

June 30, 1942.

C. P. FELDHAUSEN ET AL

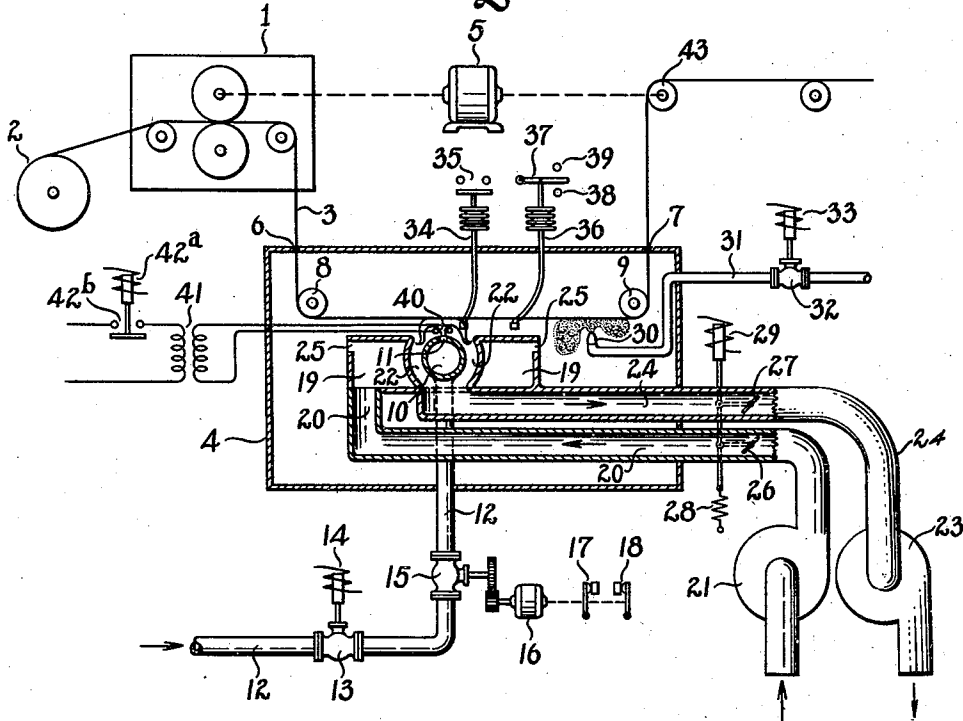
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CONTROL APPARATUS FOR PRINTING EQUIPMENT

