Dec. 10, 1929. H. W. COWAN 1,738,641

METHOD AND APPARATUS FOR REMOVING VAPORS

Filed April 4, 1927 2 Sheets-Sheet 1

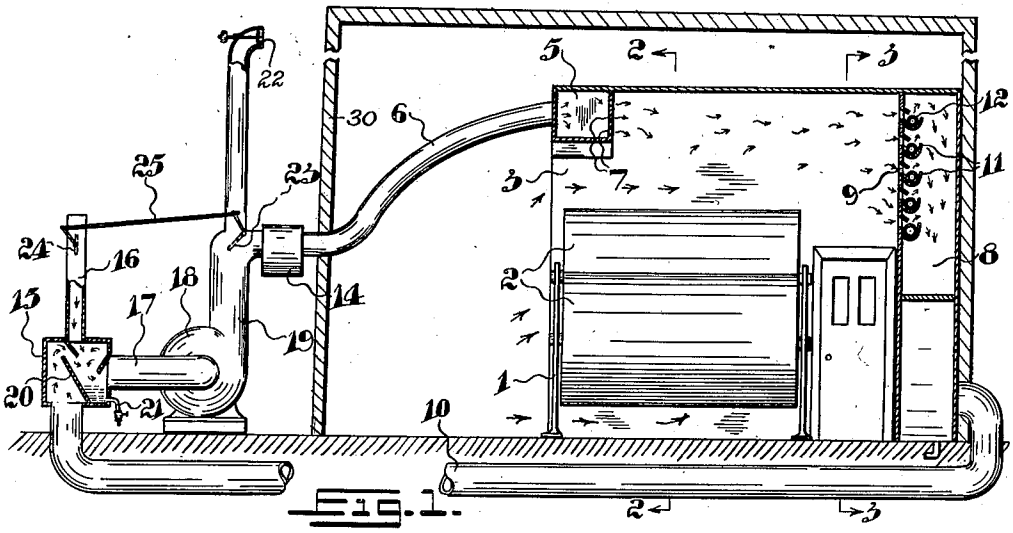

Fig. 1.

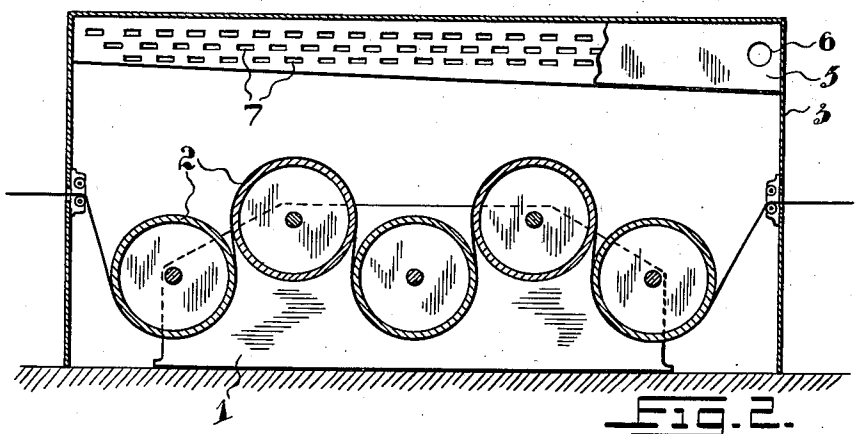

Fig. 2.

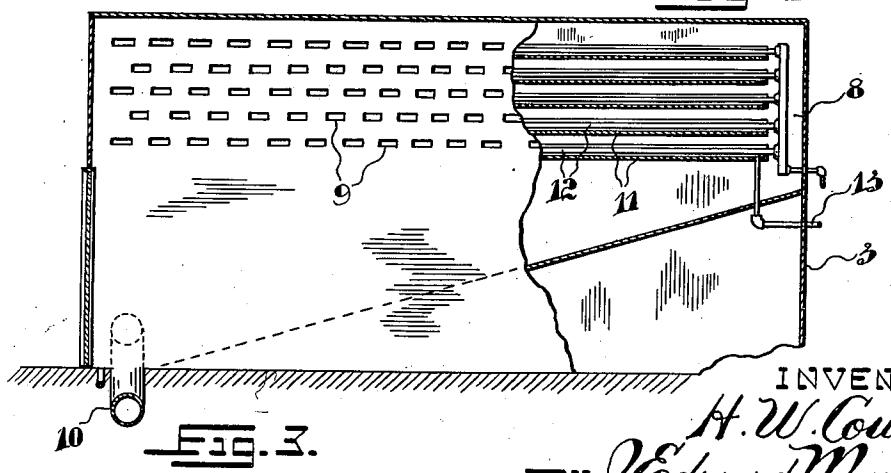

Fig. 3.

