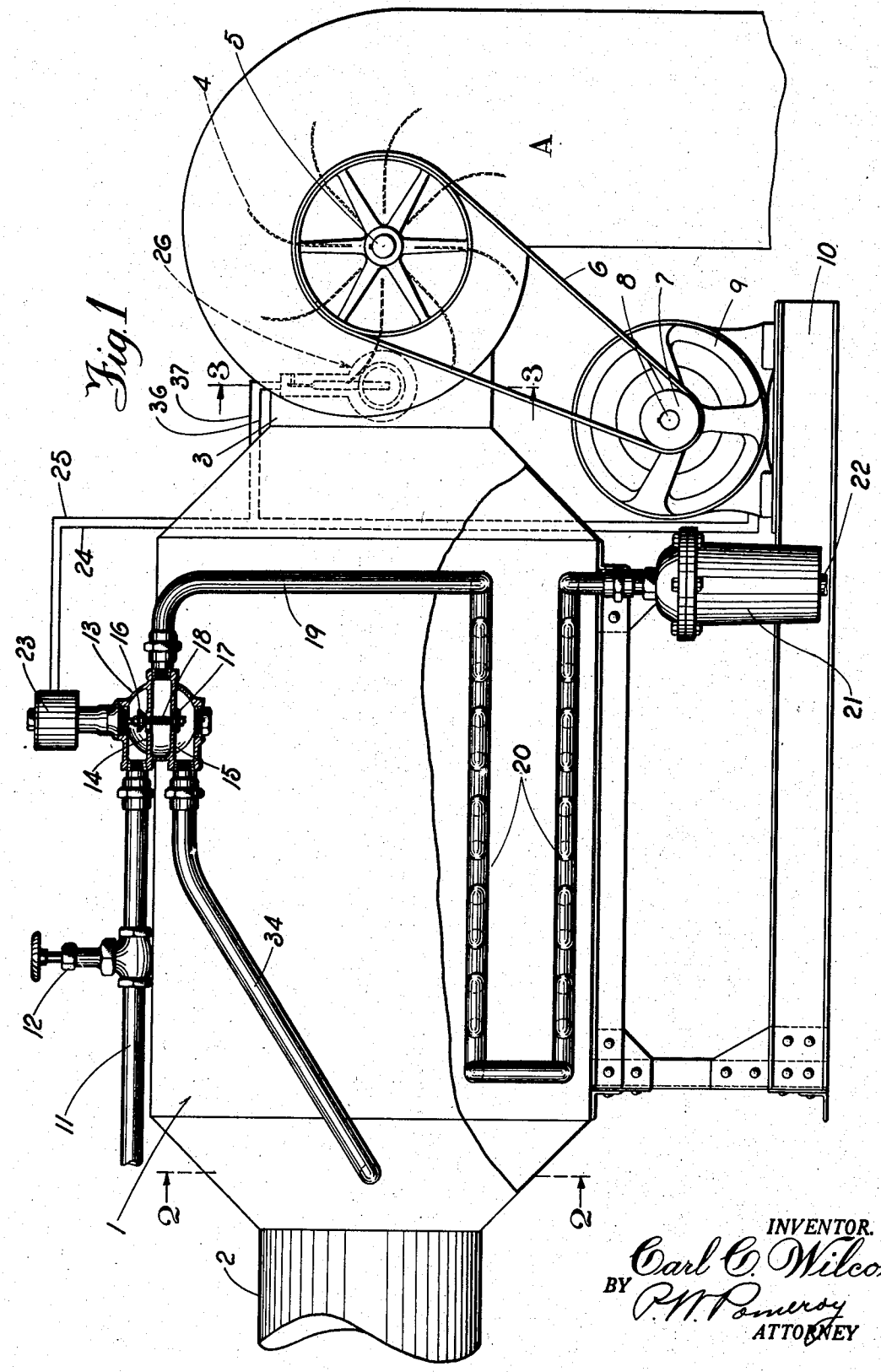
Feb. 13, 1934. C. C. WILCOX 1,946,923

DRYING OVEN

Filed Oct. 27, 1930 2 Sheets-Sheet 1

Fig. 1



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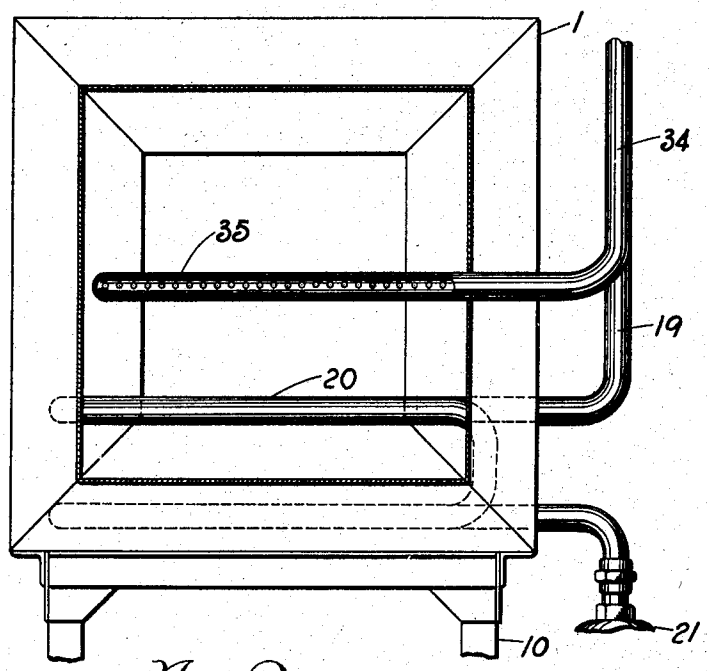


Fig. 2

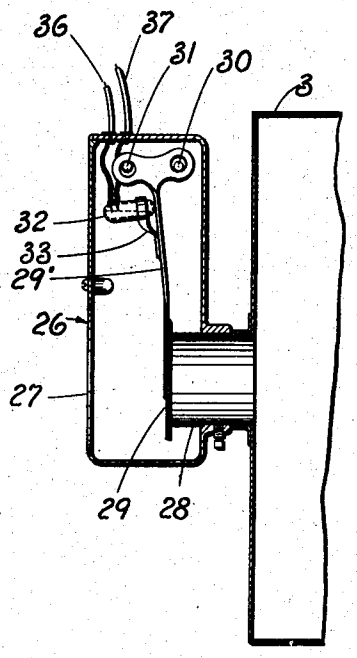


Fig. 3

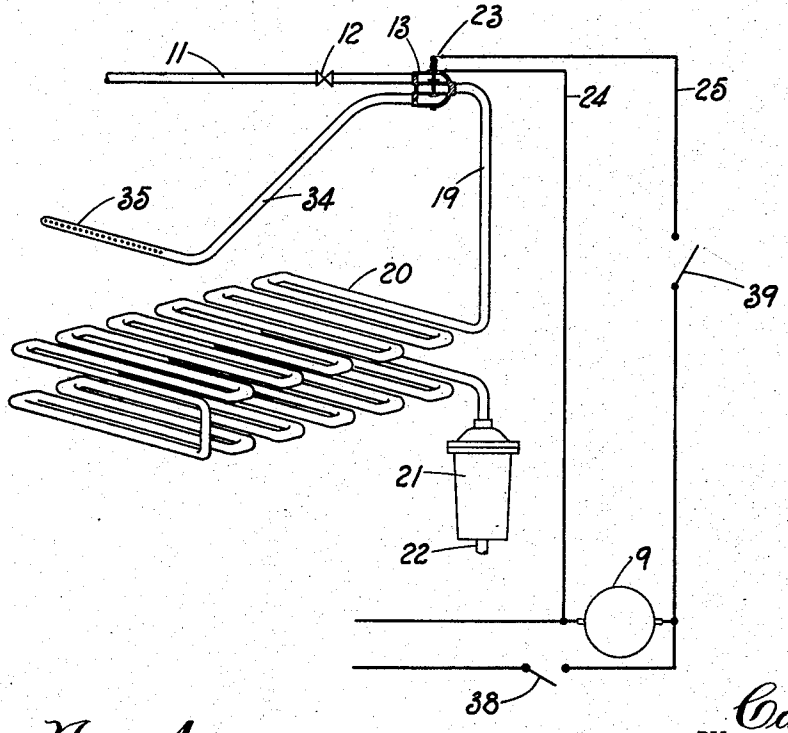


Fig. 4

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UNITED STATES PATENT OFFICE

1,946,923

DRYING OVEN

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Application October 27, 1930. Serial No. 491,520

13 Claims. (Cl. 34—18)

This invention relates to a novel process for drying lacquered articles, and embraces also a novel apparatus capable of carrying out the process.

