July 26, 1932. E. A. LOWE ET AL 1,869,202

FLUID CONTROLLED SYSTEM

Filed April 20, 1926 2 Sheets-Sheet 1

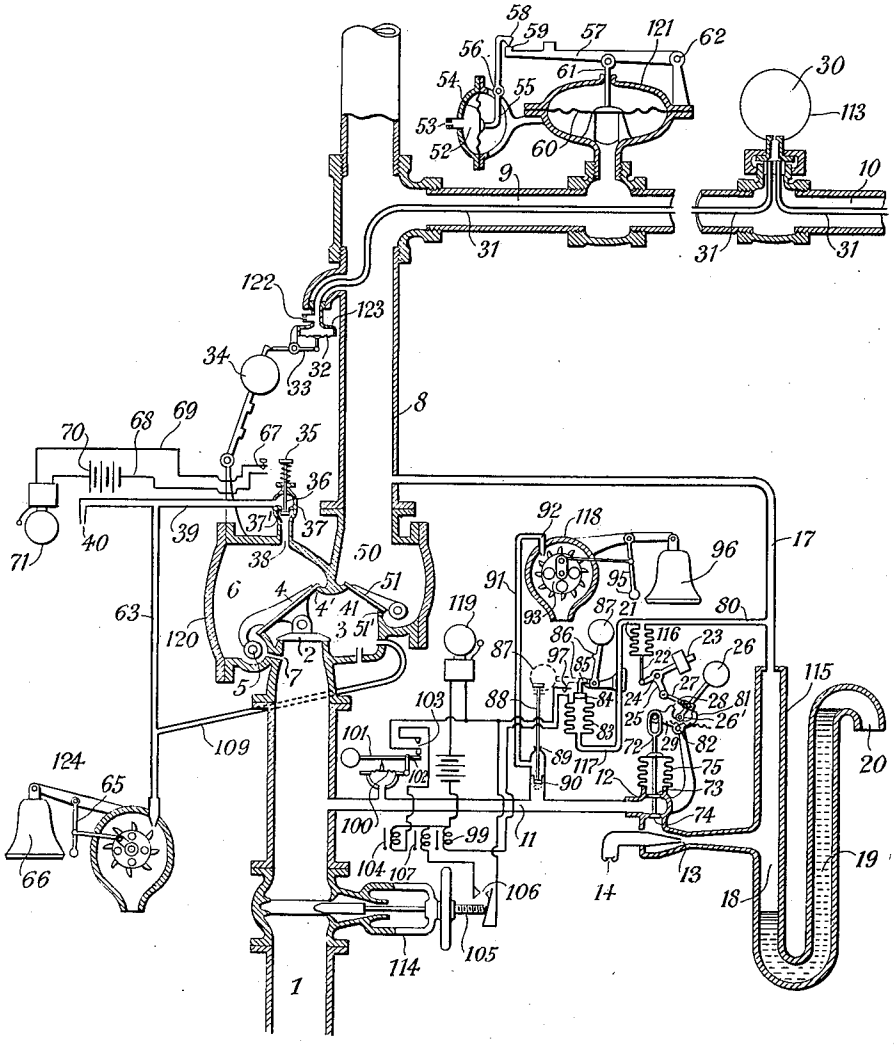


Fig. 1.

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FLUID CONTROLLED SYSTEM

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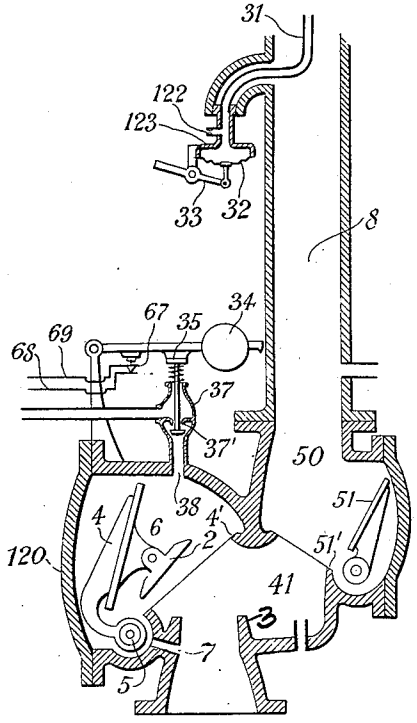


Fig. 3.

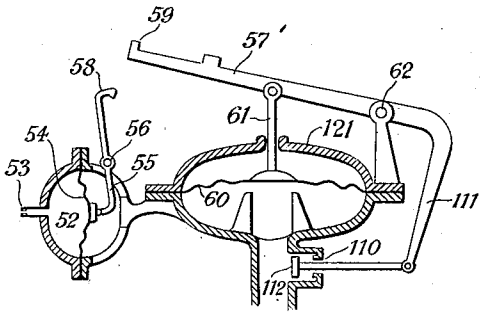


Fig. 4.

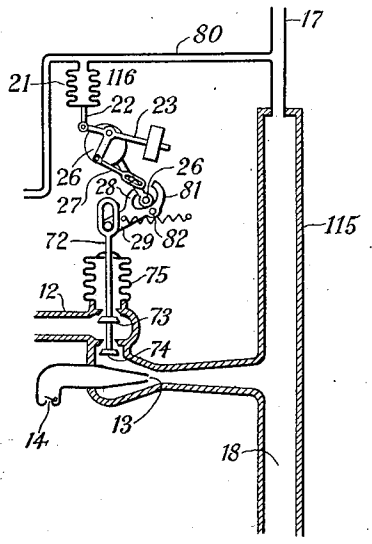


Fig. 2.