Filed April 11, 1940

3 Sheets-Sheet 1

Fig. 1



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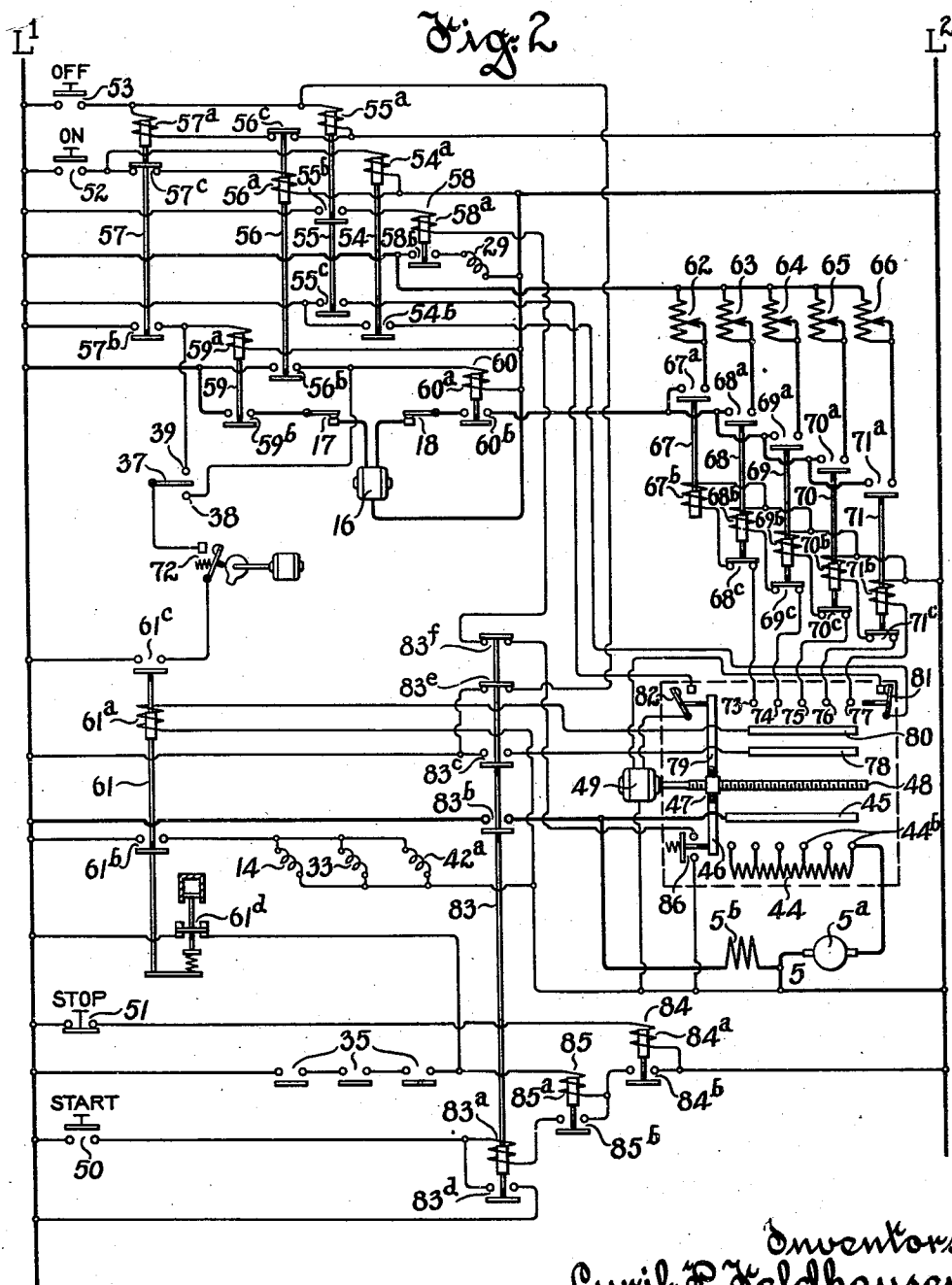
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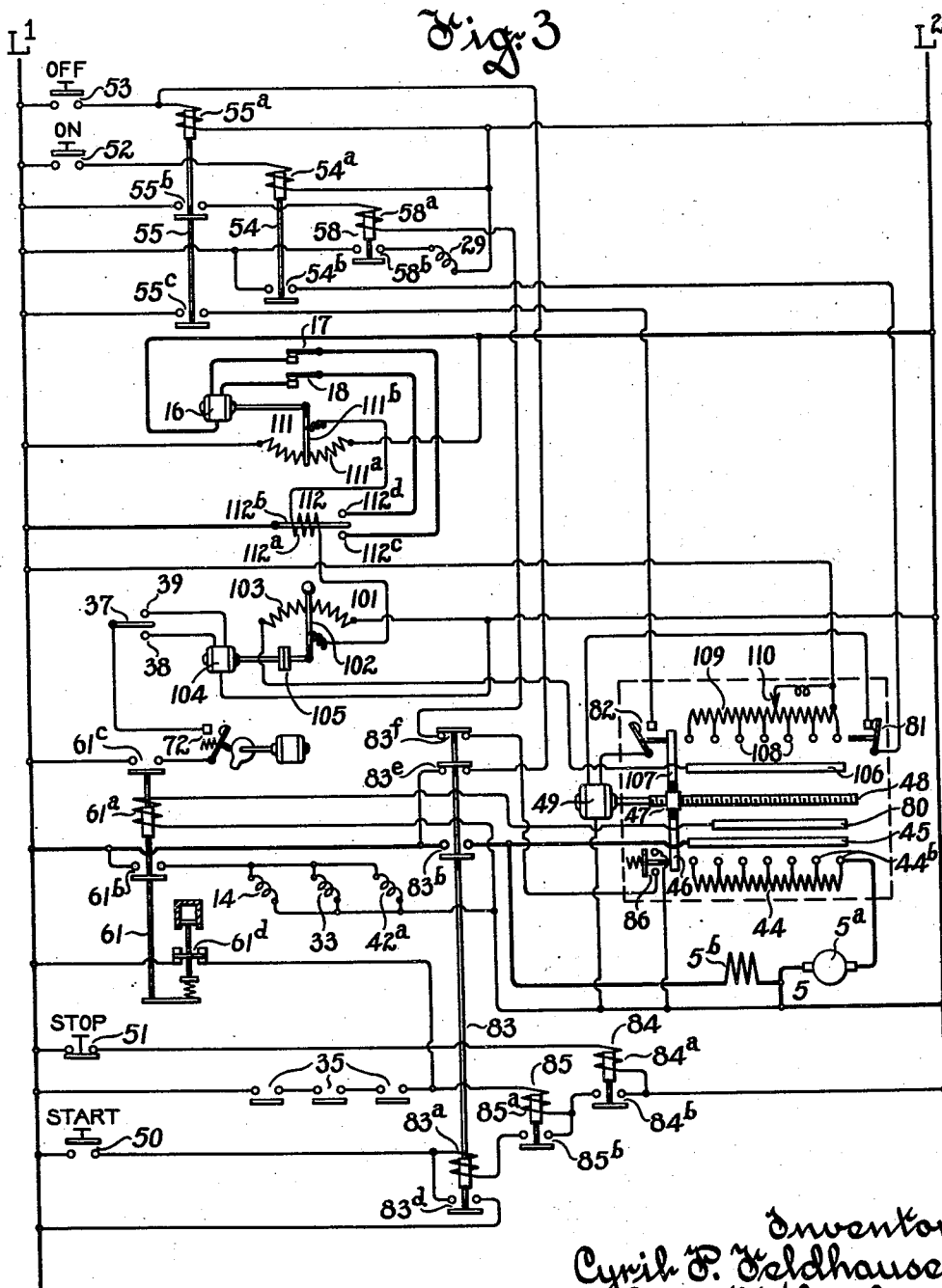
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CONTROL APPARATUS FOR PRINTING EQUIPMENT