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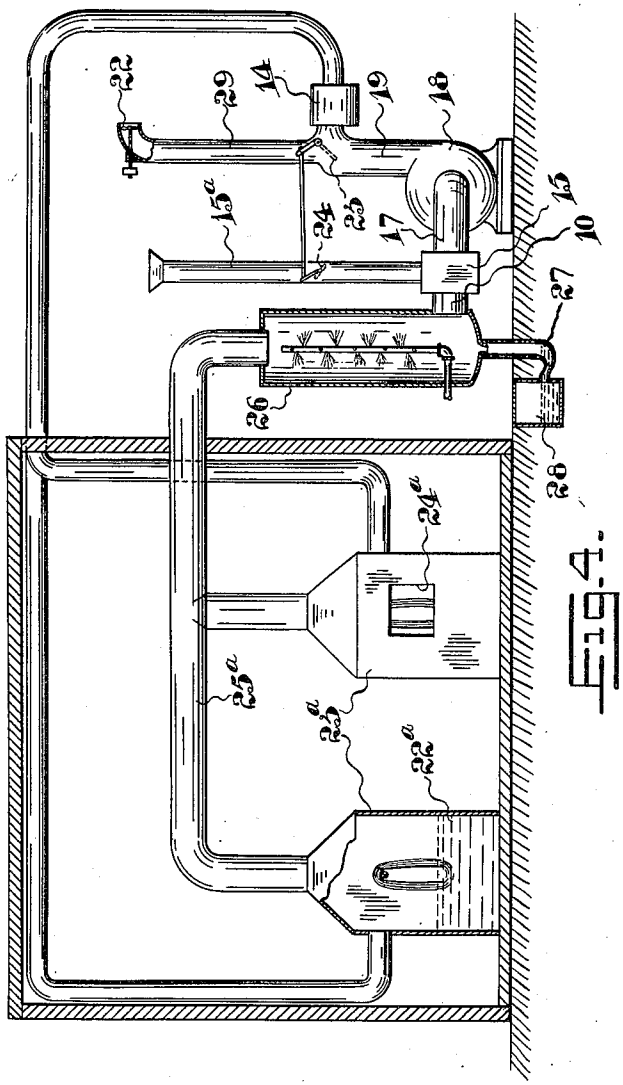

Fig. 4.

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1,738,641

UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR REMOVING VAPORS

Application filed April 4, 1927, Serial No. 180,903, and in Canada October 29, 1926.

This invention relates to vapor removing means adapted particularly for use with drying apparatus such as used in connection with the manufacture of paper. According to present methods the paper after leaving the making screen is led between drying rolls. These drying rolls are hollow and are heated internally by steam. In some cases, also, the paper may be led over suitable rolls in close proximity to heated coils.

The heat from the drying rolls or coils converts the moisture in the paper into the form of vapor, and various arrangements have been tried to get rid of this vapor. None of these arrangements have been entirely satisfactory and consequently the room in which the apparatus is located is constantly filled with vapor which is liable to condense and be redeposited and while the room is maintained at a high temperature, which is extremely uncomfortable for the workmen as well as dangerous to their health, this temperature is not sufficient to maintain the moisture in the vaporized form until the vapor escapes from the room.

My object therefore is to devise means for getting rid of this vapor without allowing it to pass into the room in which the drying apparatus is located and at the same time to enable me to use air for maintaining the moisture in the vaporized form of a much higher temperature than formerly while maintaining the temperature of the room as a whole at a comfortable degree and to utilize said hot air in such a manner that no cross currents will be created tending to hinder the travel of the moisture laden air from the drying rolls. A further object is to provide means for removing the moisture from the air whereby the air may be again circulated, thus avoiding the necessity of always using the cold outside air, which naturally is more expensive to heat up than the previously heated air which may not have been fully saturated during the previous circulation and which is only partially cooled during the process of removing the moisture therefrom.