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Patented July 26, 1932 1,869,202

UNITED STATES PATENT OFFICE

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FLUID CONTROLLED SYSTEM

Application filed April 20, 1926. Serial No. 103,189.

Our invention relates to an automatic system of fluid control especially useful in fire extinguishing systems wherein on a change of temperature a fire extinguishing fluid is admitted automatically to a distributing system of pipes and mains.

The invention relates primarily to the means operating by abnormal changes in temperature indicating a danger condition in the premises to be protected and secondarily to means operating automatically to maintain the system in normal condition ready for functioning for fire extinguishing purposes. In connection with the secondary function or operation we provide for what we term for convenience "self supervision" in the use of signalling, indicating or alarm giving apparatus responsive to a deficiency in the normal condition referred to, or failure of the apparatus to automatically restore the normal condition.

Our invention is especially useful in connection with systems wherein the main distributing pipe is normally dry and in which an air pressure is maintained for any desired purpose but is not limited in all its particulars to that special system.

A principal purpose of our invention is to provide for automatically maintaining the normal pressure or other condition in the distributing mains or pipes which pressure or condition is, in the preferred embodiment of our invention the pressure of air retained in the system during normal condition of closure of the sprinkler head, nozzles or other outlets by which the fire extinguishing fluid is discharged into the room or premises to be protected.

A further object is to provide for automatically giving a signal or warning of the failure of the device for restoring or maintaining pressure to function and produce the intended result arising from the presence of a leak of such size that the pressure maintaining device would be insufficient to compensate for the leak.

Another object is to automatically give notice or warning in case the supply or head of the fire extinguishing fluid in the supply or main should fail.

A further object of the invention is to provide for the maintenance of an effective closure of the main outlet valve admitting fire extinguishing fluid to the system said means involving the use of by-pass pressure applied in a way to hold said main valve closed but adapted to be relieved to allow said main valve to open under the pressure of the fire extinguishing medium tending normally to unseat said valve.

A further object of the invention is to provide for giving an alarm or signal when the main valve opens automatically through the controlling action of a thermostat or in other words the occurrence of an emergency or danger condition requiring that the apparatus function in its fire extinguishing capacity.

Our invention relates further to means for utilizing the pressure of the fire extinguishing medium released for discharge into the system as a motor power agent whose application is controlled by changes of condition of a thermostat controlling device.

Our invention relates further to means for controlling the action of an air pump or other means for producing fluid pressure whereby a normal tension or pressure may be automatically maintained in the distributing system.

The invention further relates to means whereby on the occurrence of fire a signal may be given at the supervisory point or point where the main valve is located at the same time with or in advance of the operation of said main valve under the thermostatic control associated therewith as well as in advance of the opening of a normally closed sprinkler head subject to independent thermostatic control, thereby making it possible to extinguish the fire before the admission of the fire extinguishing fluid to the distributing pipes or before the emission of said fluid from the sprinkler head when the same opens under the control of its own thermostat so that damage from such fluid may be avoided.

The invention further relates to a system wherein a fire extinguishing outlet valve and the main valve controlling the admission of

fluid to the fluid distributing system are both normally closed thereby avoiding possibility of damage from leakage in and accidental operation of the main valve, the object of this particular part of our invention being to facilitate or quicken the arrival of the fire extinguishing fluid at the place of application of said fire extinguishing fluid to the fire area.

The invention consists in the combination of apparatus and details of construction for effecting the above and other objects and will be described in connection with the accompanying drawings and then more particularly stated in the claims.

Broadly stated, the system comprises a supply of fluid, such as a tank of fluid or a city water supply system, with control means therefor, a means of conveying or distributing such fluid, one or more fluid motors, if desired, suitably located and controlled, means for visibly or audibly indicating certain emergency conditions arising from change of temperature, means for visibly or audibly indicating certain changes or departures from the condition in which the apparatus is normally maintained in order to be ready for functioning by change of temperature, means for automatically restoring certain conditions within and without the system to normal, means for actuating each of the various members of the system in the manner required by the nature or degree of the emergency conditions as they may occur and other details to be more fully enumerated hereinafter. It is to be understood that the above is given solely as one form or application of fluid control by our invention, which is equally applicable to the control of fluid necessary to meet other demands.

In our system the operations are preferably controlled by change of pressure within the system produced by either a change of temperature or by a rupture of or leakage from the system.

Fig. 1 is a view showing diagrammatically the system in normal condition and for operation when the emergency or semi-emergency conditions arise.

Fig. 2 is a view showing a part of the apparatus in the position resulting from a change of normal condition of pressure in the system.

Fig. 3 is a view showing a part of the apparatus in a condition resulting from operation due to a change of temperature.

Fig. 4 is a view showing a condition and use of the apparatus in modified form for utilizing energy released by the effect of change of temperature.

We will now describe the system and its various operations by reference to Figs. 1, 2, 3 and 4, in all of which similar numbers describe like parts.