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5 Claims. (Cl. 263—3)

The invention relates to control apparatus for printing equipment, and more particularly to the control of ink drying apparatus used in connection with web printing machines.

In web printing machines the printed web leaves the printing rollers at a very high speed and while the ink on the web is still wet. It is therefore necessary to dry the ink prior to the folding and/or cutting of the web in order to prevent impairment of the quality of the printing, and it is usual to pass the sheet over a blast of hot air or the like to accomplish the result. It is customary for the purpose stated to run the sheet through a closed chamber in which the temperature of the air impinging upon the sheet is high enough to cause ignition thereof if the contact is prolonged, and the gases driven off the ink are combustible and must be promptly removed from the chamber. Accordingly the conditions in the chamber must be closely controlled.

An object of the invention is to provide improved means for controlling the temperature of the drying medium.

Another object is to control the supply and exhaust of air to and from the drying chamber.

Another object is to control the fuel supply for heating the drying air in accordance with the speed of the web.

Another object is to provide for easy adjustment at will of the operating conditions in the drying chamber.

Other objects and advantages will hereinafter appear.

The accompanying drawings illustrate certain embodiments of the invention.

In the drawings, Figure 1 is a schematic showing of a drying chamber and the control elements associated therewith.

Fig. 2 is a connection diagram of the electrical circuits for controlling the system shown in Fig. 1; and

Fig. 3 illustrates a modification of the control circuits shown in Fig. 2.

Referring to Fig. 1, the numeral 1 indicates diagrammatically a web printing press of any conventional type, which is fed with the paper to be printed from a roll 2, and which passes the freshly printed web 3 to a dryer or chamber 4. The press may be driven at variable speeds by a shunt wound direct current motor 5.

The dryer 4 is a chamber which is substantially entirely closed, except for narrow slots 6 and 7 which permit the passage of the web 3 into and out of the chamber. Guide rollers 8 and 9 are

provided in the chamber over which the web is passed in its passage therethrough. On one side of the web and intermediate of the rollers 8 and 9 is provided a gas burner comprising a tube 10 arranged transversely of the web and having on its upper side a series of holes or slots 11 to permit egress of the combustion gas. The burner is located closely adjacent to the web so that the flame and/or hot combustion gases impinge upon it to quickly evaporate the liquid vehicle in the printing ink and dry or oxidize the latter. The tube 10 is supplied with gas from a suitable source through a pipe 12 in which is inserted a normally closed solenoid operated valve 13, having a magnetizing coil 14 which causes opening of the valve when it is energized. There is further provided in the pipe 12 a motor operated regulating valve 15 which can be opened or closed to a variable extent by a reversible motor 16, connected to said valve by means of a set of reducing gears or the like. The motor also operates a pair of normally closed limit switches 17 and 18 whose contacts are opened selectively by the action of the motor when the valve 15 reaches its fully closed and fully open positions, respectively.

