normally held in elevated position by springs 35, 35′, surrounding guiding stems 36, pivoted near the opposite ends of the cross-bar $33^a$ and passing through guiding apertures in the standard 37. Deflation of either Bourdon gage $11^a$ or $11^{a'}$ causes the depression of the corresponding end of lever $33^a$, and therefore, the release of pin $25^a$ on wheel 23 which is closer to the axis of rotation than is pin $26^a$.

The pop valve arrangement $18^a$ is provided in the casing of the Bourdon spring and the stems $21^a$ for the two pop-valves are together connected for operation to a pull cord 38, so that by manually pulling cord 38 both valves may be opened and pressure released from both branches, or elements, of the duplex system.

In Fig. 9 is shown an embodiment of the invention wherein the signal transmitter is electrically controlled, and in such showing the two diaphragms of duplex pressure indicators 11, $11^a$ hold closed switches 40 and 40′ arranged in parallel circuit-branches 41, 41′, which said branches include the windings of a differential magnet 42, and are therebeyond connected to extend in single circuit to the anvil of switch $a'$ associated with the signal transmitting wheel 23. The armature 43 of magnet 42 is normally retracted and stands in position for engagement with a pin $25^b$ upon a wheel $23^b$ rotatable coincidentally with wheel 23, and is arranged when attracted by the unbalancing of magnet 42 to move into position for engagement with a second pin $26^b$ upon said wheel.

From the pen of the switch $a'$ the signaling circuit extends by wire 44 through the source of current supply $c$ and register $d$ back by wire 45 through a normally energized relay magnet 46 to the point of connection of the circuit branches 41, 41′. Magnet 46, thus normally energized holds attracted an armature 47, which when freed is arranged to fall in such manner as to press the armature 43 over to the position it assumes when attracted by its magnet and then to pass by said armature, freeing it for retraction by its spring to initial position. The armature 47 is connected by wire 48 to the anvil of the switch $a'$ and its front contact point 49, which it engages when released, is connected by wire 50 to wire 45 between the magnet winding and the source of current supply. Now it will be seen that under normal conditions current from the source of supply $c$ flows through the circuit 44, $a'$ both branches 41, 41′, balancing the magnet 42, and through the wire 45 including relay 46, back through the register D to the source of supply. The release of pressure upon either diaphragm of the duplex initiating device opens one of the two branches 41 or 41′, unbalancing magnet 42 which thereupon attracts its armature freeing the wheel 23 for partial rotation until the armature stops pin $26^b$ and restrains the operation of the potentially active transmitter. If now the other branch of the circuit is broken the magnet 42 is again deënergized and releases its armature, which moves out of the path of pin $26^b$ freeing the transmitter for the balance of its operation. Such rupture of both branches of the circuit furthermore deënergizes the magnet 46, the armature of which falls into contact with contact point 49 again closing a signaling circuit but now through the path $c$, 44, $a'$, 48, 47, 49, 45, $d$ back to $c$ so that the signal transmitting operation may be recorded at the central station.

While different forms of apparatus for carrying this invention into effect have been described in some detail, it will be obvious to those skilled in the art that the physical structures illustrated are in a large measure conventional and may be widely varied to suit particular conditions without departure from the spirit and scope of the invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent, is:

1. The combination of a piping system, a source of supply of fluid thereto having limited communication with said piping, restricted far below the piping capacity and maintaining the piping under a normal fluid

pressure above atmospheric, automatic means, responsive to a predetermined heat, for opening the system to fluid escape in excess of the restricted supply abilities of the source of supply, and means responsive to such decrease as accompanies such opening of the system for initiating a signal.

2. In a duplex alarm system, the combination of two substantially co-extensive piping systems arranged in relation to each other to supervise the same area, each of said piping systems containing a fluid and arranged to respond to the application of the heat of fire by a change of pressure within the system, independent pressure responsive devices for said separate piping systems, each arranged to respond to the change of pressure within its system due to fire, and signaling means arranged for predetermined operation by conjoint action of both of said pressure responsive devices.

3. The combination of a piping containing fluid under pressure, supply means communicating with the piping for maintaining the pressure within the piping, means for restricting communication between the reservoir and piping, automatically operable to effect such restriction upon sudden increase of pressure within the piping, means for opening the system to permit escape of fluid and consequent reduction of pressure within the system, and signal initiating means responsive to such decrease of pressure in the system to initiate a signal.

4. In a duplex heat responsive alarm system, two independent heat detecting elements each comprising piping containing fluid and indicating means responsive to change in pressure of the fluid within the piping due to the action of fire upon the piping, and a single signal transmitter operatively associated with said indicating means to transmit a signal of one character if either such indicator alone be actuated, and a different character of signal if both be actuated.

5. In a duplex heat responsive alarm system, two independent heat detecting elements, each comprising piping containing fluid, and indicating means responsive to change in pressure of the fluid within the piping due to the action of fire upon the piping, and a single signal transmitter operatively associated with said indicating means to transmit a signal of one character if either such indicator alone be actuated and a different character of signal if both be actuated, and manual means for occasioning a change of pressure in both elements to actuate the signal transmitter.

6. The combination of a piping system containing fluid under pressure, means for automatically decreasing said pressure upon the application of heat to said system to a signal initiating point, automatic means responsive to abnormal increase in the pressure in the system for permitting reduction of such pressure to a signal initiating point, and means responsive to decrease in the pressure of the system for initiating a signal.

7. In a duplex heat responsive alarm system, two independent heat detecting elements each comprising a detector structure containing fluid under pressure, means for automatically decreasing said pressure upon the application of heat to said detector structure, and signaling means arranged to give one signal in the event of decrease of pressure in one element only, and a different signal in the event of decrease of pressure in both elements.

8. In a duplex heat responsive alarm system, two independent heat detecting elements each comprising piping containing fluid and means responsive to change in pressure of the fluid in the piping due to the action of fire upon the piping, of signaling means arranged to respond to the action of one pressure responsive means by one signal and to the action of both pressure responsive means by a different signal.

9. In a duplex heat responsive alarm system, two independent heat detecting elements each comprising piping containing fluid and means responsive to change in pressure of the fluid within the piping due to the action of fire upon the piping, of a single signaling device, and means whereby either pressure responsive means, acting alone, actuates the signaling device to give one signal, and the succeeding action of the other pressure responsive means actuates said signaling device to give a different signal.

10. In a fire alarm system, a piping element containing fluid expansible under heat to generate a pressure therein, signaling means responsive to a certain change of pressure in the piping to a predetermined relatively lower pressure, and a valve for automatically relieving the pressure to said predetermined low pressure when it attains a predetermined high point.

11. In a fire alarm system, a piping element containing fluid expansible under heat to generate a pressure therein, signaling means responsive to a reduction of pressure in the piping to a predetermined point, fusible bodies normally closing the piping, and an automatic relief valve operable to open the piping at a predetermined pressure above normal, thereby to reduce the pressure to the signal initiating point.

In testimony whereof I hereunto set my hand in the presence of two witnesses.

JOHN E. SHEPHERD.

In the presence of—
GEO. T. MAY, JR.,
MARY F. ALLEN.