It is an object of the invention to eliminate fire hazards of the type which attend the drying of combustible material.

It is a further object of the invention to introduce into heating units for drying ovens an atmosphere which will not support combustion, when the drying apparatus functions so imperfectly as to present danger of fire.

Another object of the invention consists in the utilization of the heating fluid used in a drying operation, as a fire prevention medium.

Another object of the invention relates to automatic fire prevention in drying processes.

Another object relates to a novel apparatus adapted for use in drying operations, fire prevention means are put into operation automatically upon the failure of proper air circulation in the heating unit for the drying oven.

The invention also relates to novel fire prevention means operated by a drop in air pressure within the heating unit, when such drop in pressure is sufficient to create a fire hazard.

A further feature of the invention relates to a drying system in which an electrically operated fan is used as an air circulating means, and in which upon failure of the supply of electric power to the fan, fire-preventing means are energized.

Many other features of the invention will be disclosed in the detailed description of the apparatus and process constituting the subject matter of the invention.

Referring to the drawings which illustrate a form of apparatus which may be used in the practice of my invention:

Figure 1 is an elevation partially in section of a heating unit for drying ovens and associated elements.

Figure 2 is a view taken along section lines 2—2 of Figure 1.

Figure 3 is a view taken along section lines 3—3 of Figure 1.

Figure 4 is a detail view showing heating fluid and electric circuits associated with the heating unit.

In high temperature oven operations, and particularly in the drying of lacquered articles, dangerous and destructive fires very frequently occur due to improper functioning of the mechanism associated with the drying ovens. The fires usually occur in the heating unit positioned in advance of the fan due to the collection of fine particles of the lacquer on the heating coils, which lacquer has a firing point at about the same temperature as the air which is blown into the ovens for drying the finish on the automobile bodies. As most lacquers have a pyroxylin base and use highly volatile and inflammable organic solvents, constant vigilance must be exercised to insure safe operation of the heating system, since even a slight increase in the temperature of the ovens may cause a fire especially when there is an interruption or slowing down of the fan causing a decreased flow of air through the heating unit. The heating units in drying assemblages are usually well lagged, the temperature in the heating units rising very rapidly if circulation of air through the ovens is not maintained at a smooth and constant rate. The temperature in lacquer drying ovens is generally maintained rather high and if the temperature within the heating unit rises perceptibly above a predetermined point, the lacquer will distill, collect on the heating elements, and ignite causing a fire.

In a drying system not having my invention included therein, there was recently a short interruption in the power which resulted in the stopping of the fan and within only a few minutes several fires broke out due to a slight accumulation of lacquer dust which it is very difficult, if not impossible to remove from the steam pipes in the heating units.

In the application of my invention, I have effectively eliminated the dangers attendant upon the lacquer-drying processes now known in the art.

My invention will be better understood from the following description of the drawings, in which. I have shown as any conventional construction for drying the finish on automobile bodies or other articles, a heating chamber in advance of the fan which is operatively connected with the oven to be heated. The heating unit 1 is provided with an air inlet 2 and an air exit passage 3. Circulation of the air through the heating unit is maintained by a fan 4 preferably of the centrifugal type. The fan 4 is incased in a jacket A leading to an oven, not shown, for delivering the heated air to the oven for drying the lacquer or other coating on the articles to be finished. The fan shaft 5 has a pulley keyed thereon adapted to be rotated by a belt 6 driven from the pulley 7 on the armature shaft 8 of an electrically energized motor 9. The motor and heating unit may be anchored on a suitable

frame 10, or they may be, if desired, mounted on separate foundations, but the use of a common foundation is preferred.