In Fig. 1 the fire extinguishing medium in the system is obtained from any source of supply such as the feed main pipe 1, and is normally restrained at a predetermined point by the action of a differential valve of which clapper 2 constitutes the main water valve of the system. Valve 2 is normally held to its seat 3 against the thrust or pressure in pipe 1 by the superior thrust in pressure in chamber 6 on disc 4 which has a larger fluid pressure area than 2 and is suitably connected to clapper 2 and arranged to pivot around 5. The differential action is preferably obtained by means of a by-pass for the fluid pressure in pipe 1 said by-pass fluid entering chamber 6 through restricted opening 7 and pressing against the upper side of disc 4, which is of larger area than disc 2, thereby keeping the valve 2 closed although the opposed pressures per square inch on 2 and 4 may be the same. Disk 4 in addition to functioning by the by-pass pressure on its back to keep valve disk 2 seated cooperates itself with a valve seat 4′ controlling the free passage of the fluid from the chamber in which disk 2 works, past the valve seat 4′ and into the chamber 6 in large volume as compared with the smaller volume admitted through the by-pass opening 7. This larger flow through valve 4 into chamber 6 from chamber 41 when valve disk 2 is unseated is utilized as will be presently described for any secondary purpose as for instance sounding an alarm. The relief of the by-pass pressure in chamber 6 which permits the disk 2 to unseat itself through the decrease of the by-pass pressure on the back of disk 4 is effected by any suitable thermostatic control utilized in opening an outlet from chamber 6 having larger flow capacity than that of the by-pass inlet 7, as will be presently described.

Pipes 8, 9 and 10, which may extend throughout a given area, are filled with a fluid (in this instance air) which is held under pressure in the system by valve clapper 51 which rests on seat 51′ and thereby cuts off pipe 8 from the chamber 41 into which the fire extinguishing fluid is delivered for passage to pipe 8 when the main or master valve 2 is permitted to open. A vent or bleed may be provided in the bottom of chamber 41 to drain away leakage from the valve 2. In the embodiment of our invention as illustrated chamber 41 has communication through pipe 109 with an outlet delivering fluid to a hydraulic motor that operates an alarm or other device when the main valve opens on the occurrence of fire or danger condition. Obviously if such outlet were not employed it would not be necessary to employ the supplemental valve 51 which, as will be obvious, normally cuts off the pressure from the chamber 41 so that there can be no loss of the normal or maintained pressure

in pipe 8 through the outlet such as the vent or bleed or pipe 109 and automatically opens under the pressure and flow of liquid delivered into the chamber 41 by the opening of valve 2. The valve 51 is useful however in all cases in keeping the valve 2 free from the pressure of air or other fluid normally maintained in the distributing system which otherwise would tend to hold the valve 2 closed at the time it is relieved of the by-pass pressure.

Air under pressure is preferably supplied to the distributing pipes 8, 9, etc. by the action of an inspirator or air pump operated by the fluid which is normally under pressure in pipe 1 and is used as a prime mover to inject air into the system through pipe 17. In the preferred form of our invention the fluid so employed and taken from pipe 1 passes through pipe 11 and through valve 74 when the latter is opened automatically, as will be presently described, by fall of the normal pressure in pipe 8, the fluid then passing through the restricted section 13 and there operating by Venturi action to draw air through check valve 14 and nozzle opening into said restricted section. Both air and water flow into the U-shaped section or trap 18, 19 but the air being lighter than the water and being entrapped under the pressure produced by the venturi, passes through pipe 17 from the upper section 115 of the trap and into the distributing system 8, 9. The water remains in the trap or U and as it accumulates, discharges through opening 20 to any suitable place.

The opening of the valve 74 to bring the inspirator or air injector into action is secured automatically upon diminution of pressure below the normal or adjusted degree in the system 8, 9, 10. Said diminution of pressure affects the collapsible member 75 to permit the same to contract and open the valve 74 as will be presently described. Said member 75 is normally held distended and is permitted to collapse through mechanism to be presently described which is brought into action by diminution of pressure in the pipe 8, 17, 80, as will be presently described.

When the pressure of the fluid in 8, 9 and 10 diminishes to a predetermined point or degree, it will first bring about automatically the actuation of the inspirator or air pump. If the inspirator is not able to restore the pressure in 8, 9 and 10 to normal and it continues to diminish then, upon the diminution or dropping to another predetermined point, a pressure device responsive to such further diminution will be caused to collapse or operate and bring about the operation of an alarm by electrical or hydraulic means. For this purpose we may use a pressure responsive device comprising an expansible and collapsible member or chamber 83 normally held expanded by pressure through pipe 80 and pipe 117. If the leakage in 8, 9 and 10 be above a predetermined rate so that the inspirator cannot restore the initial pressure, the pressure will drop to a degree such that it will be insufficient to hold the member 83 expanded, said member having a predetermined adjustment for that purpose and thereupon said member will collapse by action of the weight 84 or other influence and through lug 85 will draw weighted lever arm 86 to the left which, upon passing center, will escape and move more or less quickly to the left, its weighted end 87 dropping and striking the valve rod 88. The latter having the usual or proper stuffing gland 89 will thereupon move down and open the water pressure valve 90 thus allowing water under head or pressure to pass from pipe 11, through pipe 91, to the nozzle 92 of an hydraulic motor 118 having suitable mechanical connection with the hammer 95 of a bell or gong 96, thereby oscillating the hammer and causing it to sound the bell. The weighted arm 86 as it falls may, if desired, operate upon a circuit closer 97 to close the circuit of an electric gong 119 as well as the circuit of the coils 99 of suitable visual signals or annunciators the armatures of which are typified at 104 and 107.