Air conduits 19 are arranged on each side of and extend parallel with the pipe 10. The conduits 19 are joined with each other and connected through a fresh air supply conduit 20 to a blower 21 which is adapted to supply combustion and cooling or ventilating air to the chamber 4. The sides of the conduits 19 which are adjacent to the burner tube 10 are spaced from the latter and shaped to form therewith combustion channels 22 into which the flame and the combustion gases are drawn by an exhaust fan 23 which is connected by a pipe 24 to said combustion channels. The air supplied to the conduits 19 is expelled therefrom into the chamber 4 through elongated slots 25 on the sides of the conduits 19 opposite to those facing the burner tube 10. Such air serves to support combustion of the gas, and at least a portion thereof (from the right-hand conduit 19) tends to cool to some extent the web 3 after heating of the latter by the gas flame. The fresh cool air passing through the conduits 19 serves also to cool the latter and to absorb the heat from the gas flame impinging thereon.

The conduits 20 and 24 are respectively provided with adjustable dampers 26 and 27. These dampers are normally biased toward fully closed position by a spring 28, but are restrained from complete closure thereof by any suitable stop

means (not shown) for partially opened positioning thereof as shown in Fig. 1. Said valves 26 and 27 may be fully opened by an electromagnet 29 to which they are jointly connected by suitable links or levers, as shown.

In order to further cool the sheet after it has passed the burner a sprayer 30 is provided near the web and beyond the burner. The sprayer which may be of any suitable type is supplied with water from a suitable source through a pipe 31 and is controlled by a normally closed valve 32 which may be opened by an electromagnet 33. The water emerges from the spray as a very fine mist and is evaporated by coming in contact with the heated air in the chamber 4, thereby reducing the temperature of the adjacent air and thus also reducing the temperature of the web 3.

In practice a number of burners with the complementary air supply and exhaust conduits are arranged side by side in the chamber 4, only one set being shown for the sake of simplicity, a single air supply and exhaust fan serving all sets of burners, but separate gas and water supplies may be employed.

Adjacent to the flame of the burner is arranged a flame detector 34 comprising an expansible chamber containing a liquid which expands due to the heat of the flame, thereby closing normally open contacts 35. There is also arranged adjacent to the web a thermostat 36 of any suitable type having a movable contact 37 which in response to an abnormal ambient temperature is moved either into engagement with a high temperature stationary contact 39 or a low temperature stationary contact 38.

An ignition device 40 is arranged near the orifice 11 and is connected to the secondary winding of a high tension transformer 41, which may be supplied with energy from any suitable source, the supply being controlled by an electromagnetic relay, having an energizing coil 42^a and normally open contacts 42^b.

The web is held in tension in its passage through the chamber 4 by a friction roller 43 over which it passes and which may be driven through suitable gearing by the motor 5 or by any other suitable means.

The controller is illustrated diagrammatically in Fig. 2. The system is supplied with energy from the direct current bus bars L¹, L². The motor 5 which may be of any suitable type is herein illustrated as a shunt motor having an armature 5^a and a shunt field winding 5^b and its speed may be regulated by a variable armature resistance 44. The latter is provided with a number of taps which are connected to contact buttons 44^b, arranged adjacent to and parallel with a contact bar 45 to which they may be connected by a sliding contact 46 insulatedly attached to a cross-head 47. The cross-head may be reciprocated by a screw 48 which engages the former and which may be rotated by a reversible pilot motor 49, one terminal of which is permanently connected to bus bar L², while one or the other of its remaining terminals may be selectively connected to bus bar L¹ to operate the motor 49 in one direction or the other.

The system is controlled by a number of manually operable push buttons as follows: a starting button 50 having normally open contacts, a stop button 51 having normally closed contacts; an "on" button 52 and an "off" button 53, each having normally open contacts. The system further provides a number of electromagnetic devices as

follows: a relay 54 having an energizing coil 54^a and normally open contacts 54^b; a relay 55 having an energizing winding 55^a and normally open contacts 55^b and 55^c, respectively; a relay 56 having an energizing winding 56^a, normally open contacts 56^b and normally closed contacts 56^c; a relay 57 having an energizing winding 57^a, normally open contacts 57^b and normally closed contacts 57^c; a relay 58, having an energizing winding 58^a and normally open contacts 58^b; a relay 59 having an energizing winding 59^a and normally open contacts 59^b; a relay 60 having an energizing winding 60^a and normally open contacts 60^b; a relay 61 having an energizing winding 61^a, normally open contacts 61^b and 61^c, respectively, and a normally closed contact 61^d. The latter is provided with a suitable time delay device so that the opening of the contact is delayed for a given period upon energization of the relay coil 61^a.