The heating unit is heated preferably by means of steam supplied through a pipe 11 controlled by a manually operated valve 12, the incoming steam entering the valve chamber 13 provided with transversely disposed division plates 14 and 15. The division plates are formed with valve seats upon which are adapted to be seated oppositely acting valves 16 and 17 which are mounted on a common valve stem 18 and held free from axial movement thereon.

During the normal operation the multiple valve is maintained in raised position, the valve 17 being held against its seat on the partition plate 15, and the valve 16 being in open position. The steam thus passes from the pipe 11 through the pipe 19 into heating coils 20 which are disposed within the heating unit and courses outwardly from the coils 20 through a steam trap 21 and outlet pipe 22.

The valve stem 18 is operated by a means of a solenoid 23 which is energized by current supplied through leads 24 and 25 which connect with the power source which supplies current through the motor 9. Under normal operating conditions, the solenoid 23 is supplied with current and lifts the valve stem to its upper position, maintaining the valve 16 open and the valve 17 closed, as shown in Figure 1. If the solenoid 23 ceases to function at any time during the drying operation, the valve stem 18 drops closing the valve 16 and opening the valve 17, thus shutting off the admission of fresh steam into the heating coils 20. Thus when the valve 16 is closed and the valve 17 is opened, the steam in the heating coils 20 expands against reduced pressure and flows in a reverse direction through the opening in the division plate 15 through the pipe 34, and is sprayed into the interior of the heating unit through the spray nozzle 35.

It will thus be seen that if, for any reason the air circulating means ceases to function properly that the supply of steam to the heating unit is cut off and that immediately steam is sprayed over the heating coils 20 which will prevent or put out any fire caused by the ignition of the lacquer dust which has been permitted to accumulate on the heating coils within the heating unit.

As a further provision for regulating the operation of the valves 16 and 17, there is connected in series with the primary coil of the unit an air flow switch 26 which may be of conventional design and which is adapted to maintain the solenoid circuit closed when the dynamic pressure caused by proper air circulation through the heating unit is above a predetermined minimum. If the fan 4 ceases to function, or if, for any reason, the circulation of the air ceases or the pressure caused by the air circulation drops below such minimum, the switch automatically breaks the solenoid circuit and the valve stem falls to its lower position, closing the valve 16 against the inflow of steam and opening the valve 17 so that there will be a reversed flow of steam which will pass through the opening in the division plate 15 into the pipe 34 and spray through the spray nozzle 35 on to the heating coil 20.

One form of air switch which may be satisfactorily used is shown in Figure 3. The casing 27 for enclosing the switch mechanism is mounted in the air exit passage 3 or on the fan casing A by means of a tubular member 28 which is opened at its inner end to the air pressure within the exit passage or fan casing. The outer end of the tube 28 is adapted to be closed by means of a flat valve 29 fastened to a valve arm 29' which is loosely mounted for limited pivotal movement on pins 30 and 31. A mercury switch 32 is fixed to the valve arm 29' by means of a bracket 33 and is provided with leads 36 and 37 which form a series of connections with leads 24 and 25 and with the power source for the motor 9. The valve arm 29' is preferably so mounted on the pins 30 and 31 that the valve 29 is out of contact with the end of the tube 28 when the fan 4 is inoperative or when the air circulation is below a given minimum. When the valve 29 is in closed position the switch contacts will be bridged by the body of mercury within the switch envelope 32 and when the valve 29 is opened, the bridge will be broken.

It will thus be seen that when the air circulating medium is functioning properly that the valve 29 will seat against the end of the tube 28 and the mercury switch will function to energize the solenoid 23 so that the valve stem 18 will be raised, opening the valve 16 and closing the valve 17 so that the inflow of steam into the heating unit is unrestricted. Upon the air circulating medium ceasing to function properly, the bridge between the lead wires 36 and 37 is broken, opening the electric circuit leading to the solenoid 23 which will permit the valve stem 18 to drop, closing the valve 16 and opening the valve 17 to thus prevent the inflow of steam into the heating unit and to permit the reverse flow of steam, all as above described whereby the steam escapes through the spray nozzle 35 on to the heater coils 20.

A manually operated switch 38 may be placed in the line leading from the power source, and if desired, the manually operated switch 39 may take the place of the air switch, as illustrated in Figure 4.