The diminution of pressure in the main distributing system 8, 9 and 10 may bring the inspirator into action automatically by allowing a collapsible and expansible device 21 subjected to said pressure and normally held distended against its tendency to collapse, said device 21 being in the nature of a bellows arrangement or chamber connected with pipe 80 and having, through rod 22, suitable connection with a weighted lever 24 the weighted arm of which is indicated at 23. When the pressure diminishes the weighted arm 23, pressing up on the stem 22 to collapse the member 21, causes said lever 24 to turn on its pivot and thereby, through elbow lever or arm 25 and link 27, draws the weighted arm 26 over until the latter, turning on its pivot 26', passes the vertical center, falls to the left and strikes the upwardly extending horn 28 of pivoted arm or lever 29, thereby forcing the same downward so that, through the connection of the same with the rod or stem 72, by pin and slot arrangement shown, said rod which is connected to the expansible member 75 will be forced downward and thereby actuate the valve 74 and open the passageway for the water under pressure from pipe 11 through the inspirator. Said valve 74 may be of the balance type being provided for that purpose with a balancing disk or pressure device 73. The superior lifting action of the expansible device 75 holds the valve 74 normally closed. The collapsible member 75 serves to maintain a liquid-tight seal between the body of valve 12 and the stem

72. This opening of valves 73, 74 starts a flow of water through pipe 11 from the larger pipe 1 and through Venturi action, as heretofore described, pumps air into pipes 8, 9 and 10, establishing any desired pressure predetermined by varying the lengths of the legs 18 and 19. Should the decrease of pressure in system 8, 9 and 10 be below a predetermined rate, the hereinbefore described action of the inspirator would restore the initial pressure and when this was reestablished expansive member 21 would push rod 22 downward, causing weighted lever 23 to revolve around the center 24, pushing arm 25 to the right and through the link action of 27 carry weighted lever 26 also to the right. This lever, after passing center, would more or less quickly move and strike the outer horn 81 of the rocker arm 29 causing rocker arm to revolve on its pivot 82, striking valve stem 72 by means of the pin rocking in the slot of said stem and closing valves 73 and 74, thereby discontinuing the action of the air pump until again called into service.

As will be seen, in the general operation of the system so far as concerns the functioning of the devices for maintaining the air pressure, the diminution of pressure of the air or similar fluid in the pipe system 8, 9, 10 to a predetermined point will first automatically bring about the operation of the air pump or inspirator and ordinarily the pressure will be restored to the normal. As soon as this happens the air pump will be automatically shut off. Should the air pump not be able to restore the pressure owing to the magnitude of the leak or escape and said pressure should continue to diminish, then upon a predetermined further drop of pressure the pressure responsive device 83 adjusted for operation with reference to said predetermined drop will come into action and cause an alarm or indication to be given either by a mechanical or electrical operation of a bell or by a visual indication as already described. In addition to the automatic supervision thus provided for leaks in the distributing pipe or system by the alarm or indication thus given and due to abnormal drop of pressure in the distributing pipe we provide further automatic supervision of the condition of the supply of fire extinguishing medium afforded by the supply pipe 1. In effecting the latter automatic supervision we utilize the fact that the motive power of the medium under pressure in pipe or source 1, is applied to supplying air or other medium under pressure to the distributing system. In case of failure of pressure in the distributing system due to the absence of additional supply of air by the inspirator or other means operated by power from the pipe 1, the alarm or indication brought into action by the failure of such pressure will indicate not only a possible abnormal condition in the distributing pipe system itself as for instance air leak but may be also read as an indication of the failure of the air compressor itself to work, which failure would necessarily take place if there were not pressure of the fire extinguishing medium in pipe or source 1. The automatic supervision of the condition of the supply of fire extinguishing medium by either or both of the means hereinbefore described is an important feature of our invention since obviously it would be fatal to the operation of the system if the supply medium in 1 were wanting at the time the valve 2 should open on the occurrence of a fire condition.

It may be desired to further supervise the normal state of the fluid held in restraint in pipe 1 by giving an alarm if abnormal changes take place therein, as for instance, if the pressure of such fluid should drop to a predetermined point. For this purpose we may employ a diaphragm 100 or other pressure responsive means connected to the system and so adjusted that the pressure on falling abnormally would no longer be able to hold diaphragm 100 in normal position due to downward pressure of weighted lever 101. The descent of the diaphragm would then allow weighted lever 101 to revolve around center 102 and if desired close electric contacts 103, the closing of which might be made also to operate electrical gong 119 and, for instance, a visual signal 104 giving the desired signals.

The relief of the by-pass pressure in chamber 6 whereby the flow of fire extinguishing medium from 1 to 8 will be permitted through automatic opening of the valve 2 is effected by any suitable valve as for instance valve 37 which normally closes an outlet 38 from chamber 6 but on being opened allows the liquid to flow freely through 38 and pipes 39, 63 and outlets connected with said pipes. Said outflow may be utilized in operating a bell or other signal or indicator or for other useful purposes.