While the invention is particularly adaptable for use in the drying of paper, it is also of value in removing vapor in connection with other apparatus, such, for example, as vapor rising from dye kettles in dye houses and this and similar uses all fall within the scope of my invention.

I attain my object by means of the apparatus hereinafter described and illustrated in the accompanying drawings in which

Fig. 1 is a more or less diagrammatic view, partly in section, illustrating the apparatus for carrying out my invention;

Fig. 2 a longitudinal section of the casing for the drying rolls on the line 2—2 in Fig. 1;

Fig. 3 a similar view on the line 3—3 in Fig. 1; and

Fig. 4 is a view similar to Fig. 1 showing my invention as used in connectoin with the removal of vapor rising from dye kettles.

In the drawings like numerals of reference indicate corresponding parts in the different figures.

Referring particularly to Figs. 1 to 3, 1 indicates a suitable supporting frame in which are journalled the rolls 2 of the machine over which the paper is led during the drying operation. In actual practice these rolls may be steam heated as is common in the art or heating coils may be positioned in close proximity thereto. The frame with its rolls is enclosed in a housing 3 located in a room, the latter being indicated by the wall 30. This housing is open at one side and is provided with a slot in each end for the passage of the paper to and from the drying rolls. At the top of the housing at its open side is formed a hot air supply duct 5. To one end of this duct is connected one end of a hot air supply pipe 6, the other end of which is connected with an air heater 14. The duct is provided with a plurality of outlets 7 in its side throughout its length and for the purpose of equalizing the discharge through each outlet, the duct is preferably tapered from end to end, the end of the supply pipe 6 being connected with the end of the duct having the greatest capacity.

At the opposite or closed side of the housing 3 adjacent the top thereof is provided a collecting duct 8 having inlet openings 9

in its side, which openings are preferably arranged in rows. The total effective area of the inlet openings 9 is, for a purpose which will hereinafter appear, greater than the total effective area of the outlets 7 of the hot air supply duct.

To the exhaust duct is connected one end of a suction pipe 10.

The collecting duct 8 has within it a series of longitudinal gutters 11, one below each row of inlet openings 9, and along these gutters are laid cold water pipes 12 perforated in a suitable manner to direct sprays of cold water, the water being collected in the gutters and led off through a discharge pipe 13 for re-use.

The suction pipe 10 preferably leads to a mixing chamber 15 to which mixing chamber is also connected a pipe 16 through which fresh cool air may enter. From the mixing chamber leads a pipe 17 which leads to a suction fan 18, which fan discharges a pipe 19, which leads to a branched pipe 14, one branch leading both to the heater and the other branch to the atmosphere.

The mixing chamber 15 is preferably provided with baffles 20 to cause the air to take a circuitous course therein and from the mixing chamber leads a waste pipe 21.

If desired I may employ a fan 22 in the branch of the pipe 19 leading to the atmosphere for the purpose of assisting the exhausting of air through said pipe.

In the pipe 19 I preferably provide a damper 23 while in the cold air inlet pipe 16 is also provided a damper 24. These dampers 23 and 24 are preferably connected by means of a link 25 so that they will be actuated simultaneously and thus the incoming of air through the pipe 16 will be proportional to the exhaust of air through the branch of the pipe 19 which leads to the outside air.

The method of operation is as follows: Heated air from the heater 14 is led through the pipe 6 to the duct 5 from which it is discharged through the openings 7 into the upper part of the housing 3. The hot air naturally tends to remain near the top of the housing and as the inlets 9 of the collecting duct 8 are also near the top of the housing, the natural flow of the hot air is directly across the upper part of the housing from the duct 5 to the collecting duct 8. To reduce the danger of hot air escaping into the room 30 I prefer to arrange the hot air duct and its discharge so that the air is directed across the housing towards the discharge opening. One of the most important features of my invention is, however, my arrangement whereby more air is withdrawn through the duct 8 than is discharged through the duct 5. This extra air must come therefore through the open side of the housing and it carries upward with it the vapor formed by the passing of the wet paper over the heated rolls and is mixed in the upper part of the housing with the hot air from the duct 5. The mixed air and vapor is drawn into the collecting duct where it is immediately cooled by means of the water spray from the pipes 12, thus causing the vapor in the air to condense. The air having lost a large percentage of its moisture passes through the pipe 10 to the mixing chamber 15, where most of the remaining moisture is condensed by contact with fresh cold air entering through the cold air pipe 16. The condensed moisture gathers in the bottom of the mixing chamber, and is led off through the waste pipe 21.

