

[54] APPARATUS FOR DRYING A PHOTOGRAPHIC MATERIAL

[75] Inventors: **Dale S. Endter; Edwin E. Miller,**
both of Rochester, N.Y.

[73] Assignee: **Eastman Kodak Company,**
Rochester, N.Y.

[22] Filed: Nov. 17, 1972

[21] Appl. No.: 307,754

[52] U.S. Cl..... 34/54, 34/48, 34/43

[51] **Int. Cl.**..... F26b 21/02

[58] **Field of Search**..... 34/54, 45, 72, 48, 43,
34/55, 78, 131, 46, 221; 219/369, 378

[56] **References Cited**

UNITED STATES PATENTS

3,400,249	9/1968	Mekjean et al.	219/378
-----------	--------	----------------	---------

3,675,600	11/1972	Jones	110/8 R
-----------	---------	-------------	---------

1,467,306 9/1923 Carrier..... 34/46

3,702,030 11/1972 Janke..... 34/45

Primary Examiner—John J. Camby

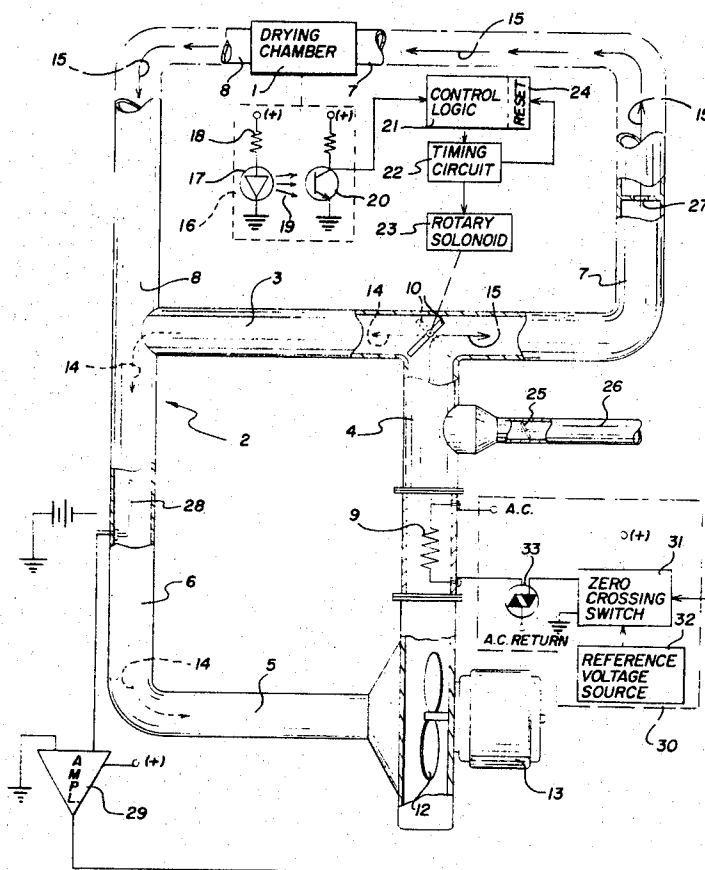
Assistant Examiner—Henry C. Yuen

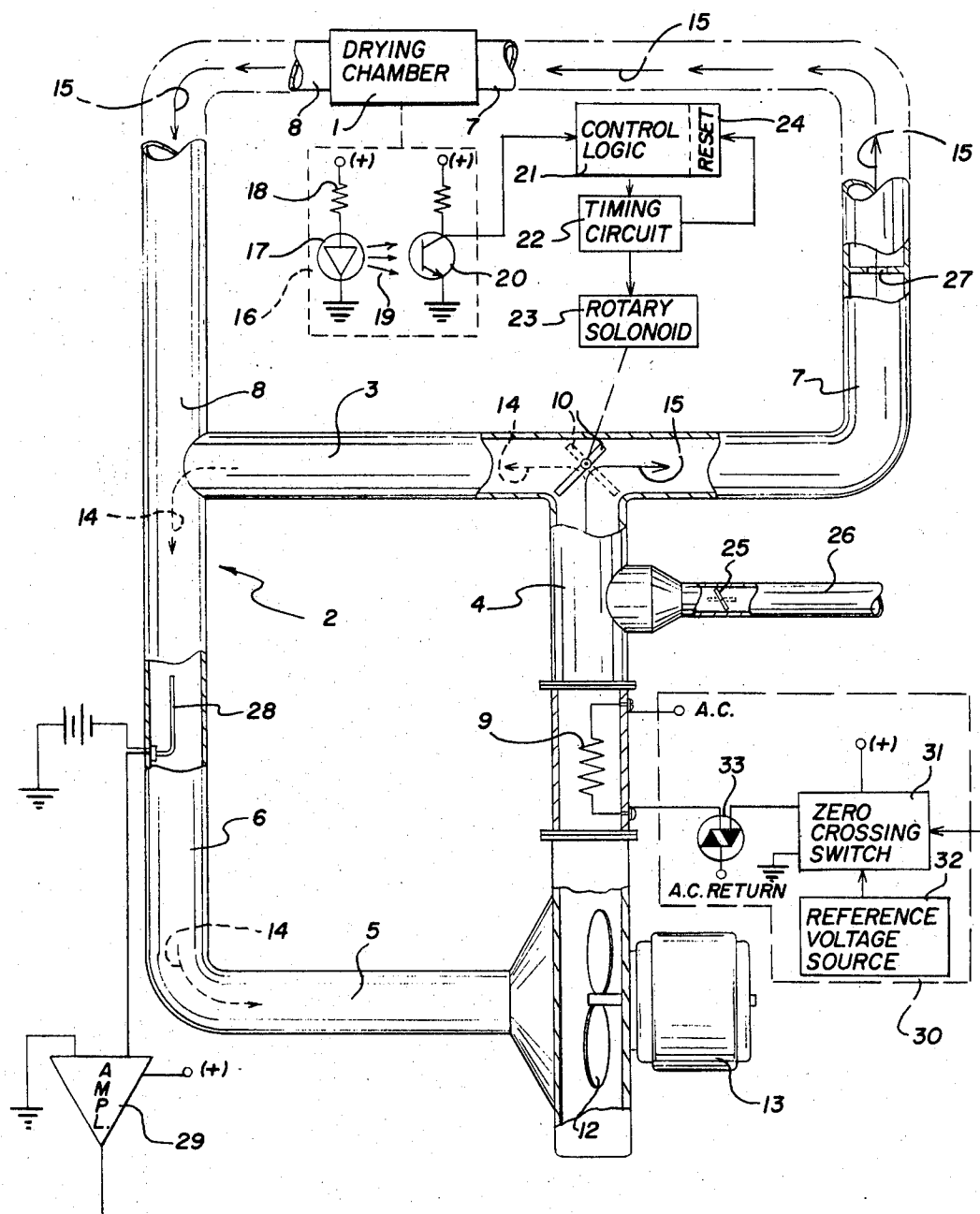
Attorney, Agent, or Firm—Roger A. Fields

[57] **ABSTRACT**

A drying apparatus is provided with a holding chamber, in which a heated gas is stored at a substantially constant temperature, and with a drying chamber, in which a photographic material can be located for drying by the heated gas. Gas supply and return ducts separately connect the holding and drying chambers. A blower is disposed for circulating the heated gas in the holding chamber and, alternately, for urging the heated gas from the holding chamber, along the supply duct, to the drying chamber and from the drying chamber, along the return duct, to the holding chamber. A valve is effective in a closed mode to cause such circulation of the heated gas by the blower and is effective in an open mode to cause such urging of the heated gas by the blower. A detector senses the presence of a photographic material in the drying chamber and, in response thereto, effects the open mode of the valve. After a sufficient period of time has elapsed to dry the photographic material in the drying chamber, a timing circuit effects the closed mode of the valve.

