

March 5, 1929.

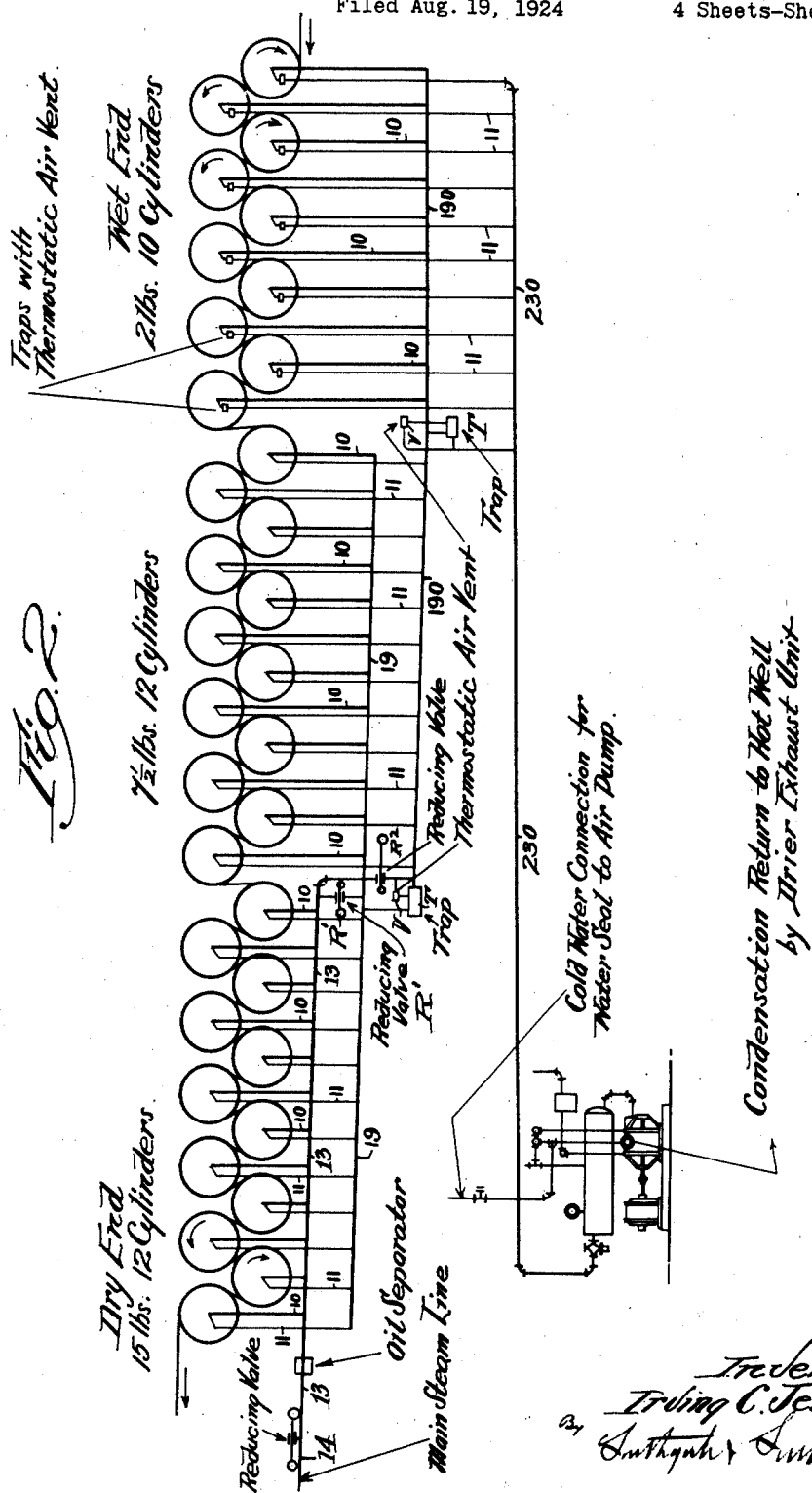
I. C. JENNINGS

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STEAM HEATING SYSTEM FOR PAPER MILLS

