W. M. GROSVENOR.

DRYING SYSTEM.

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1,014,462.

Patented Jan. 9, 1912.

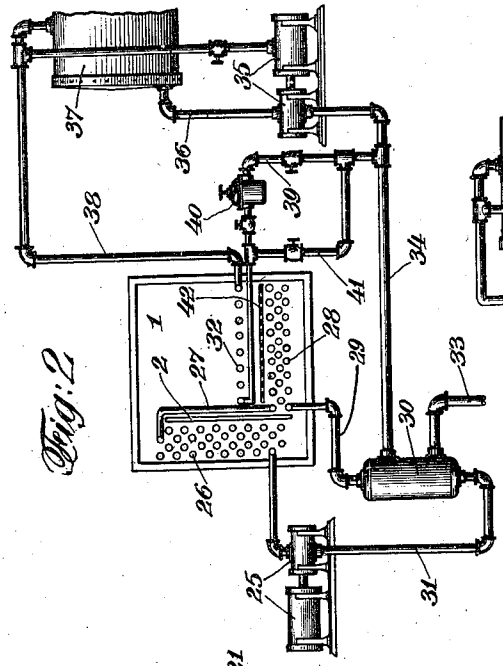

Fig. 2

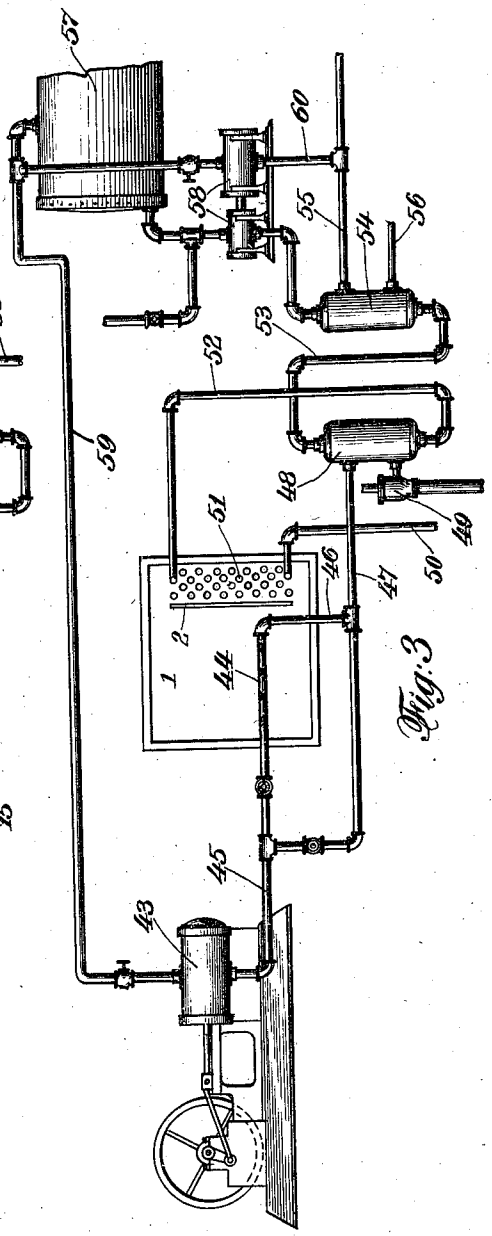

Fig. 3

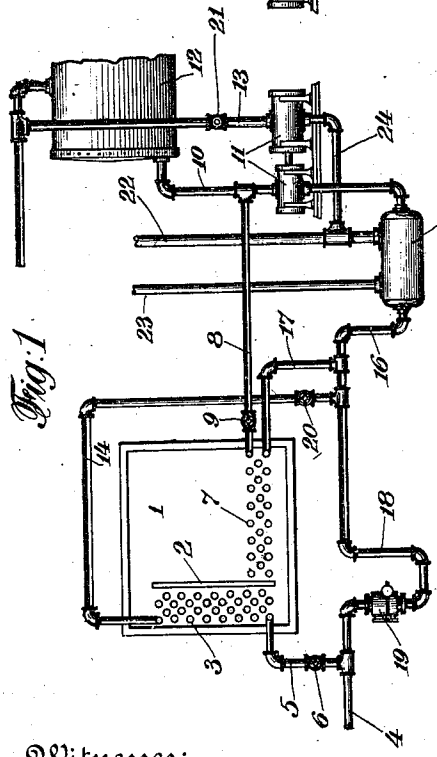

Fig. 1

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DRYING SYSTEM.

