April 17, 1945. J. S. DETWILER 2,373,877

FIRE CONTROL SYSTEM

Filed Oct. 14, 1942 2 Sheets-Sheet 1

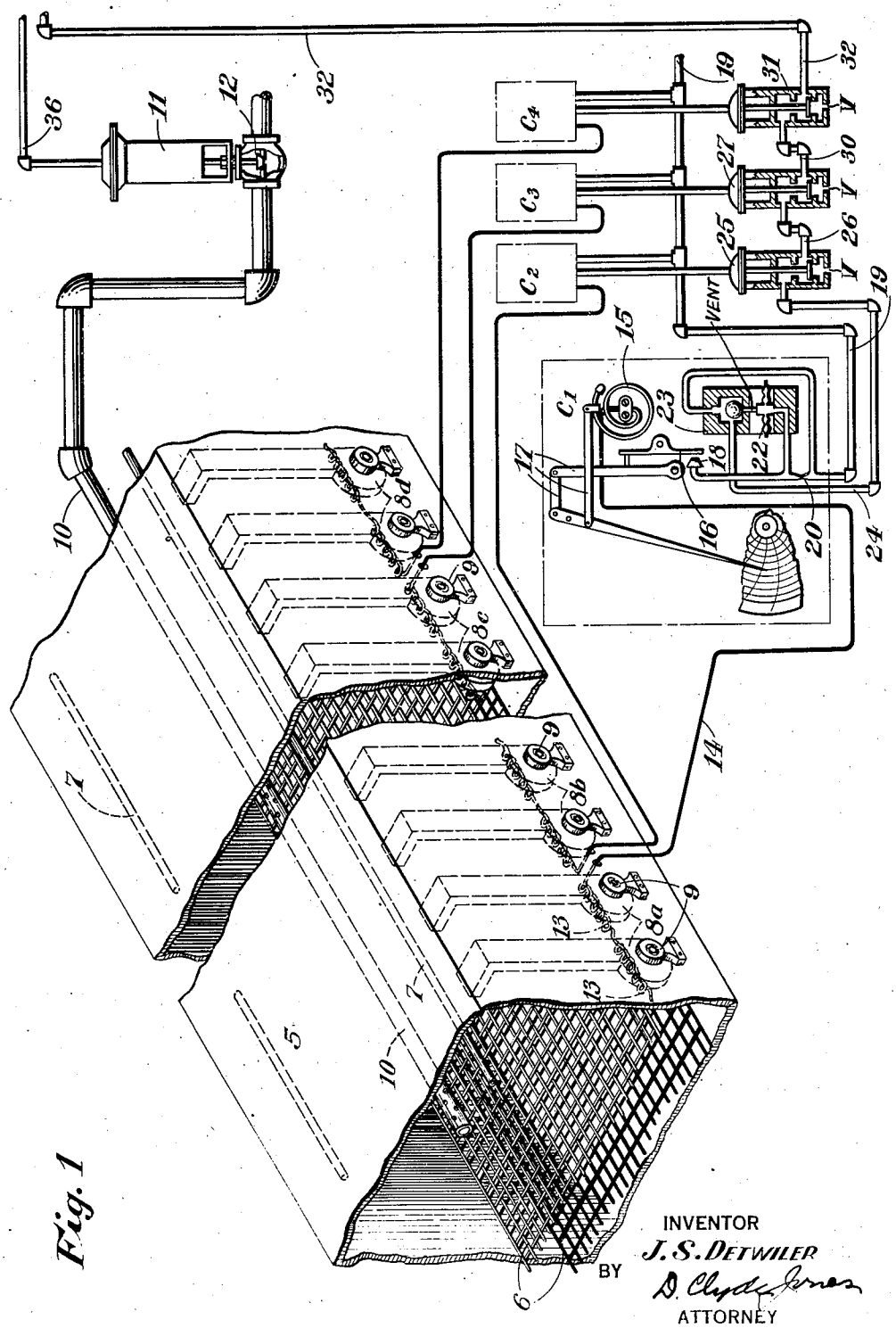

Fig. 1

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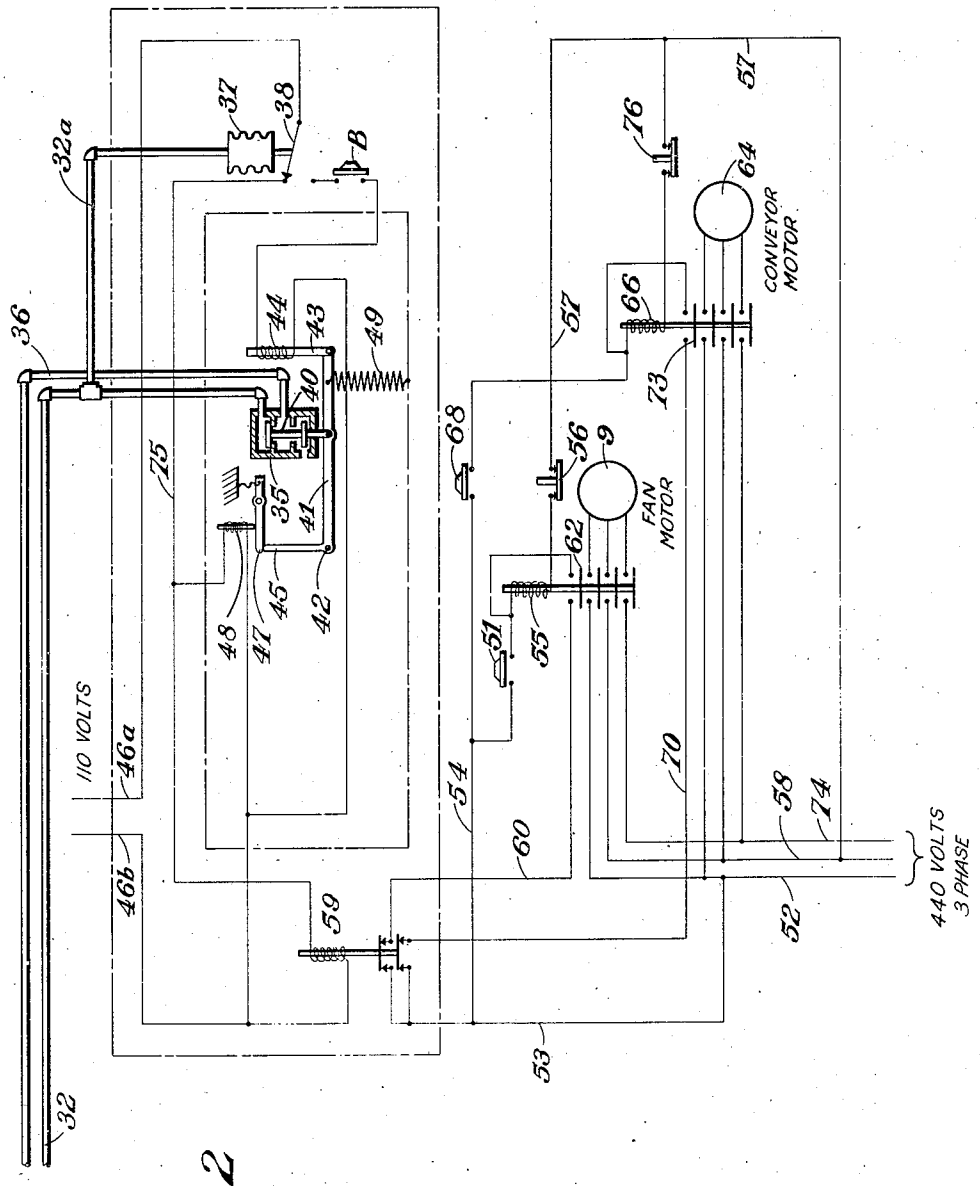

Fig. 2

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Patented Apr. 17, 1945

2,373,877

UNITED STATES PATENT OFFICE

2,373,877

FIRE CONTROL SYSTEM

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Application October 14, 1942, Serial No. 462,061

6 Claims. (Cl. 169—2)

In many drying systems and particularly in those systems used in the drying of synthetic rubber, an endless conveyor carries the product to be dried through a chamber wherein heated air is circulated by a plurality of fans. Consequently, if a fire starts in any part of the system, the conveyor and the fans, unless promptly stopped, will serve to spread and to increase the flames. Even if the conveyor and fans are stopped in the case of a fire, the construction of the chamber is such that it is difficult to combat a fire therein in the absence of automatic fire extinguishing means.