Filed Aug. 19, 1924

4 Sheets-Sheet 2



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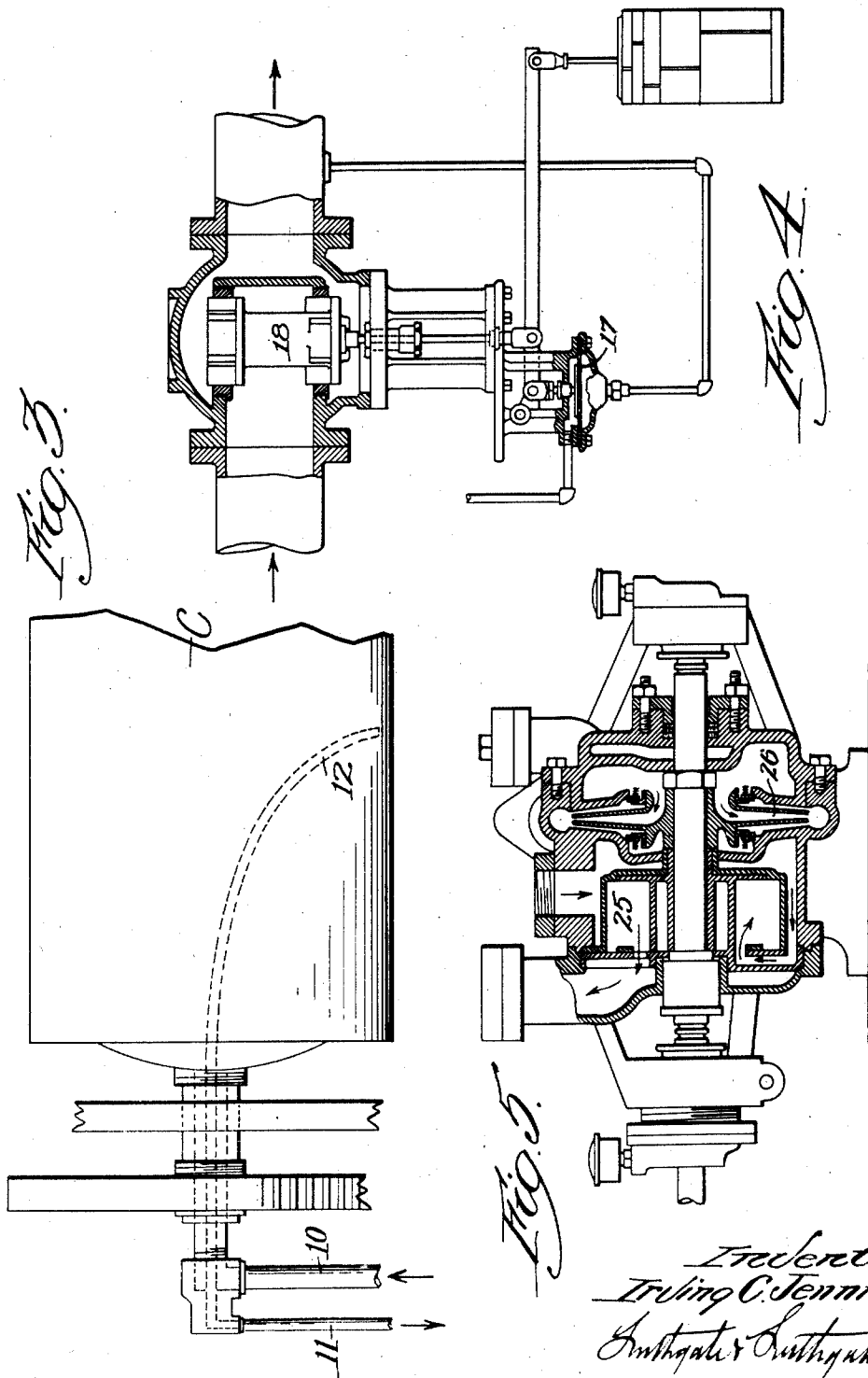
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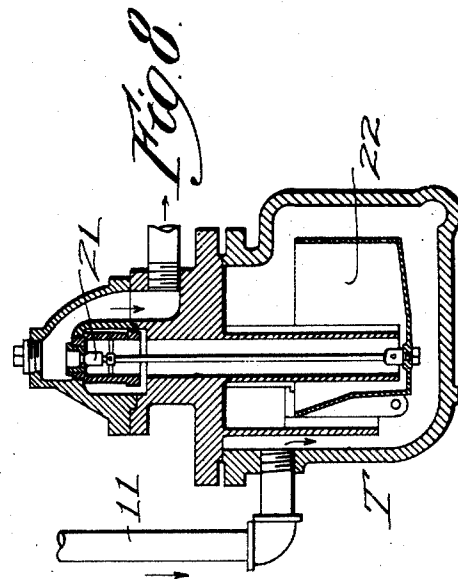
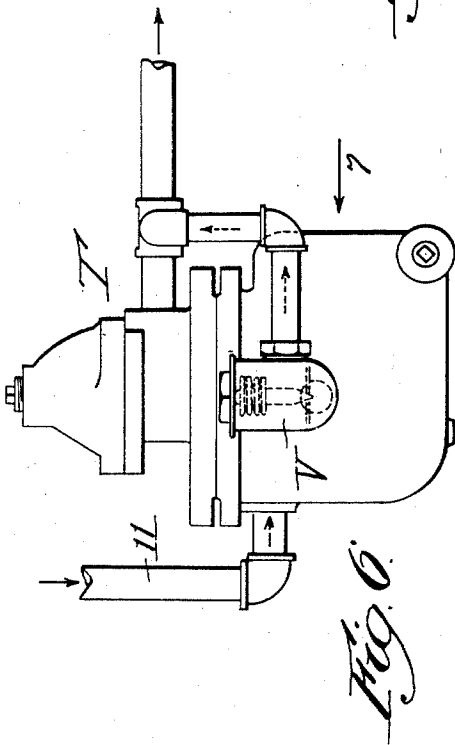
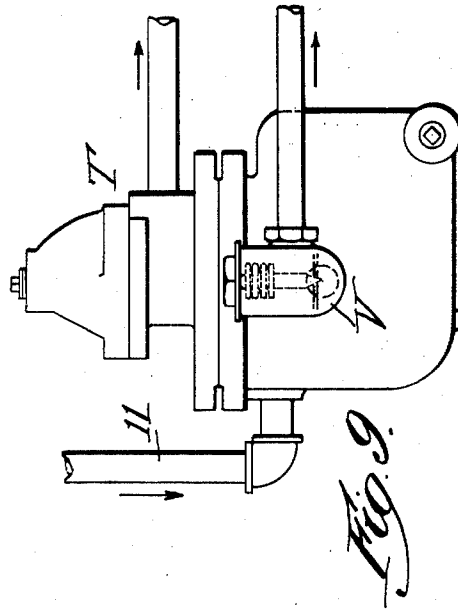
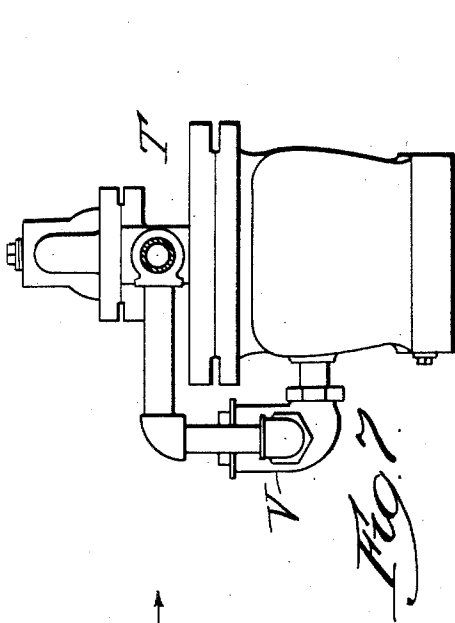
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UNITED STATES PATENT OFFICE.