From this it follows that the air upon being returned to the heater has lost much of the moisture taken up in passing through the housing 3 and is therefore more easily reheated before it again passes to the housing. Further, the air even after going through the cooling operations will not be as cold as the outside air, at least in all but the hottest summer weather, and consequently the expense of heating the air will not be as great as if all fresh air was always used to carry off the vapor created in the drying operation.

According to weather conditions the amount of air admitted through the cold air pipe 16 or allowed to escape through the exhaust branch of the pipe 19 may be varied as desired.

As stated above, more air is carried off through the collecting duct than is discharged through the hot air supply duct and consequently there is always a sufficient current of air into the housing through the open side to prevent the hot air passing out into the room and further this inward flow of air through the open side ensures that the vapor formed in drying the paper is directed into the course of the hot air to be carried off thereby to the collecting duct.

It will thus be seen that very litle vapor may enter the room in which the apparatus is located and also that practically no hot air will escape into said room. From this it follows that I may heat the air used for maintaining the moisture in the vapour form to a much greater extent than formerly without creating an unduly high temperature in the room, thus ensuring a more efficient operation without endangering the health of the workman.

It will also be apparent that the hot air is discharged into and removed from the housing in such a manner that the carrying off of the moisture laden air is accomplished without the creation of any interfering cross currents or eddies.

In Fig. 4 I illustrate a lay-out for use in connection with dyeing apparatus. 22^a indicates a dye kettle into which the material being dyed is dipped. The kettle is enclosed in a housing 23^a having a large opening 24^a for the entrance of air from the room. To

the top of the housing is connected a conduit 25ª which leads to a condenser 26, which contains a water spraying device for condensing the vapors. At the bottom of the condenser is placed an outlet 27 for the water and condensate, which outlet is led to a tank 28. To the side of the condenser is connected the suction pipe 10 which leads to the mixing chamber 15, which is connected by a pipe 17 with the pump 18, the pump being in turn connected by a pipe 19 with a heater 14. An air supply pipe 15 is also connected with the mixer 15 for the admission of fresh air. The pipe 19 is also provided with a branch 29 through which at least a portion of the air from the pump is passed to the atmosphere. This branch is preferably also provided with a fan 22 to ensure the discharge of a portion of the air to the atmosphere.

In order that the inflow of fresh air through the pipe 16 and the discharge of air through the branch pipe 29 may be suitably regulated, the former is provided with a damper 24 and the latter with a damper 23.

In the arrangement shown in Fig. 1 as well as the arrangement shown in Fig. 2, the discharging of a portion of the air from the fan 19 to the atmosphere through the branch 29, is very important, as in this way the desired result of forcing less air into the housing than is withdrawn therefrom is obtained. The amount of air discharged through the pipe 29 must, of course, be greater than the amount of fresh air admitted through the pipe 16. In Fig. 4 I show the pipe 10 leading back to the housing 23ª, but in the case of a dyeing plant, for example, where highly heated air is not essential, the dotted portion of the pipe 10 my be omitted so that the pipe discharges into the room so that all air entering the house enters through the opening 24ª.

In every case, it is very important to ensure a proper disposal of the vapors to return less air to the housing or room than is drawn off by means of the pump, and, as will be seen from the foregoing description, this is accomplished by discharging a portion of the air drawn off by the pump to the atmosphere, the remainder only being re-heated and returns to the room or housing.

From the above description it will be seen that I have devised a process and apparatus for removing vapors which will satisfactorily attain the object of my invention as set out in the preamble of the specification.

What I claim is:

1. The process of preventing vapors arising from heated liquid or moisture containing material located in a partially open housing from escaping into a room in which said housing is located, which consists in constantly supplying hot air to said housing for moisture-absorbing purposes, and continuously withdrawing air and vapor from the housing at a rate greater than the combined inflow of hot air and formation of vapor whereby a constant inflow of air is maintained through the open portion of the housing.