The operation of the device is as follows:

The article to be dried is placed in the oven, not shown, and the motor circuit is closed by throwing the switch 38. The fan 4 will cause the circulation of air through the heating unit 1, which air is delivered to the oven to dry the lacquered surface of the article and to carry out suspended lacquer dust and volatile solvent vapors. Lacquer dust (nitrocellulose) and the usual nitrocelluose solvents are highly inflammable and proper air circulation must be maintained in order to constantly sweep these materials from the heating unit, and likewise to induce sufficient air into the oven to insure proper drying.

The air switch closes the solenoid circuit, raising the valve stem 18 and steam is admitted to the heating coils 20 by superatmospheric pressure, preferably around 100 lbs. per square inch and at a temperature sufficient to heat the coils 20 at about 300° F. This will create a temperature in the oven sufficiently elevated to dry the lacquer, and at about the ignition temperature of the lacquer dust which, as above explained, will ignite very quickly when the circulation of the air in the heating unit is reduced by the slowing down or stopping of the fan. In the event the power to the motor fails and the rotation of the fan is retarded or stops and the circulation of the air is reduced, the heater coils will quickly heat up and the lacquer dust which has settled on the heating coils will distill, and

will readily ignite to cause a damaging fire as long as combustion supporting atmosphere obtains in the heating unit.

However, in the apparatus above described, if the power fails the solenoid is no longer supplied with current and the valve 16 is closed, cutting off the supply of steam and the valve 17 is opened. The flow of steam in the coils 20 will be reversed since the pressure imposed on it drops to the pressure in the heating unit, which is approximately atmospheric, and which will be sprayed through the nozzle 25 on to the heating coils 20.

The steam in the coils, together with the aqueous condensate which will flash into steam upon the reduction of the pressure, has been sufficient to create an admission which will not support combustion.

Although the most common case of failure of the air circulation is due to power failure, it sometimes happens that a breakage occurs in the fan, or for some other reason, the fan functions improperly. Whenever the air circulation drops to a predetermined danger point, the air pressure diminishes proportionately, and the valve 29 of the air switch rocks the mercury envelope 32, breaking the solenoid circuit and closing the steam inlet valve 16. The reverse flow of the steam into the heating unit then takes place in the manner previously described.

It will be understood from the above description of the preferred form of the invention that fire hazards in heating units for drying ovens for lacquered articles may be substantially eliminated by the practice of my invention. The details of my novel apparatus and process are susceptible of a considerable range of variation without departing from the concept of the invention and, therefore, it is not my intention to be limited to the exact details of construction shown, but on the contrary I desire to claim my invention broadly as well as specifically as indicated in the appended claims, the above detailed description being merely illustrative of the invention and not limiting the same.

Having thus described my invention, what I claim is:

1. A proces for eliminating fire hazards in the drying of highly combustible materials comprising heating a heating chamber for a drying oven by indirect heat exchange with a heating fluid, circulating air through the heating chamber, and introducing into the heating chamber upon failure of proper air circulation, the fluid from said heat exchange which will create in the heating chamber an atmosphere which will not support combustion.

2. A process for eliminating fire hazards in the drying of highly combustible materials comprising heating a heating chamber for a drying oven by indirect heat exchange with a heating fluid, circulating air through the heating chamber, and automatically introducing into the heating chamber upon failure of proper air circulation, the fluid from said heat exchange which will create in the heating chamber an atmosphere which will not support combustion.

3. A process for eliminating fire hazards in the drying of highly combustible materials comprising heating a heating chamber for a drying oven by indirect heat exchange with a non-combustible heating fluid, circulating air through the heating chamber, and upon failure of proper air circulation shutting off the supply of fluid to said heat exchange and discharging a portion of the heating fluid in said heat exchange sufficient to create in the heating chamber an atmosphere which will not support combustion.

4. A process for eliminating fire hazards in the drying of combustible materials comprising heating a heating chamber for a drying oven by indirect heat exchange with a non-combustible heating fluid, circulating air through the heating chamber, automatically cutting off the supply of heating fluid to the heating chamber upon a failure of proper air circulation through the heating chamber, and thereafter introducing into the heating chamber a portion of said heating fluid sufficient to create within the heating chamber an atmosphere which will not support combustion.