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STEAM-HEATING SYSTEM FOR PAPER MILLS.

Application filed August 19, 1924. Serial No. 733,004.

The object of this invention is to provide a new and improved steam heating system for driers for paper mills or other machines designed to obtain a rapid circulation of steam therethrough and the removal of all air and condensate therefrom. The drier, which is attached to or used in conjunction with a paper mill or paper making machine, consists of a number of cylinders, around which the wet freshly formed paper is drawn, steam being admitted to the inside of these cylinders, whereby they are heated so that the paper will be dried and finished in its passage around the cylinders. As a large number of cylinders is usually employed, it has been a difficult matter to get steam to circulate properly through and to get the air and water out of these cylinders. Various systems have been used, but none of them, so far as I am advised, has been entirely satisfactory.

One method in common use has been to employ an individual trap on the exit pipe of each cylinder. This has been found to be efficient only where a low steam pressure is used and it is open to the serious objection that a great number of traps have to be installed which require more or less attention and which add a great deal to the expense.

Efforts have been made to overcome this difficulty by using one trap in connection with several cylinders. This has not proved satisfactory because steam may be blown through one or two of the cylinders first and the same may back up in the return and prevent the other cylinders from discharging their condensate.

Another trouble with most systems installed has been due to the fact that they are laid out for one steam pressure and if this pressure varies the cylinders may become water bound.

The object of this invention is to overcome these difficulties, to provide for a more economical use of steam, and to produce better paper.

Briefly stated, my improved system is arranged as follows:—The cylinders are divided into groups, and steam is supplied at whatever pressure may be desired to one group of cylinders. The exhaust from these cylinders passes into an exhaust line which is used as the supply line for the next group of cylinders. The groups and piping are so

proportioned that not enough steam will pass into the exhaust line to supply the second group of cylinders. An automatic pressure reducing valve is arranged between the steam supply line and the exhaust line of the first group of cylinders which supplies the second group. This reducing valve is set to maintain a proper differential pressure, whereby the setting of this reducing valve will determine the pressure and temperature of the steam supplied to the second group of cylinders. Thus a definite differential pressure will always be maintained between the first group and the second group of cylinders, which assures that the condensate will always be removed properly from the first group. A steam trap is applied on the exhaust line from the first group of cylinders to remove any condensate which has accumulated and a thermostatically controlled air valve is provided to allow any air which may accumulate in this part of the system to blow out. The condensate may be withdrawn by a suitable exhausting pumping apparatus or unit. My improved system may be applied to different groupings of cylinders as hereinafter described.