The speed with which the gas valve motor 16 operates to open the valve 15 is regulated by a plurality of individually adjustable resistors 62 to 66, inclusive, which resistors have one each of their respective terminals connected to bus bar L¹, while their other terminals are connectable selectively through normally open contacts 67^a to 71^a, respectively, of relays 67 to 71, inclusive, and through contacts 60^b and 18 to one of the reversing terminals of motor 16; the other reversing terminal of said motor being connected through contacts 17 and 59^b to L¹; while the common terminal of the motor is connected to L².

To further control the speed with which the motor 16 opens and closes the gas valve 15 and to provide a step by step motion thereof, an interrupter 72 which opens and closes the current supply to the contact 37 of the thermostat 36 (Fig. 1) is interposed in a circuit extending from L¹ over contacts 61^c, 72, 37, 38, coil 60^a to L²; or alternatively from contact 37 to 39, coil 59^a to L², so as to periodically open and close the energizing circuit of the relays 60 and 59, respectively, when they are under the control of the thermostat 36 to prevent hunting of the system due to overrunning.

The relays 67 to 71, inclusive, are provided respectively with energizing coils 67^b to 71^b having one each of their respective terminals jointly connected to L². The other terminals of coils 67^b to 70^b are connected respectively to one contact of each of the sets of normally closed contacts 68^c to 71^c of relays 68 to 71, the other contacts of said sets 68^c to 71^c being respectively connected to contact buttons 73 to 76. The other terminal of coil 71^b is connected directly to contact button 77. The aforementioned contact buttons 73 to 77, inclusive, are arranged adjacent to a contact bar 80, in such manner that a brush 79 attached to but insulated from the cross-head 47 connects said buttons selectively to said bar as the cross-head is reciprocated by motor 49. A further contact bar 78 is also connected to bar 80 by said brush 79 except when the cross-head is at the left in its "off" or its first "on" position.

Adjacent to the extreme positions of the cross-head and operable by the latter are limit switches 81 and 82, which are normally biased to closed position by any suitable means (not shown). Switches 81 and 82, when opened selectively by the cross-head at its respective extreme positions, act to open the respective reversing wires of motor 49.

The circuit of motor 5 is controlled by a main switch 83, having an energizing winding 83^a, nor-

mally open main contacts 83^b, normally open auxiliary contacts 83^c and 83^d, and normally closed auxiliary contacts 83^e and 83^f. The main switch energizing winding 83^a is controlled by a "stop" relay 84, having an energizing winding 84^a and normally open contacts 84^b, and by an interlocking relay 85 which has an energizing winding 85^a, and normally open contacts 85^b.

A normally closed contact 85 which is opened by the crosshead 47 in its "off" position is interposed between L² and one terminal of coil 58^a.

The system illustrated in Figs. 1 and 2 operates as follows: If it is desired to operate the press, the blower 21 and suction fan 23 are started. With stop button 51 closed a circuit is established from L¹ over contact 51, coil 84^a to L². Relay 84 is thus energized and contacts 84^b thereof are closed. Inasmuch as relay 61 is de-energized, contacts 61^d are closed and another circuit is closed from L¹ over 61^d through coil 85^a, over contacts 84^b to L². This energizes relay 85 and closes contacts 85^b. If now the start button 50 is closed a further circuit is established from L¹ through button 50, through coil 83^a, over contacts 85^b and 84^b to L². This energizes main switch 83 which in turn closes contacts 83^d, the latter thereby short-circuiting the contacts of start button 50 so that it may be released, while the main switch remains closed and maintains closed the main contacts 83^b and the auxiliary contacts 83^c, and maintains open auxiliary contacts 83^e and 83^f. The closure of contacts 83^c presets a circuit for coil 61^a of relay 61 for completion upon bridging of contact bars 78 and 80 by portion 79 of cross-head 47. Closure of 83^b energizes field winding 5^b of motor 5.