2. The process of preventing vapors arising from heated liquid or moisture containing material located in a partially open housing from escaping into a room in which said housing is located, which consists in constantly supplying hot air to said housing for moisture-absorbing purposes, constantly withdrawing air and vapor from the housing at a rate greater than the combined inflow of hot air and formation of vapor whereby a constant inflow of air is maintained through the open portion of the housing, discharging a portion of the withdrawn air to the atmosphere, and reheating the remainder of the withdrawn air and returning it to the housing as at least part of the heated air aforesaid.

3. The process of removing vapors arising from heated material containing moisture, which consists in arranging said material in a housing located in a room in which the operators work, said housing having an opening through which atmospheric air may enter, constantly supplying hot air to said housing at an elevation entirely above the material, and constantly withdrawing air from the upper portion of said housing at a point remote from the point of introduction of the hot air and at a rate sufficient to reduce the pressure in the housing, and thus maintain a constant flow of air through said opening to the interior of the housing, whereby the escape of vapors from the housing through said opening is prevented.

4. The process of removing vapor arising from heated material containing moisture, which consists in arranging said material in a housing located in a room in which the operators work, said housing having an opening through which atmospheric air may enter, constantly introducing hot air into said housing at an elevation entirely above the material, constantly withdrawing air from the upper portion of said housing at a point remote from the point of introduction of the hot air and at a rate sufficient to reduce the pressure in the housing, and thus maintain a constant flow of air through said opening into the housing, allowing a portion of said withdrawn air to escape to the atmosphere, and reheating the remainder of the withdrawn air and returning it to the housing.

5. The process of removing vapor arising from heated material containing moisture, which consists in enclosing said material in a housing located in a room in which the operators work, said housing having an opening in one of its side walls through which atmospheric air may enter the housing, constantly forcing hot air to said housing at an elevation entirely above the material, and

constantly withdrawing air from the upper part of said housing at a point remote from the point of introduction of the hot air, and at a rate sufficient to reduce the pressure in the housing and thus maintain a constant flow of air through said opening to the interior of the housing, whereby the escape of vapors through said opening is prevented.

6. The process of removing vapor arising from heated material containing moisture, which consists in enclosing said material in a housing located in a room in which the operators work, said housing having an opening through which atmospheric air may enter, constantly introducing hot air into said housing at an elevation entirely above said material, constantly withdrawing air from the upper part of said housing at a rate sufficient to reduce the pressure therein, and thus to maintain a constant flow of air through said opening into the housing, allowing a portion of said withdrawn air to escape to the atmosphere, and reheating the remainder of the withdrawn air and returning it to the housing.

7. The process of removing vapor arising from heated material containing moisture which consists in enclosing said material in a housing located in a room in which the operators work, said housing having an opening through which air from the exterior of the housing may enter the latter, constantly supplying hot air to said housing at an elevation entirely above said material, constantly withdrawing air from the upper portion of said housing at a point remote from the point of introduction of the hot air and at a rate sufficient to reduce the pressure in the housing, and thus maintaining a constant flow of air through said opening into the housing, constantly allowing a portion of said withdrawn air to escape to the atmosphere, and reheating the remainder and returning it to the housing.

8. In apparatus for removing vapor arising from heated material containing moisture, the combination of a housing, means therein for heating said material, said housing having an opening in its lower portion substantially equal in length to said heating means, means for constantly supplying hot air to said housing at an elevation entirely above the heating means, and means for constantly withdrawing air from the upper portion of said housing at a rate sufficient to reduce the pressure therein, and thus maintain a flow of air through said opening to the interior of the housing, whereby the escape of vapors from the housing through said opening is prevented.

9. In apparatus for removing vapor arising from heated material containing moisture, the combination of a housing, means in the housing for heating said material, said housing having an opening its lower portion through which air may enter the housing, means for introducing hot air into the housing at an elevation entirely above the heating means, an exhaust outlet for the housing located at a point remote from the means for introducing heated air into the housing, a conduit leading from the exhaust outlet to the means for introducing hot air into the housing, means for condensing the moisture out of the air withdrawn from the housing, means for constantly discharging a portion of the withdrawn air to the atmosphere, means for introducing air from the atmosphere into said conduit, and means for heating the air passing through said conduit to the housing.

Signed at Toronto, Canada, this 19th day of March, 1927.

HENRY W. COWAN.