1,014,462. Specification of Letters Patent. Patented Jan. 9, 1912.

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To all whom it may concern:

Be it known that I, WILLIAM M. GROSVENOR, a citizen of the United States, and a resident of Grantwood, Bergen county, and State of New Jersey, have invented certain new and useful Improvements in Drying Systems, of which the following is a specification.

My invention relates to improvements in drying systems and apparatus and more especially to such systems in which a substantially closed chamber is provided in which the drying medium circulates in a substantially closed circuit being heated therein to raise the temperature of the drying medium to the proper point and then cooled to condense the moisture absorbed from the material being dried. In such systems an economical arrangement is to provide steam heating coils for heating the drying medium at one part of the circuit and water cooling coils for cooling and dehydrating the drying medium at another part of the system.

One object of my invention is to provide an arrangement whereby the heat absorbed by the cooling fluid may be utilized to supply all or part of the heat used in the heating coils and thereby decrease the loss of energy which would otherwise take place.

I have found that by providing suitable novel and advantageous arrangements of apparatus that it is possible to carry out the drying operations with very great efficiency by operating the drying medium in a substantially closed circuit so that substantially none of the energy imparted thereto is lost and by retaining the heat absorbed by the cooling means and properly augmenting it or conserving it in such a manner that it may be utilized in other parts of the system.

Further objects, features and advantages will more clearly appear from the detailed description given below taken in connection with the accompanying drawing which forms a part of this specification.

In the drawing, Figure 1 represents somewhat diagrammatically an arrangement designed to carry out the drying operations at comparatively low temperatures. Fig. 2 is a similar view showing a modified arrangement in which the drying is designed to be carried out at relatively high temperatures. Fig. 3 is still another similar view showing a modified arrangement of apparatus in which the drying operations are designed to be carried out in a system in which condensing engines are used and in which the exhaust from the engines is of a sufficiently high temperature to be directly utilized in the heating means of the drying apparatus.

Referring to Fig. 1, 1 represents a substantially closed chamber provided with a partition 2 which so divides the chamber as to form a substantially closed circuit for the drying medium therein. The material to be dried is placed in the chamber in any usual and well known manner. At one side of the partition 2 I provide cooling or refrigerating coils 3 which are supplied with cold water from a pipe 4 through a pipe 5 and valve 6. The heating coils 7 are arranged at the lower part of the chamber 1 and are supplied with hot water through the pipe 8 and valve 9 from the pipe 10. Hot water is forced therethrough by means of a pump 11 operated by steam from the boiler 12 through the pipe 13. The exhaust or outlet of the cooling coils 3 is connected to a pipe 14 which leads through the feed water heater or heat transferrer 15 by means of a pipe 16. The exhaust or outlet from the hot water heating coils 7 also connects with the pipe 16 by means of a pipe 17 so that the cold water which has been somewhat heated in the refrigerating coils 3 and the hot water which has been somewhat cooled in the heating coils 7 are both conducted to the feed water heater 15. If the supply of feed water from these two sources is not sufficient cold water may be by-passed around the drying apparatus through a pipe 18 and back pressure valve 19. The pump 11 besides operating to force the hot water through pipe 8 to the heating coils 7 also operates to force the feed water to the boiler 12. Valve 20 is provided in the pipe 14 and a valve 21 in the pipe 13 to properly regulate the flow of fluid through these pipes. The water passing through the feed water heater 15 is further increased in temperature by exhaust steam which passes thereto from other steam apparatus of the plant through pipe 22. The outlet for this exhaust steam from the feed water heater 15 is through a pipe 23 which may lead to any well known apparatus for the utilization thereof. The exhaust steam from the pump 11 is fed to the general exhaust main 22 by means of a pipe 24. With the drying being carried on at 120° F. and the incoming water being at