6 Claims, 1 Drawing Figure





APPARATUS FOR DRYING A PHOTOGRAPHIC MATERIAL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to apparatus for drying a photographic material and, more particularly, to such drying apparatus in which a drying gas is stored in a holding chamber preparatory to use at a drying chamber.

2. Description of the Prior Art

Many forms of drying apparatus have been previously devised. In one well known form, a drying chamber is directly connected to a hot air blower for receiving heated drying air from such blower. Once impinged on a photographic material located in the drying chamber, the spent drying air is exhausted to the atmosphere. Examples of this kind of drying apparatus are described in U.S. Pat. No. 3,223,532 patented Feb. 8, 1966 and U.S. Pat. No. 3,446,134 patented May 27, 1969. In another form, such as described in U.S. Pat. No. 1,467,306 patented Sept. 11, 1923, a drying chamber receives heated drying air from a supply duct and exhausts the spent drying air into a return duct. The return duct conveys the spent drying air to the supply duct, where the spent air is again heated for renewed introduction into the drying chamber immediately after such heating. A fresh or outside air damper is disposed between the supply duct and a fresh air source, and a return air damper is disposed between the supply and return ducts. These dampers are connected by a suitable mechanism in a manner such that the partial opening of one damper will cause the partial closing of another damper, so as to enable any desired proportion of fresh air and return air to be supplied continually to the drying chamber.

Although the foregoing kinds of drying apparatus are satisfactory for drying a photographic material located in the drying chamber, such apparatus in operation is adapted to draw in amounts of fresh or outside air which must be heated immediately before introduction into the drying chamber. This heating step in the drying cycle causes some delay in the rate of drying, because of the time required to heat the fresh air.

In most instances, drying apparatus for drying a photographic material is located in a photographic processor. This drying apparatus is either actuated simultaneously with actuation of the processor or in timed relation to the processor actuation. When the dryer actuation occurs in timed relation to the processor actuation, the dryer actuation is usually coincidental with, or immediately before, introduction of the photographic material into the drying chamber. Typically, a timing circuit effects such timed actuation of the drying apparatus and, after a certain period of time has elapsed which is sufficient to dry the photographic material in the drying chamber, the timing circuit effects deactuation of the drying apparatus. However, if operation of the processor is stopped and the photographic material is removed before drying, some means must be provided in the processor for resetting the timing circuit to an original or starting condition, in preparation for a new cycle of operation of the processor. In the absence of such resetting means, actuation of the drying apparatus during the new cycle of operation would occur too soon before introduction of the photographic material

into the drying chamber, causing deactuation of the drying apparatus after elapsing of the aforementioned period of time but before the photographic material is satisfactorily dried.

SUMMARY OF THE INVENTION

It is therefore a general object of the present invention to provide a drying apparatus which is improved over the kinds of drying apparatus previously described.

A further object of the present invention is to provide a drying apparatus in which a drying gas is stored in a holding chamber preparatory to use at a drying chamber.

Yet a further object of the present invention is to provide a drying apparatus in which the drying gas, after use at the drying chamber, is returned for storage in the holding chamber.

Another object of the present invention is to provide a drying apparatus in which the drying gas is maintained at a substantially constant temperature in the holding chamber.

Yet another object of the present invention is to provide a drying apparatus in which an amount of the drying gas is released from the holding chamber, for use at the drying chamber, in response to detecting the presence of a photographic material in the drying chamber.

Still another object of the present invention is to provide a drying apparatus in which other amounts of the drying gas are blocked from introduction into the drying chamber after a sufficient period of time has elapsed to dry the photographic material in the drying chamber.

In accordance with a preferred embodiment of the present invention there is disclosed, in detail hereinafter, a drying apparatus in which a holding chamber is adapted to store a heated gas at a substantially constant temperature and in which a drying chamber is adapted to receive a photographic material for drying the heated gas. Gas supply and return ducts separately connect the holding and drying chambers. A blower is disposed for circulating the heated gas in the holding chamber and, alternately, for urging the heated gas from the holding chamber, along the supply duct, to the drying chamber and from the drying chamber, along the return duct, to the holding chamber. A valve is effective in a closed mode to cause such circulation of the heated gas by the blower and is effective in an open mode to cause such urging of the heated gas by the blower. A detector senses the presence of a photographic material in the drying chamber and, in response thereto, effects the open mode of the valve. After a sufficient period of time has elapsed to dry the photographic material in the drying chamber, a timing circuit which is coupled to the detector effects the closed mode of the valve.