In accordance with the present invention, a novel arrangement is provided in which there is means for detecting the presence of a fire in a drier system and also means responsive to such detection, for immediately releasing a fire extinguishing fluid as well as immediately stopping the conveyor belt and the circulating fans.

The drawings, with Figs. 1 and 2 arranged in the order named and with the pipes **32** and **36** of Fig. 2 connected as continuations of these pipes from Fig. 1, disclose the system of the present invention, a portion thereof being shown in perspective and the remainder thereof being shown diagrammatically.

The present system includes a drying chamber **5** which may be of relatively large size, although, of course, the invention is not limited to any particular dimensions. Size is mentioned, since the system is particularly adapted for use in drying synthetic rubber in large quantities, and consequently the drying chamber must be of ample capacity. An endless belt **6** of foraminous material, conveys the material to be dried through the chamber. Drying is effected in the chamber by air heated by the steam heating pipes **7** located near the ceiling of the chamber. The air, thus heated, is recirculated by a plurality of groups of fans **8***a*, **8***b*, **8***c* and **8***d*, driven by individual motors **9**, which fans have their intakes in uniformly spaced relation beneath the belt and which have their outlets terminate near the ceiling of the chamber above the level of steam-heated pipes **7**. By this arrangement, the fans draw heated air through the conveyor belt and discharge this air near the top of the room where it is reheated by the steam-heated pipes for further recirculation. It will be appreciated that the air currents from so many fans in the chamber, as well as the moving belt **6**, tend, when a fire once starts, to spread it rapidly through the entire chamber. In addition, the material to be dried is usually highly inflammable. Fire extinguishing means is therefore provided, comprising a steam pipe **10** which is perforated within the chamber to discharge steam therein from an ample steam source. The flow of the steam through this pipe is governed by a diaphragm motor valve **11** of the type which normally maintains its valve disc **12** in open position unless pressure fluid is supplied to its diaphragm motor, as will be described. The diaphragm motor of this valve may be similar in construction to the valve V disclosed in Fig. 1 of the patent to Foote 2,088,055.

In accordance with the present invention, there is provided a novel arrangement which senses abnormal temperatures in any part of the drying chamber, and in response to such temperatures, supplies steam through the pipe **10** to extinguish any fire that starts in the chamber and immediately stops the operation of the fans **8** as well as the movement of the conveyor belt **6**. The arrangement utilized for sensing such abnormal temperatures comprises several thermosensitive tube systems, each tube system being common to a group of circulating fans. Each tube system includes a plurality of temperature sensing elements or bulbs **13**, one in each fan inlet of a group, communicating with each other and with a capillary tube **14**, which terminates in a Bourdon spring or other pressure responsive unit **15**. Each tube system, including the serially connected bulbs **13**, the capillary tube **14**, and the Bourdon spring **15**, is filled with a medium the volume of which changes in accordance with changes in temperature. In the arrangement shown, it is preferred to have not more than five thermosensitive bulbs connected in series in each tube system. Since there is a relatively large number of fans and since preferably there is a thermosensitive bulb **13** at the intake of each fan, a number of such tube systems is provided.

In the system disclosed it is assumed that there are four groups of circulating fans and consequently there will be four independent tube systems, each tube system operating a well-known controller unit, such as C1, C2, C3 and C4 of the type illustrated in Fig. 1 of the mentioned Foote patent. Each of the controller units which are of like construction, includes a baffle **16** moved by its related Bourdon spring **15** and links **17** to various positions with respect to a nozzle **18** with which it cooperates. Compressed air escapes through the nozzle **18** in varying amounts depending on the position of the baffle **16**, the compressed air being supplied to the nozzle through the supply pipe **19** and restriction **20**. The varying back pressure developed between the nozzle **18** and

restriction 20, as a result of the varying position of the baffle with respect to the nozzle, actuates a capsular chamber 22 of a pilot relay valve 23. Although the portion of the controllers C1, C2, C3 and C4 inclosed within the broken line rectangles, are preferably identical in construction, the relay valve 23 of the controller C1 is connected directly in the main passage for supplying compressed air to pipe 32. However, the corresponding relay valves (not shown) of the controllers C2, C3 and C4 are not connected in this passage but instead, they control pilot valves 25, 27 and 31, respectively, which are directly connected in the mentioned passage to control the connection of compressed air to pipe 32.