To start the equipment the operator now presses the "on" button 52, thereby establishing a circuit from L¹ over contacts 52, through coil 54^a to L², thereby energizing relay 54 which completes a circuit from L¹ over contacts 54^b, 81 through winding of motor 49 to L², whereupon motor 49 rotates to move the cross-head 47 to the right. As soon as the brush 46 connects the bar 45 with the resistor 44, the circuit of motor armature 5^a is completed and the press 1 and roller 43 (Fig. 1) rotate at a low speed which increases as the cross-head travels farther to the right, the motor 49 stopping as soon as the button 52 is released. As soon as the cross-head 79 makes contact between the bars 78 and 80 a circuit is completed from L¹ over 83^c, 78, 79, 80, through coil 61^a to L². Thereupon relay 61 is energized and closes contacts 61^b and 61^c. The relay also tends to open contact 61^d, but such opening is delayed for some time by the time delay mechanism of said contact. Closure of contact 61^b completes an energizing circuit for the coils 14, 33 and 42^a, from L¹ over contacts 61^b through the respective coils in parallel to L². Thus the gas supply line 12 and the water supply line 33 are opened and the igniter 40 is energized to ignite the gas escaping from the burner holes 11. If the gas ignites in a given time it causes closure of contacts 35 of detector 34 prior to the opening of the contact 61^d of relay 61, thus paralleling the contact 61^d and maintaining energization of relay 85 and main switch 83. If, however, the ignition of the escaping gas should be unduly delayed or the flame be extinguished at any time, the contacts 35 will open or remain open so that the energizing circuit of relay 85 and thus also the

circuit of the main switch 83 are interrupted and the main motor 5 is stopped. Opening of main switch 83 also interrupts the energizing circuit of relay 61 which in turn shuts off the gas and water supply and interrupts the ignition circuit. At the same time contacts 83^e and 83^f close, the former paralleling button 53, while the latter completes the circuit through coil 58^a. Relay 58 closes and energizes magnet 29 which opens the dampers 26 and 27 as afore-described, the dampers remaining open until the cross-head has returned to the starting position and opened limit switch 86. The opening of the dampers 26 and 27 to a predetermined degree (preferably to the fully open position) increases the circulation of air through the chamber 4 to remove all combustible fumes therefrom and to provide a flow of cool air through the chamber to prevent over-heating and/or ignition of the web prior to a complete shutdown of the press. Thereafter the system cannot be started again, except by pressing the "start" button 50.

As the cross-head 47 travels to the right (Fig. 2) toward the high speed position it successively connects the contact buttons 73 to 77 to the bus bar 78 and thus, as long as the contacts 83^c are closed, to L¹. This energizes one or another of the relays 67 to 71, referred to, thereby completing a circuit from L¹ through one of the resistors 62 to 66, inclusive. As long as "on" button 52 is held closed the relay coil 56^a is energized by a current flowing from L¹ over contacts of button 52 and 57^c, through coil 56^a to L². This closes contacts 56^b thereby completing a circuit from L¹ over contacts 56^b, through coil 60^a to L². Relay 60 closes contacts 60^b. Thus a circuit is completed from L¹ through one of the resistors 62 to 66, inclusive, contacts 60^b, switch 18, motor 16 to L², so that motor 16 rotates to open gas valve 15 (Fig. 1) at a speed determined by the adjustment of the respective resistors 62 to 66, inclusive. Thus the rate of increase in the supply of gas and the resulting heat supply can be accurately and automatically correlated to the speed of the press as determined by the position of the cross-head.

If the cross-head is in an intermediate position or in the high speed position and the motor 5 operates at a corresponding speed and it is desired to reduce its speed, the "off" button 53 is depressed, thus completing the circuit from L¹ over the contacts of button 53, through coil 55^a to L².

If it is desired to stop the apparatus, the stop button 51 may be depressed. This deenergizes relay 84, which in turn opens the energizing circuit of relay 85 and relay 85 opens the energizing circuit of main switch 83, the latter thereafter remaining deenergized until the start button 50 is depressed. Deenergization of main switch 83 stops current supply to the main motor 5, at the same time energizing relay coil 55^a through contacts 83^e to return the cross-head 47 to the "off" position and of relay coil 58^a through contacts 83^f. The energization of relay 58 energizes the magnet 29 to open the dampers 26 and 27 as afore-described.