70° F. the condenser 3 will heat the water passing therethrough above 85° F. and under some conditions as high as 100° F. At this temperature it passes through pipe 14, and the feed water heater 15 under the suction of the pump 11. The pump 11 also serves to draw the warm water from the heating coils 7 through the pipes 17 and 16 and feed water heater 15 where it is mixed with the condensing water from coils 3. The feed water heater 15 heats the water passing therethrough to a sufficiently high temperature so that it is in proper condition to be directly used in the heating coils 7. It will thus be seen that substantially all of the heat absorbed by the condenser 3 in cooling and dehydrating the drying medium is utilized to form part of the heat used in the heating means 7.

Referring to Fig. 2, the cooling water is circulated through a substantially closed circuit by means of a pump 25 through the condensing coils 26, pipe 27, preheating coils 28, pipe 29, heat transferring means 30, pipe 31 back to the pump 25. In passing through the condensing coils 26 the water becomes sufficiently heated to be used in the coils 28 so that the drying medium in passing therethrough is somewhat heated before it comes in contact with the final heating coils 32. Cold water enters through the pipe 33 and passes through the heat transferrer or feed water heater 30 thereby cooling the condensing water sufficiently, so that it is in a proper condition to again be used for condensing. From the heat transferrer 30 the cold water which enters the pipe 33 and has been slightly warmed passes through pipe 34 and is forced into the boiler by means of pump 35 through the pipe 36. The arrangement shown in this figure being designed to operate where drying at comparatively high temperature is desired the heating coils 32 are directly supplied with steam from the boiler 37 through the pipe 38. The outlet or exhaust of the heating coils 32 also leads to the pump 35 through a pipe 39 and trap 40. The trap 40 is for the purpose of removing any condensate which may be collected therein. A by-pass pipe 41 is provided for use when it is desired to clean or renew the trap 40. It will, therefore, be apparent that the heat absorbed in the condenser 26 is partially used again and given up in the preheating coils 28. The remainder of the heat absorbed in the condenser 26 is substantially given up to the feed water in the feed water heater 30, so that this heat is conveyed by the feed water to the boiler through pipes 34 and 36. The heat energy remaining in the exhaust steam from the final heating coils 32 is also utilized in increasing the heat in the feed water, so that substantially all of the heat energy used in heating is preserved. An insulated and perforated diaphragm 42 is provided between the heating coils 28 and 32 in order to prevent direct radiation between said coils.

Referring to Fig. 3 I show various of my improvements arranged in connection with the condensing engine 43. This system is designed to carry out the drying operations at relatively low or medium temperatures. The exhaust from the engine 43 is led directly to the heating coils 44 by means of pipe 45. The exhaust steam having some of its heat taken from it here is then passed through pipes 46 and 47 to a feed water heating device 48. After imparting a large portion of its heat to the feed water passing through the device 48 the heat in the exhaust steam is passed to a jet condenser 49. The incoming feed water enters through a pipe 50 and passes directly to the condensing coils 51. The water after becoming somewhat heated there is passed out through pipe 52 to the heat transferrer or feed water heating device 48. From here it is passed through a pipe 53 to a second feed water heating device 54, which is heated by means of an exhaust from other steam apparatus of the plant, which exhaust steam passes in through a pipe 55 and out through a pipe 56. From the feed water heater 54 the feed water is forced into a boiler 57 by means of pump 58. The steam used for driving the engine 43 is fed thereto from the boiler 57 by means of a pipe 59. The exhaust from the pump 58 is carried to the general exhaust main 55 by means of a pipe 60.