In the case of the first controller unit C1, this relay valve 23, when the temperature in chamber 5 is normal, permits compressed air from the supply line 19 to pass through pipe 24 to the inlet of a three-way pilot valve 25. This pilot valve 25 is controlled by compressed air supplied to its diaphragm motor through a relay valve similar to 23 in the second controller unit C2, and in one position, allows compressed air to flow through the pipe 26 to the inlet of a second pilot valve 27, while in its other position compressed air is permitted to drain from the pipe 26 through the vent V. The second pilot valve 27, which is also of the three-way type, is adjusted by compressed air supplied to its diaphragm motor through a relay valve similar to 23 in the third controller unit C3. The outlet pipe 30 of the second pilot valve 27 is connected to the inlet of the third pilot valve 31 which is similarly adjusted by compressed air supplied to its diaphragm motor through a relay valve similar to 23 in the fourth controller unit C4. The four controller units C1, C2, C3 and C4 include mechanisms (not shown) to adjust their set points preferably 10° higher than the normal operating temperature prevailing within the chamber 5 so that while this normal operating temperature continues, the controller units will operate in such a way, that the second, third and fourth controllers will supply pressure to the diaphragm tops of the three pilot valves 25, 27 and 31, while the first controller C1 will supply compressed air from the supply pipe 19, thence through these pilot valves to the pipe 32. It should be mentioned that the diaphragm tops of pilot valves 25, 27 and 31 may be similar in construction to that of the valve V in the mentioned Foote patent. When, however, an abnormal temperature equaling or exceeding the mentioned set-point temperature, prevails at any of the thermosensitive bulbs, the thermosensitive fluid in the tube system in which this bulb is included, will expand to unwind its related Bourdon spring which reduces the space between the baffle 15 and the nozzle 18 of its controller. This change in the baffle nozzle space relation closes the relay valve, such as 23, in this controller unit. If this unit happens to be the first unit, it will shut off the supply of compressed air which normally is supplied through the pipe 24 and permits the compressed air in pipe 24 and connected pipes, including pipes 32 and 36, to vent to atmosphere about the stem connected to the ball valve of relay 23. If controller unit C2 is affected it will shut off the supply of compressed air from the diaphragm top of the pilot valve 25, causing its valve disc to shut off the air supply from pipe 24 and to open the vent V so that compressed air leaks through this vent and through pipes 32 and 36 from the diaphragm motor top of valve 11 in the steam line 10. Valve 11 thereupon opens to discharge steam into the chamber 5. Similarly, if the controller unit C3 is operated, the pilot valve 27 will move to its venting position and a like operation will take place in the case of the pilot valve 31 when the controller unit C4 is operated. Thus, an abnormal temperature condition at any bulb in any one of the four tube systems will cause the mentioned operation of its related controller unit. This operation of any one of these controller units, thus disconnects the air supply from the pipe 32, and permits compressed air in the pipe to drain away to the atmosphere through some one of the pilot valves.

The mentioned pipe 32 communicates through the electrically operated valve 35 and through pipe 36 with the diaphragm motor of the previously mentioned valve 11 in the steam supply line. The pipe 32 also communicates through a branch pipe 32*a* terminating in the bellows 37 of a pneumatically operated electric switch 38. The mentioned electrically operated valve 35 has its valve stem 40 fastened to the arm 41 of an L-shaped lever pivoted on the fixed pivot 42. The right end of this lever is pivotally connected to the core 43 of a solenoid 44, while the upper or left end 45 of this lever is located so that in certain positions its side is engaged by the left end of the armature 47 of a latch relay 48. It will be appreciated that when the relay 48 is energized its armature will be raised so that the spring 49 can swing the L-shaped lever clockwise until its upper end 45 passes beneath the armature 47. However, when the relay 48 is deenergized, its armature will be in position to latch the L-shaped lever in its counterclockwise position to which it is moved by the energization of solenod 44. The remainder of the apparatus and the circuit arrangement for controling them will be understood from the following description of the operation of the system.