Closure of contacts 55^c completes a circuit from L¹ over said contacts 55^c and contacts of limit switch 82, reverse winding of motor 49 to L² and motor 49 moves the cross-head to the left toward the off position to slow down the press motor 5. Relay coil 57^a is also energized by a current flowing from L¹ over contacts of button 53

through coil 57^a over contacts 56^c to L². This closes contacts 57^b which in turn connects relay coil 59^a across the power supply, and closes contacts 59^b thereby energizing motor 16 through contacts of limit switch 17 to operate gas valve 15 to reduce the degree of opening thereof.

It will be noted that as long as either the "on" button 52 or "off" button 53 is depressed the valve motor 16 is energized to operate the valve in the opening or closing direction, respectively, subject to control by the aforementioned limit switches 17 and 18. However, when buttons 52 and 53 are in their open positions the relays 59 and 60 are under the control of the thermostat 36 (Fig. 1) through a circuit from L¹ over contacts 61^c, interrupter contacts 72, contact lever 37, and thence (if the temperature in the chamber 4 is too low) to contact 38 and through relay coil 60^a to L², which as aforedescribed causes energization of motor 16 to increase the degree of opening of the valve 15. On the other hand, if the temperature in the chamber 4 is higher than that desired, the contact lever 37 engages contact 39 which causes the current to flow through relay coil 59^a to energize motor 16 to decrease the degree of opening of valve 15. The cycle of the interrupter 72 is such that after a current impulse which operates the motor 16 and valve 15 the motor comes to rest for a period which is sufficient to permit the temperature of the flame to attain a new value corresponding to the changed gas supply and for the thermostat 36 to respond to the new temperature and operate accordingly.

In the modification illustrated in Fig. 3 the opening of the gas valve is controlled in accordance with the speed of the web, but subject to a supplemental control by the thermostat 36 aforementioned. The elements of the system which are identical with those shown and described in connection with Fig. 2 are indicated by like numerals, and we will now describe those elements in Fig. 3 which are different from those shown in Fig. 2. A variable sender rheostat 101 is provided with a sliding contact attached to a lever 102 which may be moved between limits, to contact at different points of the rheostat resistor 103, by a reversible motor 104. Interposed between the motor shaft and the lever 102 is a slip coupling 105 to permit manual operation of said lever independently of the operation of motor 104. One fixed terminal of the resistor 103 is connected to the bus bar L², while the other fixed terminal is connected to a contact bar 106 which is adapted to make contact with a brush 107 insulatedly mounted on the cross-head 47, except in the "off" position of said cross-head. Adjacent to the bar 106 and in the path of brush 107 to make contact therewith, is a series of contact buttons 108 which are respectively connected to taps of an adjustable resistor 109, the one end terminal of said resistor at the full speed end of the cross-head being connected to bus bar L¹ and is also connected to a movable contact 110 adapted to short circuit a variable amount of the resistor 109.

Connected across the bus bars L¹, L² is a resistor 111^a of a receiver potentiometer 111, provided also with a movable contact lever 111^b operatively connected to the valve motor 16 to be moved in accordance with the movement of the valve 15. The operating coil 112^a of a polarized relay 112 is connected between the lever 102 and the lever 111^b. The movable armature 112^b of said relay is connected to bus bar L¹ and

is adapted to make circuit with the contacts 112^c and 112^d, respectively, when the armature is deflected in one direction or the other by the direction of current flow in the coil 112^a. Circuits extend from the contacts 112^c and 112^d through the limit switches 17 and 18, respectively, to one or the other of the reversing terminals of the motor 16, the common terminal of which is connected to bus bar L², thus energizing the motor to open or close valve 15.

The operation of the system to control the press motor 5 is the same as already described in connection with Fig. 2. However, the control of operation of valve 15 (Fig. 1) by motor 16 through the system of Fig. 3 is different from the control provided by the system of Fig. 2. With the equipment as shown in the drawings (Figs. 1 and 3), after the motor 5 has been started and the brush 107 makes circuit with one of contacts 108 the resistor 103 is connected in a circuit from L¹ through resistor 109, resistor 103 to L². As the resistor 111^a is also connected across the bus bars L¹, L², a current flows through the coil 112^a, if the potential at the lever 102 differs from that at lever 111^b. This deflects the relay armature 112^b to close a circuit for motor 16 to either open or close valve 15 (Fig. 1), depending upon the direction of the current in coil 112^a, the movement continuing until the position of the valve corresponds to the position of the lever 102. The valve position, is, however, modified by the position of portion 107 of the cross-head 47, which as it accelerates the motor 5, cuts out part of the resistor 109 which has the effect of increasing the relative potential of lever 102 for a given position thereof, thus providing a relatively further opening of valve 15. By adjusting the contact 110 the relative position of the valve 15 for a given speed of the press may be further modified.