5. A process for eliminating fire hazards in the drying of combustible materials which comprises heating a heating chamber for a drying oven by indirect heat exchange with a non-combustible heating fluid, circulating air through the heating chamber, automatically cutting off the supply of heating fluid upon a failure of proper air circulated, and then introducing directly into the heating chamber heating fluid previously passed in indirect heat exchange with the heating chamber, in an amount sufficient to create within the heating chamber an atmosphere which will not support combustion.

6. A process for eliminating fire hazards in the drying of combustible material comprising heating a heating chamber for a drying oven by indirect heat exchange with a non-combustible heating fluid, circulating air through the heating chamber, and introducing a portion of said heating fluid into the heating chamber upon a failure of proper air circulation, in an amount sufficient to create in the heating chamber an atmosphere which will not support combustion, said introduction of heating fluid being controlled by the pressure of air induced by the circulation of air through the heating chamber.

7. A process for eliminating fire hazards in the drying of combustible materials comprising heating a heating chamber for a drying oven by indirect heat exchange with a non-combustible heating fluid, circulating air through the heating chamber by power means, and introducing into the heating chamber, upon failure in the supply of said power, a portion of said heating fluid in an amount sufficient to create an atmosphere which will not support combustion.

8. A process for eliminating fire hazards in the drying of combustible materials comprising heating a heating chamber for a drying oven by indirect heat exchange with a non-combustible heating fluid, circulating air through the heating chamber by means of power supplied from an electrical power source, automatically cutting off the supply of heating fluid upon a failure in the supply of said power, and thereafter introducing a portion of said heating fluid into the heating chamber in an amount sufficient to create an atmosphere which will not support combustion.

9. An apparatus adapted for the drying of combustible material comprising a heating chamber, an air inlet passage therefor, an air outlet passage therefor, means for effecting a circulation of air through the heating chamber, means for supplying a non-combustible heating fluid in indirect heat exchange with the heating chamber, means put into operation by a failure in air circulation for cutting off the supply of heating fluid to the heating chamber, and means for introducing a portion of the heating fluid

into the heating chamber when the supply of heating fluid is cut off.

10. An apparatus adapted for the drying of combustible material comprising a heating chamber, an air inlet passage therefor, an air outlet passage therefor, means operated by electrical power for effecting a circulation of air through the heating chamber, means for supplying non-combustible heating fluid in indirect heat exchange with the heating chamber, means for cutting off the supply of heating fluid upon a failure of electrical power to said last-named means, and means put into operation when the supply of heating fluid is cut off for introducing a portion of the heating fluid into the heating chamber in an amount sufficient to create an atmosphere which will not support combustion.

11. An apparatus suitable for use in drying combustible materials comprising a heating chamber, an air inlet passage, an air outlet passage, and means for effecting a circulation of air through the heating chamber, steam coils for heating the heating chamber, a steam pipe for supplying steam to the coils, a valve for controlling the flow of steam in said pipe, and means for operating the valve, responsive to the circulation of air in the heating chamber.

12. An apparatus suitable for use in drying combustible materials comprising a heating chamber, an air inlet passage, an air outlet passage, and means for effecting a circulation of air through the heating chamber, steam coils for heating the heating chamber, a steam pipe for supplying steam to the coils, a valve for controlling the flow of steam in said pipe, means responsive to a failure in air circulation for operating the valve to cut off the steam supply, and means associated with said last named means for introducing steam from the heating coils into the heating chamber when the steam supply is cut off.

13. An apparatus suitable for use in drying combustible materials comprising a heating chamber, an air inlet passage, an air outlet passage, means for effecting a circulation of air through the heating chamber, operated by electrical power, steam coils for heating the heating chamber, a steam pipe for supplying steam to the steam coils, a valve for controlling the supply of steam to the coils, means responsive to a failure in the electrical power supplied to the air circulating means for operating the valve to cut off the supply of steam, and means associated with said last named means for introducing steam from the heating coils to the heating chamber when the steam supply is cut off.

CARL C. WILCOX.