The action of valve 37 for this purpose results from the operation of the thermostatic device or devices distributed or located in position or under conditions as may be demanded for fire protection purposes said thermostatic device being suitably connected with means for operating or causing the operation of the valve 37. In the preferred system employed by us said thermostatic devices are operated by air pressure resulting from temperature changes of air in a suitable container connected by pipe 31 with a pressure responsive device responding to changes of the air pressure in said pipe and connected container. The piping 31 opens at or near the main valve into a chamber 123 having a diaphragm 32 collapsible and expansible under the varying pressure in the pipe 31. Preferably the thermostatic action is upon the principle of what is known as

the "rate of rise principle" and the changes of pressure in 123 results from temperature changes of the air in a metal container 30 consisting preferably of a bulb or other form of container having a large heat absorptive surface. The pipe 31 may be interrupted at any desired number of points and connected with the bulb or chamber 30 as shown and said pipe is likewise provided with one or more compensating vents 122 of a predetermined area or size to determine the rate at which the temperature must rise or fall as the case may be in order to secure effective action upon the member 32 by the expansive force of heated air. Air from the surrounding atmosphere enters at open vent 122 and fills chamber 30, chamber 123 and pipe 31, and any change in the temperature surrounding the system would either increase or diminish its volume, depending upon whether the temperature increased or decreased. This change in volume in tube 31, chamber 123 and chamber 30, regulated by restricted opening 122, would tend to equalize the pressure in chamber 123, tube 31, and chamber 30, with the atmosphere, but if its change in volume was so great in a given time that it could not equalize through the vent 122, the diaphragm 32 would be deflected up or down, depending on the increase or decrease of pressure, rotating latch 33 sufficient to disengage release arm 34, permitting it to move to the right and contact with valve stem 35, pushing down valve rod 36 and opening valve 37, forcing same from its seat 37′, permitting the water held in chamber 6 of valve 2 to flow through opening 38 and pipe 39 to any suitable place of discharge, such as 40. The sizes of passages 38, 39 and 40 being so much greater than restricted opening 7 that the latter could no longer maintain sufficient pressure in chamber 6 to enable clapper 4 to restrain clapper 2, clappers 2 and 4 will revolve around pivot 5 to the left. Water in pipe 1, no longer held back by clapper 2, would flow into chambers 41 and 50 of the valve, pushing air clapper 51 from its seat 51′ thereby entering the system and compressing the air in pipes 8, 9 and 10, which it will be understood had been impounded at a substantially less pressure than the normal pressure of the water in pipe 1.

When valve 2 operates, a portion of the fluid allowed to escape through 38, 39 and 40 for relieving the pressure back of 4 may be admitted to pipe 63 and operate water motor gong 124 by oscillating striker arm 65 causing it to sound emergency gong 66, while if desired a portion of the fluid passing through chamber 41 may be admitted through pipe 109 to assist in the operation of the gong.

The falling of release arm 34, heretofore described, could also be made, if desired, to act upon circuit closer 67 and through wires 68 and 69 and any suitable source of electrical energy 70, operate electrical bell 71.

By placing the pipe 31 for the valve controlling medium within the distributing piping or system 8, 9 and 10 as shown we not only protect the same from mechanical injury and render it less liable to be affected by changes of temperature taking place at other points than the location of the bulb 30 but we also introduce into the system a supervisory feature which takes care of accidental leaks in said pipe 31 which would be liable to render it inoperative at the critical time when it should function to cause the main valve 2 to open by increase of pressure in said pipe due to increase of temperature.

While the system is in the condition shown in Figs. 1 and 2, should tubing 31 become damaged to an extent that would cause a leak in it greater than the capacity of vent 122 the pressure held in the piping 8, 9 and 10 would enter the tubing 31 and flow into chamber 123 thus causing valve as described in previous paragraphs and shown in Fig. 3 and also Fig. 2 to be actuated causing bells or indicators 71 and 66 to operate.

The gate valve 114, which it may be desired to use for the manual control of fluid in pipe 1, may be supervised by an arrangement such as indicated in which the stem 105 of the valve when in a fully opened position will maintain the electrical circuit closer 106 in an open position. If the gate valve should be wholly or partially closed the movement of the threaded stem 105 to the left would permit circuit closer 106 to actuate electrical gong 119 and another signal, visual, if desired, at 107, notifying that gate valve 114 is in abnormal condition. In other words, the alarms described as in connection with the system are semi-emergency alarms, indicating an inefficient condition of the system more or less of vital import, which should have attention more or less immediately.

Fig. 3 shows a phase of the system resulting from emergency condition of operation and is intended to illustrate a condition in which for instance, the apparatus has been affected by temperature changes and, through the action described, increase or decrease of air pressure has taken place in chamber 30, tube 31 and chamber 123, causing the release of weighted arm 34 which in falling to the right will strike valve stem 35, thus opening valve 37 and permitting the valve 2 to function thus allowing fluid to flow from pipe 1 and more or less fill piping system 8, 9 and 10.