BRIEF DESCRIPTION OF THE DRAWING

The above mentioned and other features and objects of the present invention and the manner of obtaining them will become more apparent by reference to the following detailed description of a preferred embodiment of such invention taken in conjunction with the accompanying drawing, wherein there is shown a schematic view of a drying apparatus according to a preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, there is shown a drying chamber 1 in which a photographic material can be located for drying by a drying gas such as heated air. A holding chamber 2 for storing the heated air is defined by four duct-like or conduit-like sections 3, 4, 5 and 6 which are arranged so as to generally enclose a rectangular shaped area. A heated air supply duct or conduit 7 connects the holding chamber 2, at a junction of the holding chamber sections 3 and 4, with the drying chamber 1. A spent air return duct or conduit 8 connects the holding chamber, at a junction of the holding chamber sections 3 and 6, with the drying chamber 1. An electric heater 9 is disposed in the holding chamber section 4 for heating air in the holding chamber 2. A diverter valve or damper 10 is disposed at the junction of the holding chamber sections 3 and 4 and the supply duct 7. This valve 10 is movable, by means described in detail hereinafter, between a closed position (shown in broken line), in which the valve closes the holding chamber 2 to the supply duct 7, and an open position (shown in solid line) in which the holding chamber is open to the supply duct. A blower 12, disposed in the holding chamber section 4, is connected to a motor drive 13, disposed outside of the same section. This blower 12 serves to provide a heated air current which circulates the heated air in the holding chamber 2, as schematically illustrated by several direction arrows 14, when the valve 10 is in the closed position. However, when the valve 10 is in the open position, the blower 12 serves to urge the heated air from the holding chamber 2, along the supply duct 7 to the drying chamber 1 and from the drying chamber, along the return duct 8, to the holding chamber, as schematically illustrated by several direction arrows 15.

An electro-optical card detector 16 is disposed in the drying chamber 1 for sensing the presence of a photographic material in that chamber and for generating a signal in response to such sensing. In the detector 16, a light emitting diode 17 is coupled to a positive source of potential through a current limiting resistor 18. The diode 17 emits an infrared beam 19 which is normally impinged on a phototransistor 20. When a photographic material is located in the drying chamber 1, such material interrupts the beam 19, causing the phototransistor 20 to apply a triggering input signal to a control logic 21. The control logic 21 can take various forms known in the art and may, for example, be provided by a JK flip-flop. Upon receiving the input signal from the phototransistor 20, the control logic 21 changes state in a manner energizing a timing circuit 22. Timing circuits are well known in the art, and one such circuit which may be used herein is set forth in G. E. Transistor Manual, 5th Edition, Section 13, (1960), wherein the timing circuit is shown to include a unijunction transistor and a charging capacitor. Energization of the timing circuit 22, in turn, energizes a rotary solenoid 23 which is mechanically linked to the diverter valve 10. The solenoid 23, when deenergized, holds the valve 10 in the closed position (shown in broken line). However, energization of the solenoid 23 serves to move the valve 10 to the open position (shown in solid line). At this time, as previously described, the heated air normally circulating in the holding chamber 2 is urged from the holding chamber,

through the drying chamber 1, and back to the holding chamber. After the elapse of a first period of time which is sufficient to dry the photographic material in the drying chamber 1, the timing circuit 22 de-energizes the solenoid 23 to, in turn, move the valve 10 to the closed position; whereupon, the heated air is again circulated in the holding chamber 2. Subsequently, after the elapse of a second period of time which is sufficient to allow removal of the photographic material from the drying chamber 1, the timing circuit 22 causes a reset signal to be applied to a reset 24 in the control logic 21, serving to return such logic to an original or starting state. Now, if a new piece of the photographic material is located in the drying chamber 1, so as to interrupt impingement of the beam 19 on the phototransistor 20, the foregoing cycle will be repeated.