Let it be assumed that there is compressed air in pipe 19 and that a supply of steam is available to pipe 10. Let it also be assumed that the several control units C1, C2, C3 and C4, have their set points adjusted at about ten degrees higher than the temperature normally prevailing in the chamber. Under these conditions, the bellows 37 expands causing the switch 38 to move to its alternate position from that shown. Then when start button B is closed, solenoid 44 will be operated in a circuit traceable from the power lead 46*a*, switch 38 in its alternate position, button B, winding of solenoid 44 to power lead 46*b*. Solenoid 44 attracts its core which in turn swings the L-shaped lever in a counterclockwise direction to operate valve 35 in such a way that it extends the air supply in pipe 32 to pipe 36 and closes the vent of this valve. Since the latch relay 48 is now deenergized, the left end of its armature engages the part 45 of the L-shaped lever to hold this lever in its counterclockwise position.

The motors 9 for the several fans which are electrically connected in multiple and which are collectively represented in the circuit diagram (Fig. 2) by the circle 9, are started by depressing the start button 51. This completes a circuit from one side 52 of the power line, conductors 53 and 54, start button 51, winding of the relay 55, through the normally closed contacts of the stop button 56, conductor 57, to the lead 58 of the mentioned power line. Relay 55 is thus energized and at its three lower armatures and contacts, connects the fan motors 9 to the power leads 52 and 58. The relay 55 when once energized locks itself operated independently of the start button

51, in a circuit traceable from conductors 52 and 53, back contacts and armature of the relay 59, conductor 60, the uppermost contacts and armature 62 of the relay 55, winding of this relay and thence through the remainder of this circuit through conductor 57 to the lead 58 of the power line, as previously described.

Likewise, the conveyor motor 64 is started by depressing the start button 68 which completes a circuit from one side 52 of the power line, conductors 53 and 54, start button 68, winding of the relay 66, through the normally closed contacts of the stop button 76, conductor 57 and the lead 58 of the power line. Relay 66 is thus operated and at its three lower armatures and contacts connects the conveyor motor 64 to the power leads 58 and 74. The relay 66, on operation, locks itself operated independently of the start button 68. This circuit extends from one side 52 of the power line through the conductor 53, normally closed contacts and lowermost armature of the relay 59, conductor 70, uppermost contacts and armature 73, now closed, of the relay 66, through the winding of this relay and thence through stop button 76, conductor 57 to power lead 58. Under the control of the circuits, described above, the conveyor motor 64 as well as the fan motors 9 will continue to operate until their respective stop buttons 56 and 76 are depressed or until the relay 59 is operated, as will be described.

Since the proper temperature is prevailing in the chamber 5, the relay valve such as 23 in each of the four controller units C1, C2, C3 and C4 will permit compressed air to pass. The second, third and fourth control units will apply this compressed air to the diaphragm motors of the respective three-way pilot valves 25, 27 and 31, causing them to close their vents and to permit air to pass from the compressed air supply source 19 to the bellows 37 (Fig. 2) of the pneumatic switch 38 and also through the electrically operated valve 35 and through the pipe 36 to the diaphragm motor top of the valve 11 in the steam line 10. The compressed air applied to the motor of this valve causes its valve disc to move to its closed position so that steam cannot be discharged into the chamber 5.

Let it now be assumed that an abnormal temperature exists in the chamber 5 at some one of the bulbs 13. The thermosensitive filling medium in this bulb and its related tube system will be expanded to close the relay valve such as 23 of its related controller. The controller will function as previously described to cut off compressed air from pipe 32 and also to permit compressed air from the motor of valve 11 to drain away. Valve 11 thereupon opens to apply steam through pipe 10 to the chamber 5. Whenever compressed air is cut off from pipe 32 and its branch 32a, bellows 37 contracts to move switch 38 to the position shown. As soon as this takes place, the latch relay 48 and relay 59 are energized in a parallel energizing circuit. This circuit extends from power lead 46a, switch 38, conductor 75, windings of relays 48 and 59 in parallel to power lead 46b. When relay 59 is energized, it interrupts the locking circuits of relays 55 and 66 which deenergize to open the circuits of the fan motors 9 and conveyor motor 64. This immediately stops the fans and the conveyor. When the latch relay 48 is energized, it disengages the left end 45 of the L-shaped lever whereupon the spring 49 swings this lever in a clockwise direction. This movement of the mentioned lever moves the stem of valve 35 to open its vent to the atmosphere and to shut off the flow of compressed air from the pipe 32 to the pipe 36 leading to the motor of valve 11.