Water in pipe 1 would thus more or less completely fill pipes 8, 9 and 10 and be in a position to act as a motive power for motor device 121, if desired. The motor device is caused to work in response to the speed of change principle as already described for thermal unit 30. Thus for instance air in chamber 52, which is free to flow to and from

the surrounding atmosphere through restricted opening 53, would be increased or decreased in volume by a change in temperature surrounding chamber 52 and should the speed of the change in volume in 52 be such that the equalizing opening 53 could not maintain pressure in 52 at normal or atmosphere, the diaphragm 54 would be moved to the right or left as the case might be, rotating latch arm 55 on its pivot 56 until the work arm 57 was released by point 58 passing to right or left a sufficient distance to disengage the pawl 59, thereby permitting the pressure in piping 8, 9 and 10 to push upward on diaphragm 60 and arm 61, revolving work arm 57 around pivot point 62, and this motion of work arm may be made to perform such work as might be desired.

Motor device 121 may be made to have the same or a different speed-of-change or temperature operating point than 113 and its operation predeterminedly arranged to occur before, at the same time, or after, thermo unit 113, and the operation of motor device 121 could, if desired, open valve 110 by the air or other pressure in 8, 9, 10 pushing upward on diaphragm 60 (see Fig. 4 which illustrates a secondary phase of operation) thus permitting air to escape from the distributing piping when the main valve opens and allowing fluid to flow from the piping system 8, 9 and 10 for extinguishing fire or for other purposes.

As will be seen if the outlet for the fire extinguishing fluid delivered from pipe 8 be made to open under the control of the thermostat previously to the opening of the main valve under the control of the thermostat 30 the air in 8 will escape and thus permit the fluid to more quickly reach the outlet since the flow through the pipe 8 will not be opposed by counter pressure of the air therein. If the main valve be caused to open under the thermostatic control of 30 and water thus be admitted to the main pipe ready for ejection through the valve 112 before or as soon as the temperature proper for causing said valve 110 to open has been reached in the thermostatic device 52, this also obviously would accelerate the arrival and application of the fire extinguishing medium to the fire area as soon as a dangerous condition of temperature predeterminedly arranged to be effective before the action of the device 52 has been reached. In the latter instance the flow at the outlet would not take place as promptly as in the case first supposed since in the latter instance the flow of the liquid from the main valve would be opposed by the pressure of the air confined in the distributing pipes. In either case however, inasmuch as the valve 112 is normally closed and can only be released under the control of the thermostat, any accidental or premature opening of the main valve will have no evil effects since water admitted to the distributing piping will still be held under control at the normally closed and thermostatically controlled valve or outlet 112 while furthermore upon the giving of a signal or alarm by the devices 71 or 124 immediate measures may be taken to control the fire without emission of fire extinguishing medium from the thermostatically controlled outlet or sprinkler to which said medium is conducted through the piping by opening of the main valve.

The devices just described also afford means for giving a signal at the main office in advance of the opening of the main valve so that measures may be taken to extinguish the fire before the main valve is opened thus avoiding unnecessary damage by the water or other fire extinguishing fluid. Such advance notice will obviously be given when the valve 112 is opened under thermostatic control in advance of the opening of the main valve under its thermostatic control since the escape of air from the main pipe 8 will cause the release of the weight 87 at the supervisory point and thereby cause the bell 96 to sound.

It will be understood that the various signals or signalling devices are located at a supervisory point where the means for automatically releasing the fire extinguishing fluid to the piping is located. Therefore upon the sounding of an alarm such as 96 which, in one form of our invention, is made to take place before the operation of the main supply valve as just described or upon the operation of the signal 124 or of 71 which are brought into action by the temperature responsive means operating by comparatively quick rate of rise of temperature causing said signals to act before the opening of the outlet valve under its own thermostatic control, not only may measures be taken immediately to extinguish the fire at the distant point but the main gate valve may be closed or other measures taken to prevent the operation of the automatic main valve whose action may not be desired or to forestall the opening of the outlet and damage from the fire extinguishing fluid escaping therefrom in case the fire is an incipient fire or of small extent permitting its extinction by emergency measures.

Alarm 124, it will be noticed, is actuated by conditions described in connection with Fig. 3 in which the system is shown in fire emergency condition. This and electrical bell 71 could, if desired, have a different tone, or be located in such a place as to be distinctive from emergency gong 96 and 119, or they could be distinctive in any one of several ways—as it might be desirable that gongs 124 and 71 would indicate emergency conditions, while gongs 96 and 119 would indicate semi-emergency conditions. As will be seen, in the foregoing dry pipe fire extinguishing system the sprinkler head or outlet is normally

closed and controlled by its own thermostat independent of the action of another thermostat employed for controlling the operation of the main valve, and in addition means are provided for sounding a signal or alarm whenever through the control of the latter thermostat said main valve is opened to admit the water or other extinguishing medium to the dry piping, said alarm or signal, whether it be the alarm 124 or 71, obviously giving a prolonged signal or alarm whereupon an attendant or other person hearing said alarm may use a small hand extinguisher to put out the fire before it reaches such intensity that the sprinkler head or outlet will be caused to open by its own thermostat. Should the hand means resorted to be insufficient water will be retained in the pipe until the fire develops sufficient head to cause the sprinkler outlet to open thereby applying the fire extinguishing medium in the necessary large quantities to extinguish the fire.