A manually set make-up valve or damper 25, disposed in an exhaust port 26 of the holding chamber 2, permits a portion of the heated air in such chamber to be exhausted to the atmosphere. This insures that any amount of moisture drawn off the photographic material in the drying chamber 1 and conveyed with the spent air to the holding chamber 2 can be removed from that chamber. The small quantity of moistened air bled in this manner from the holding chamber 2 is made up or replenished by fresh air which is sucked into the drying chamber 1 at an entrance and exit opening (not shown) for the photographic material. An orifice 27, disposed in the supply duct 7, is sized to restrict the flow of heated air along the supply duct, sufficiently to bring about a slight negative pressure in the drying chamber 1. Such an in-leak arrangement tends to minimize the transfer of heat from the drying chamber 1 to any equipment which may be located in close proximity to such chamber.

A thermister sensor 28, disposed in the holding chamber section 6, is formed by an electrical resistor made of a material whose resistance varies inversely in a well known manner with the temperature of the heated air in the holding chamber 2. The sensor 28 causes an input voltage signal to be applied to an amplifier 29 which, in turn, causes an output or amplified voltage signal to be applied to a temperature control 30. Although the input voltage signal varies directly with the temperature of the heated air in the holding chamber 2, the amplified voltage signal varies inversely with such heated air temperature. This may be accomplished, as is well known, by a voltage dividing network at the input of the amplifier 29 or by a phase reversal circuit within the amplifier. In the temperature control 30, a zero crossing switch 31, coupled to a source of reference voltage 32, receives the amplified voltage signal. By way of illustration, the reference voltage source 32 may include a conventional Zener diode arrangement. The reference voltage is indicative of a desired temperature of the heated air in the holding chamber 2, whereas the amplified voltage signal is indicative of the actual temperature of the same air. The zero crossing switch may take various forms known in the art, one of which is commercially available as RCA 3059 manufactured by Radio Corporation of America. When the amplified voltage signal becomes more positive than the reference voltage, the zero crossing switch 31 causes a positive AC signal to be applied to a gate electrode of a triac 33. By applying the positive AC signal to the gate electrode of the triac 33, the triac which has

previously been in a non-conductive mode switches to a conductive mode and closes a circuit to the electric heater 9, shown as a resistor. Accordingly, the heater 9 raises the temperature of the heated air in the holding chamber 2, causing the amplified voltage signal to eventually become less positive than the reference voltage. When this happens, the zero crossing switch 31 removes the positive AC gate signal from the triac 33, switching the triac from the conductive mode to the non-conductive mode and opening the circuit to the heater 9. Thus, by the foregoing means, the heated air in the holding chamber 2 is maintained at a substantially constant temperature, as a result of turning on the heater 9 if the actual temperature of the heated air is lower than the desired temperature of the same air and turning off the heater if the actual air temperature is higher than the desired air temperature.

The present invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

We claim:

1. Apparatus for drying a photographic material, comprising:

means defining a drying chamber in which a photographic material can be located for drying by a heated gas;

means defining a holding chamber for storing a heated gas;

means for heating a gas in said holding chamber;

a gas supply duct connecting said drying chamber and said holding chamber;

means for urging a heated gas from said holding chamber, along said supply duct, to said drying chamber;

valve means actuatable from a closed mode, for blocking such urging of a heated gas by said urging means, to an open mode, for allowing such urging of the heated gas by said urging means; and

means for detecting the presence of a photographic material in said drying chamber and, in response thereto, for actuating said valve means from said closed mode to said open mode, thereby to effect drying of the photographic material.

2. Apparatus for drying a photographic material, comprising:

means defining a drying chamber in which a photographic material can be located for drying by a heated gas;

means defining a holding chamber for storing a heated gas; and

means for detecting the presence of a photographic material in said drying chamber and, in response thereto, for moving a heated gas from said holding chamber to said drying chamber and, after a sufficient period of time has elapsed to generally dry the photographic material, for ceasing movement of the heated gas from said holding chamber to said drying chamber.