The opening of the valve 15 is further controlled by the thermostat 36 which controls reversible motor 104 to move the lever 102 through the clutch 105 in one direction or the other in accordance with the temperature in chamber 4. The motor 104 is energized intermittently through the interrupter 72 to move the lever 102, and thus move valve 15 step by step, as aforedescribed. The slip clutch 105 provides for energizing the relay 112 by manual movement of the lever 102, thus permitting a further adjustment of the relationship between the degree of valve opening and the speed of the press. However, as will be apparent, while the motor 16 tends to adjust the opening of the valve 15 in accordance with the speed of the press, such opening is always subject to final control by the thermostat 36.

What we claim as new and desire to secure by Letters Patent is:

1. In a device of the character described, in combination, a drying chamber, a motor adapted to move a printed web through said chamber, a valve for controlling the supply of a heating medium to said chamber, means for controlling the speed of operation of said motor, means for controlling the degree of opening of said valve and for varying the rate of said opening in response to the speed of operation of said motor, means responsive to a temperature in said chamber and arranged to modify the controlling effect of said former means upon said valve, means to supply a given volume of cooling and combustion air to said chamber, and means to increase the supply of said air upon stoppage of said motor.
2. In a device of the character described, in combination, a drying chamber, a motor adapted

to move a printed web through said chamber, means for controlling the speed of operation of said motor, a gas valve for controlling the supply of heating gas to said chamber, means operable in accordance with said speed for controlling the degree of opening of said valve, means responsive to a temperature in said chamber for modifying the controlling effect of said last mentioned means upon said valve, means to supply a given volume of cooling and combustion air to said chamber, means to exhaust said air from said chamber, and means to modify the effect of said supply and said exhaust means upon stopping the operation of said motor, for the purpose set forth.

3. In a device of the character described, in combination, a drying chamber, means including electric power means for moving a printed web through said chamber and for controlling its speed of movement, a gas valve for controlling the supply of heating gas to said chamber, means operable in accordance with said speed for controlling the degree of opening of said valve, means responsive to a temperature in said chamber for modifying the controlling effect of said last mentioned means upon said valve, means to supply a given volume of cooling and combustion air to said chamber, means to modify the rate of supply and exhaust of said air while said power means are being stopped, means to supply energy for igniting said gas, means to supply a cooling liquid to said chamber during movement of said web by said power means, and means subject to a time delay and responsive to said temperature to assure continued operation of said power means upon starting thereof and to terminate operation thereof upon said temperature becoming abnormal.

4. In a device of the character described, in combination, a drying chamber, a motor adapted to move a printed web through said chamber, means for controlling the speed of said motor,

an adjustable gas valve for controlling the supply of heating gas to said chamber, means for varying the opening of said valve, means operable in accordance with said speed for controlling the rate of varying the opening of said valve, means responsive to a temperature in said chamber for modifying in a step by step manner the effect of said last mentioned means upon said valve controlling means, means to supply a given volume of cooling and combustion air to said chamber, means to exhaust said air from said chamber, and means to modify the rate of supply and exhaust of said air upon stopping the operation of said motor.

5. In a device of the character described, in combination, a drying chamber, means including electric power means for moving a printed web through said chamber and for controlling its speed of movement, an adjustable gas valve for controlling the supply of heating gas to said chamber, means for varying the opening of said valve, means operable in accordance with said speed for controlling the rate of varying the opening of said valve, means responsive to a temperature in said chamber for modifying in a step by step manner the effect of said last mentioned means upon said valve, means to supply a given volume of cooling and combustion air to said chamber, means to exhaust said air from said chamber, means to modify the rate of supply and exhaust of said air upon stopping the operation of said web, means to supply energy for igniting said gas, means to supply a cooling liquid to said chamber during operation of said web by said power means, and means subject to a time delay and responsive to said temperature to assure continued operation of said power means upon starting thereof and to terminate operation thereof upon said temperature becoming abnormal.

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