The uses to which the energy called into action by the operation of motor device 121 may be put are very numerous. For instance, a motor may be shut down or started, large or small protective openings may be operated, vats or other fluid containers may be drained or filled, conveyors started or stopped, valves of various types opened or closed. Devices 121 may, if desired, be constituted a prime mover in actuating devices to accomplish the desired results. In Fig. 4 we have illustrated a simple use of 121 where-in 52 is the air chamber, 54 the diaphragm, 55 the latch arm, 57′ the motor arm, an extension 111 of which is formed into a bell crank pivotally connected to valve stem 110 and valve disc 112. Thus when work arm 57 is elevated in action previously described, the bell crank arm 111 is moved to the left where it would force open valve disc 112 permitting the discharge of fluid from pipes 8, 9 and 10 if this was desired for fire extinguishing or other purposes.

We claim:

1. In a dry-pipe system containing air under pressure in the distributing pipes, the combination with means responsive to a diminution of air pressure in said system, of an air compressor controlled by said means and adapted to supply air to the system upon diminution of pressure to a predetermined degree, means for giving a signal responsive to a further diminution of pressure to a predetermined degree consequent upon failure of the compressor to bring the pressure back to normal and independent thermally controlled means operable independently of the pressure condition in said system for controlling the admission of fire extinguishing fluid to said pipes.

2. In a dry-pipe system having a distributing pipe and connections containing air normally under pressure, the combination of an air compressor embodying a venturi and a source of water under pressure, a balanced valve controlling the admission of water to the venturi and normally in closed condition so long as the air pressure is maintained in the pipes, an expansible and contractible member connected to the valve, means for holding said member in extended condition to keep the valve closed and means responsive to diminution of pressure for freeing said expansible member to permit it to contract and open said water valve.

3. In a dry-pipe system having a distributing pipe and connections containing air normally under pressure, the combination of an air compressor embodying a venturi and a source of water under pressure, a valve controlling the admission of water to the venturi and normally in closed condition so long as the air pressure is maintained in the pipes at normal, means responsive to diminution of normal pressure to a predetermined degree for opening said water valve to bring the air pressure back to normal and means responsive to a further diminution of pressure below the degree resulting in the opening of said water valve for giving a signal in case the air pressure should fail to return to normal by the action of the venturi.

4. In a dry-pipe system having a distributing pipe and connections containing air normally under pressure, the combination of an air compressor embodying a venturi and a source of water under pressure, a valve controlling the admission of water to the venturi and normally in closed condition so long as the air pressure is maintained in the pipes, means responsive to diminution of pressure for opening said water valve and means for giving a signal responsive to a further critical diminution of pressure due to failure of the compressor to bring the pressure back to normal, said means comprising an hydraulic motor and motor operated signal and a valve controlling the admission of the water from the source to said motor and means for operating said valve automatically in response to said further diminution of pressure.

5. In a dry-pipe system, the combination with the mains in which air pressure is maintained, of an air compressor comprising a water-operated venturi, a valve controlling the admission of water thereto, a pivotal weighted device adapted to swing from one side to the other of the vertical through its pivot to strike the valve to open the same and a collapsible element normally holding said weighted device inactive by the air pressure from the system and adapted on collapsing through diminution of pressure to throw the weighted device over its center for the purpose of causing it to strike and open the valve.

6. In a system of the character described,

the combination of a valve controlling the operation of an air compressor, a pivotal striker adapted to engage and operate the valve, means for throwing said striker over the pivotal center upon the diminution of pressure in the system and means for reversing the striker and throwing it back past center upon the restoration of pressure thereby reversing the position of the valve.

7. In a system of the character described, the combination of means for supplying air, means controlling the operation of the air supplying means, a lever operatively connected with said controlling means by a lost motion and provided with two arms or prongs, a pivoted striker adapted to play between said arms and engage one or the other as it passes the vertical in one direction or the other, and means responsive to changes of air pressure in the system for moving the striker between said arms or prongs.

8. In a system of the character described, the combination of a water-operated air pump, a valve controlling the admission of water thereto, a lever having two prongs or arms and operatively connected with said valve, a pivoted weighted striker adapted to play between said arms and engage one or the other as it passes the vertical in either direction, and means responsive to changes of air pressure produced by the air compressor and operatively connected with said striker arm to move the same backward and forward according as the pressure rises and falls.

9. In a system of the character described, the combination of a main supply of a fire extinguishing medium under pressure, a distributing system in which pressure of air is maintained, a valve interposed between the main supply and the distributing system and normally closed, means for controlling said valve comprising a thermally responsive control apparatus operable independently of the pressure condition in said system and extending from a fire zone to said valve, pressure responsive means responsive to a predetermined drop of said air pressure, means operated by the pressure of the fire extinguishing medium derived from the main supply and automatically controlled by said pressure responsive means for automatically restoring or maintaining the normal pressure in the distributing system and indicating means operated in response to a further predetermined drop of air pressure in the distributing system.

10. In a system of the character described, the combination of a main supply of a fire extinguishing medium under pressure, a distributing system in which pressure of air is maintained, a valve interposed between the main supply and the distributing system and normally closed, an air pipe within a pipe of the distributing system and means actuated by increase of air pressure in said pipe due to increase of temperature for controlling the operation of the valve.