From the above it will be seen that the heat energy absorbed by the incoming water in the condensing coils 51 is utilized in the fed water and goes into the boiler 57, whence it is carried to the engine 43 and finally to the heating coils 44. The heat energy remaining after the fluid has passed through the heating coils 44 is utilized in the feed water heater 48 and jet condenser 49. It will be further apparent that in each of the systems shown that the heat energy absorbed by the condenser or refrigerating means is conveyed to another part of the system in which it is utilized to furnish at least part of the energy for the heating means of the dryer or for preheating or other treatment of the material to be dried. Thus by providing a substantially closed circuit for the drying medium and incorporating therewith proper connections whereby the heating and condensing fluid may be properly operated together, I have provided a system in which extremely great efficiency is the result. In fact, the efficiency may be so great that substantially no energy is lost as far as the drying operations are concerned.

Although I have described my improvements in great detail and have shown several modifications, nevertheless I do not desire to be limited to such details, but

Having fully and clearly described my invention what I claim as new and desire to secure by Letters Patent, is:

1. In a drying system, the combination of a suitable chamber in which the material to be dried may be placed, means for heating the drying medium before it comes in contact with the material, means for cooling the drying medium after it comes in contact with the material and means for utilizing heat absorbed in the cooling by transferring it to the heating means.

2. In a drying system, means for producing different temperatures in the drying medium at different points in the system, and means for transferring heat from one portion of the system to another independently of the drying medium.

3. In a drying system, means for heating the drying medium at one part of the system, means for cooling the drying medium at another part of the system, and means for conveying heat absorbed by the cooling means to the heating means to be used in said heating means.

4. In a drying system, means for heating the drying medium, means for supplying a fluid to said heating means, means for cooling the drying medium, means for supplying water to the cooling means, a heat transferrer and means for conveying the water from the cooling means to the heat transferrer.

5. In a drying system, the combination of heating apparatus for the drying medium cooling apparatus for condensing the moisture absorbed by the drying medium, and means for augmenting the heat absorbed by the cooling apparatus so that it is available for reuse.

6. In a drying system, a steam plant, a drying apparatus including a cooling means for the drying medium, and means for transferring heat energy absorbed by the cooling means to the steam plant.

7. In a drying system, the combination of drying apparatus arranged to form a closed circuit for the drying medium, a condenser at one part of said circuit for cooling the drying medium said condenser being provided with a condensing fluid and means for transferring heat absorbed separate from the drying medium by the condensing fluid to be utilized in another part of the system.

8. In a drying system, the combination of drying apparatus arranged to form a closed circuit for a drying medium which absorbs moisture from the material to be dried, a condenser at one part of the circuit for condensing the moisture from the drying medium and absorbing heat therefrom, and means for utilizing the heat absorbed for reheating the drying medium.

9. In a system including drying apparatus, means for heating the drying medium at one part of the system, liquid means for cooling the drying medium at another part of the system and means for conveying heat energy absorbed by the cooling means to another part of the system.

10. In a drying system, drying apparatus arranged to form a closed circuit for a drying medium, a fluid heating means therefor, a fluid cooling means for dehydrating the drying medium, and means for causing the exhaust fluid from the heating means to supply heat to the fluid heating means.

11. In a drying system, drying apparatus arranged to form a substantially closed circuit for the drying medium, fluid heating coils in the circuit for heating the drying medium, water cooling coils in the circuit for cooling and dehydrating the drying medium, a water heater, means for conducting the exhaust from the heating coils to the water heater to impart heat to water therein and means for raising the temperature of the water thus heated and utilizing it to furnish fluid for the heating coils.

12. In a drying system, means for exposing the material to a drying medium, means for heating the drying medium before bringing it in contact with material, means for exposing a cold fluid to the action of the heated medium and means for again using the heated fluid from said exposing means in connection with treatment of material to be dried.

13. In a drying system, the combination of heating means for the drying medium, means for cooling the drying medium to condense moisture absorbed thereby and means for utilizing the heat absorbed in the cooling by transferring it to the heating means.

14. In a drying system, a steam plant, a drying apparatus including a cooling means for condensing moisture absorbed by the drying medium, and means for transferring that energy absorbed by the cooling means to the steam plant.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

WILLIAM M. GROSVENOR.

Witnesses:
GORHAM CROSBY,
EDWIN SEGER.