Steam will continue to be supplied to chamber 5 until the normal temperature condition has been restored therein and until the button B is depressed. Under this normal temperature condition, the controllers C1, C2, C3 and C4 will operate to supply compressed air to pipes 32 and 32a so that the bellows 37 expands to move the switch 38 to its alternate position. The push button B completes an operating circuit, as previously described, for the solenoid 44 which actuates the valve 35 to its normal operating condition wherein it is latched by the relay 48. The fan motors 9 and the conveyor motor 64 can then be started by depressing their respective start buttons.

The present disclosure is given as an example of the invention which is not to be limited thereby except as specifically set forth in the appended claims.

What I claim is:

1. In a drying system, in combination, a chamber for drying material, several groups of fans for circulating a heating medium around said material, a source of fire extinguishing fluid, a pipe connecting said source to the interior of said chamber, a valve controlling the flow of fluid through said pipe, a temperature sensing mechanism for each group of fans and including a sensing unit for each fan, a controller individual to each sensing mechanism for actuation thereby, and means including all of said controllers for governing the operation of said valve.

2. In a drying system, in combination, a chamber for drying material, several groups of fans for circulating a heating medium around said material, a source of fire extinguishing fluid, a pipe connecting said source to the interior of said chamber, a valve controlling the flow of fluid through said pipe, a fluid filled thermosensitive tube system having a bulb connected therein for each fan of a given group, a controller individual to each tube system for actuation thereby, and means including all of said controllers for governing the operation of said valve.

3. In a drying system, in combination, a chamber, several groups of fans for circulating a heating medium around said material, a source of fire extinguishing fluid, a pipe connecting said source to the interior of said chamber, a pneumatically operated diaphragm motor valve controlling the flow of fluid through said pipe, said valve being of the type whic his maintained closed by the application of a pressure fluid to its diaphragm motor, a source of pressure fluid, temperature sensing mechanism individual to each group of fans, and a plurality of controller units operated by said sensing mechanisms, said units under normal temperature conditions in said chamber completing a series connection therethrough from said source to said diaphragm motor, at least one of said units operating on an abnormal temperature condition in said chamber for interrupting said series connection.

4. In a drying system, in combination, a chamber for drying material, several groups of fans for circulating a heating medium around said material, motor means for operating said fans, a source of fire extinguishing fluid, a pipe connecting said source to the interior of said chamber, a pneumatically operated diaphragm motor valve controlling the flow of fluid through said pipe,

said valve being of the type which is maintained closed by the application of a pressure fluid to its diaphragm motor, a source of pressure fluid, temperature sensing mechanism individual to each group of fans, a plurality of controller units operated by said sensing mechanisms in one manner in response to normal temperatures in said chamber and operated in another manner by said sensing mechanisms in response to abnormal temperatures in said chamber, said units under normal temperature conditions in said chamber completing a series connection therethrough from said source to said diaphragm motor whereby said valve is maintained closed, and a pneumatically operated switch responsive to the absence of fluid pressure in a portion of said connection for stopping said motor means.

5. In a drying system, a chamber, a conveyor for carrying material to be dried along a given course, a motor for driving said conveyor, several groups of fans for circulating a heating medium in contact with said material passing along said course, motor means for operating said fans, temperature sensing mechanism individual to each group of fans, a source of fire-extinguishing fluid, a pipe connecting said source to the interior of said chamber, a valve controlling the flow of fluid through said pipe, a plurality of controller units governed by said sensing mechanisms, and means including said units for conjointly governing the operation of said valve as well as said motor and said motor means.

6. In a drying system, in combination, a chamber for drying material, several groups of fans for circulating a heating medium around said material, motor means for operating said fans, a source of fire extinguishing fluid, a pipe connecting said source to the interior of said chamber, a pneumatically operated diaphragm motor valve controlling the flow of fluid through said pipe, said valve being of the type which is maintained closed by the application of a pressure fluid to its diaphragm motor, a source of pressure fluid, temperature sensing mechanism individual to each group of fans, a plurality of controller units operated by said sensing mechanisms in one manner in response to normal temperatures in said chamber and operated in another manner by said sensing mechanisms in response to abnormal temperatures in said chamber, said units under normal temperature conditions in said chamber completing a series connection therethrough from said source to said diaphragm motor whereby said valve is maintained closed, a pneumatically operated switch responsive to the absence of fluid pressure in a portion of said connection for stopping said motor means, and means including a manually operated device and said pneumatically operated switch for starting said motor means.

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