3. Apparatus for drying a photographic material comprising:

means defining a drying chamber in which a photographic material can be located for drying by a heated gas;

means defining a holding chamber for storing a heated gas;

means for heating a gas in said holding chamber;

a gas supply duct connecting said drying chamber and said holding chamber;

a gas return duct connecting said drying chamber and said holding chamber;

blower means for circulating a heated gas in said holding chamber and, alternatively, for urging the heated gas from said holding chamber, along said supply duct, to said drying chamber and from said drying chamber, along said return duct, to said holding chamber;

valve means effective in a closed mode for causing such circulation of a heated gas by said blower means and effective in an open mode for causing such urging of the heated gas by said blower means;

means for detecting the presence of a photographic material in said drying chamber and, in response thereto, for effecting said open mode of said valve means; and

means for effecting said closed mode of said valve means after a sufficient period of time has elapsed to generally dry a photographic material in said drying chamber.

4. Apparatus for drying a photographic material, comprising:

means defining a drying chamber in which a photographic material can be located for drying by a heated gas;

means defining a holding chamber for storing a heated gas;

a heater disposed in said holding chamber for heating a gas in said holding chamber;

a gas supply duct connecting said drying chamber and said holding chamber;

a gas return duct connecting said drying chamber and said holding chamber;

a valve disposed between said holding chamber and said gas supply duct, and actuatable respectively for opening and closing said holding chamber to said supply duct;

a blower disposed in said holding chamber for circulating a heated gas in said holding chamber, in the event said holding chamber is closed to said supply duct, and for urging the heated gas from said holding chamber, along said supply duct, to said drying chamber and from said drying chamber, along said return duct, to said holding chamber, in the event said holding chamber is open to said supply duct;

means disposed in said drying chamber for detecting the presence of a photographic material and for generating a signal indicative of the same;

means energizable for actuating said valve to open said holding chamber to said supply duct and de-energizable for actuating said valve to close said holding chamber to said supply duct; and

means coupled to said detecting means and said valve actuating means, for receiving such a signal generated by said detecting means and energizing said valve actuating means, and for de-energizing said valve actuating means after a sufficient period of time has elapsed to generally dry a photographic material in said drying chamber.

5. Apparatus as recited in claim 4, further comprising:

7

means disposed in said holding chamber for sensing the actual temperature of a heated gas in said holding chamber and for generating a signal indicative to that temperature; and

means coupled to said heater and said sensing means for receiving such a signal generated by said sensing means and, if the actual temperature of a heated gas in said holding chamber is lower than a desired temperature of the heated gas, controlling said heater to raise the actual gas temperature to the desired gas temperature and, if the actual gas temperature is higher than the desired gas temperature, controlling said heater to lower the actual gas temperature to the desired gas temperature.

6. Apparatus as recited in claim 4, wherein said photographic material detecting means includes a light emitting diode and a phototransistor arranged with respect to each other such that a beam emitted by said diode is normally impinged on said phototransistor, said phototransistor generating a signal in response to

8

interruption of the beam, wherein said valve actuating means includes a solenoid coupled to said valve, said solenoid energizable and de-energizable respectively to actuate said valve to open and close said holding chamber to said supply duct, and wherein said means for energizing and de-energizing said valve actuating means includes a timing circuit coupled to said solenoid, said timing circuit energizable to energize said solenoid and, after a sufficient period of time has elapsed to generally dry a photographic material in said drying chamber, de-energizing to de-energize said solenoid, and a control logic coupled to said phototransistor and said timing circuit for receiving a signal from said phototransistor and, thereupon, changing state from an original one to energize said timing circuit and, after said timing circuit has de-energized and a sufficient period of time has elapsed to allow removal of the photographic material from said drying chamber, returning to its original state.

* * * * *

25

30

35

40

45

50

55

60

65