11. In a fluid medium distributing system the combination of a source of fire extinguishing medium, a distributing pipe or system containing a fluid under pressure, a valve controlling the admission of said fire extinguishing medium to the distributing system, an air pipe in the latter, means actuated by thermostatic increase of air pressure in said air pipe for causing said valve to open and for controlling the operation of an indicator in case of a leak in said air pipe admitting the medium in the distributing pipe thereto.

12. In an automatic system of fluid control the combination of distributing piping for a fluid medium, a valve controlling the admission of the fluid under pressure to said piping, a motor device connected to said pipe and operated by the pressure of the fluid extinguishing medium when the latter is admitted to said distributing piping upon a change of temperature, a catch normally restraining said motor device from acting under said pressure and thermostatically controlled means for releasing the catch.

13. In an automatic system of fluid control the combination of a distributing piping system, a valve controlling the admission of the fluid under pressure to said system, a motor device connected to said system and operated by the pressure of said medium when admitted to the system, a thermostat and means controlled thereby for freeing said motor device and a valve connected to said motor device and adapted to open under the action of said motor device when operated by the admitted pressure.

14. In an automatic system of fluid control the combination with a distributing system of piping, a source of fire extinguishing fluid, a thermostatically controlled inlet valve for admitting the fluid to said piping, a motor device normally free from pressure of the fire extinguishing fluid and adapted to be operated by pressure of fluid in said piping when admitted to the piping by said thermostatically controlled valve, means for normally locking said motor device out of action, additional thermostatic means for freeing said locking device and means actuated by said motor device.

15. In an automatic system of fluid control the combination with a distributing system of piping of a source of fluid under pressure, a valve controlling the admission thereof to the piping, a motor device actuated by the pressure of said admitted fluid, a thermostatically controlled catch normally holding said motor device out of action and means actuated by the admitted pressure applied to said motor device for opening a valve or out-

let through which the admitted fluid may escape.

16. In an automatic system of fluid control the combination with a distributing system of piping of means for admitting fluid under pressure to said piping, a normally detained flexible diaphragm exposed to the pressure of said admitted fluid, a catch holding said diaphragm immovable, an air thermostat having a diaphragm or flexible member connected to said catch and adapted to free the same on expansion or contraction of the air within said thermostat, a valve controlling the outlet of the admitted fluid from the pipe and mechanism connecting said valve and normally detained diaphragm.

17. In an automatic system of fluid control, the combination with the distributing pipe of a pressure conveying pipe inside the same, a thermostatic air bulb or chamber located outside the piping and connected with the pressure conveying pipe and means operated by variation of pressure in said pressure conveying pipe for admitting a fluid medium to said distributing pipe.

18. In a distributing system of the character described, the combination with a distributing main or pipe containing a fluid normally under pressure, a source of fluid under pressure supplying operating pressure, a compressor operated by the pressure of said fluid for maintaining pressure in the distributing system and means directly responsive to a decrease of operating pressure as soon as said pressure falls to a critical extent such that it would then be incapable of operating the compressor and means for giving a signal by action of said directly responsive means.

19. In a fire extinguishing system of the character described, the combination of a main valve normally held closed by by-pass pressure, a valve normally holding said by-pass pressure intact, a weighted member adapted to strike and open said valve a diaphragm actuated catch normally holding the weighted member out of action, a diaphragm chamber, piping having a compensating vent determining the rate of change of tension which must take place in the medium in said piping to actuate the diaphragm and a container interposed in said piping for increasing the tension of air in said piping through heating of the air in said container at a rate predetermined by the size of the compensating vent to bring about the operation of the diaphragm.

20. In a fluid distributing system of the character described, the combination of a distributing pipe containing air under predetermined maintained pressure, an air compressor operated by pressure of a fluid medium, a signal adapted to be operated by the pressure of said fluid medium, a valve controlling the admission of the fluid to the signal operating device, a weighted arm adapted to engage and open said valve and means responsive to a diminution of air pressure consequent upon failure of the compressor to restore the adjusted or maintained pressure in the distributing pipe for bringing said weighted arm into operation.

21. In a fire extinguishing system, the combination of a main valve and means for automatically causing the same to open under control of a thermostat in the fire area, of thermostatically controlled means for giving a signal at a supervisory point in advance of the operation of said main valve, the thermostatic control of the signal means being independent of the main valve thermostat and being located in the same fire area.

22. The combination with an automatic fire extinguishing apparatus having means for automatically supplying fire extinguishing medium thereto controlled by thermostatic action, of means for giving a signal controlled by independent thermostatic action operating in advance of the operation of the thermostatically controlled means for supplying said medium and located at a supervisory point.

23. In a fire extinguishing system, the combination of a main distributing pipe, an inlet valve controlling the admission of fire extinguishing fluid thereto, a normally closed outlet valve through which said fluid may escape in the fire area, means responsive to a predetermined rate of rise of temperature in said fire area for controlling the opening of said outlet and means under the independent thermostatic control of a rate of rise of temperature thermostat in the same fire area with said outlet valve for causing said inlet valve to open.

Signed at New York, in the county of New York and State of New York, this 16th day of April, A. D. 1926.

ERNEST A. LOWE.
JOHN R. HAMILTON.