This system does away with about two-thirds of the traps, and assures a better circulation and a better control of the steam. It has been found in drying paper that it is advantageous to have the temperature at the "wet end" less than the temperature in the intermediate cylinders. It has also been found advisable to reduce the temperature on the "dry end".

The system which I have invented makes possible a graduation of temperature at either end of the machine or at the center, as desired.

My improved system is illustrated in the accompanying four sheets of drawings, in which

Fig. 1 is a diagrammatic view of a drier with my system applied thereto illustrating one grouping of the cylinders which may be employed;

Fig. 2 is a similar view showing another grouping of the cylinders with my invention applied thereto;

Fig. 3 is a detail of one of the drier cylinders showing the way the steam is led into and exhausted therefrom;

Fig. 4 is an elevation partly in section

illustrating one of the automatic pressure reducing valves which may be used;

Fig. 5 is a detail view of the exhausting unit which may be employed to remove the condensate;

Fig. 6 is an elevation of one of the float steam traps with connected thermostatic air vent which may be used;

Fig. 7 is a similar elevation at right angles thereto;

Fig. 8 is a sectional elevation relatively to Fig. 6; and

Fig. 9 is a view similar to Fig. 6 showing a different method of piping employed at higher pressures.

Referring first to Fig. 1 and in detail, it will be seen that I have shown in this figure a paper drier consisting of a number of rotating hollow cylinders C. Steam is admitted through one of the bearings or shafts of each cylinder by a pipe 10 and is exhausted therefrom through a pipe 11 extending through the bearing and having a depending pipe or siphon leg 12, as illustrated in Fig. 3.

In the system now under discussion, the drier cylinders are divided into three groups, an intermediate group and a group at the wet end and a group at the dry end of the apparatus. In the drawing, a drier having thirty-four cylinders is illustrated and these cylinders are grouped so that there will be twenty-four in the intermediate group, five in the group at the wet end, and five in the group at the dry end of the apparatus. The number of cylinders employed and the number of cylinders in each group will be determined by the size of the apparatus and the kind of paper to be handled and the character of drying desired. The numbers stated will serve for illustration.

The supply pipes 10 of the intermediate group of cylinders are connected to a horizontally extending steam supply pipe line 13. Steam is supplied to this line by a pipe 14.

The pipe 14 may be supplied with live steam from pipe 15 or with exhaust steam through pipe 16 or both. If exhaust steam is used an oil separator and trap is preferably used if the exhaust steam contains lubricant, and a back pressure relief valve vented to the atmosphere is added in the exhaust line.

A pressure reducing valve R is preferably employed in the pipe 15 so that steam at a governed pressure will be supplied to the line 13. The pressure reducing valve R employed may be of any ordinary or improved type.

These parts are arranged so that the intermediate group of drier cylinders will be supplied with steam at a governed pressure, say of five pounds. The exhaust pipes

11 from this intermediate group of cylinders are connected to a discharge line 19 extending substantially the length of the apparatus. The supply pipes 10^a of the five drier cylinders at the right hand or "wet" end of the apparatus are connected to the exhaust line 19. The exhaust pipes 11^a from these five cylinders are connected to a short discharge line 20. A float trap T with a thermostatic air vent V is preferably used in connection with each exhaust pipe 11^a. This trap may be of any ordinary or improved construction. One form thereof which may be used is illustrated in Figs. 6 to 9 which show a valve 21 controlled by an open float 22.

The thermostatic air vent consists of a valve which is operated by a thermostatic element which may consist of a spring coil filled with a volatile liquid which flashes into vapor, the expansion of which closes the valve when the temperature rises to a predetermined point. The valve thus allows air to escape but closes against steam.

It will be seen that I expose this thermostatic element of the air vent to the pressure in the system beyond the air valve or to the pressure on the discharge side of the trap so that it will not be subjected to steam under pressure of the supply. This will prevent the development of excessive pressure which might tend to distort or break the parts.

It will be seen that these thermostatic valves are all open when the apparatus is cold or out of operation, which permits the rapid escape of air from all parts of the system and allows the drier to heat up very promptly in starting. After the apparatus is warm no steam is allowed to escape.

Each of the five cylinders at the left hand or "dry" end of the apparatus is also connected to the pipe 19 through a supply pipe 10^b and the exhaust pipes 11^b from these cylinders are connected to a short discharge line 200. Float traps T with thermostatic air vents arranged as previously described are used in these exhaust pipes 11^b.

A steam pressure reducing valve R' is arranged between the steam supply 14 and the exhaust line 19. This pressure reducing valve may be one having a diaphragm 17 operating a weighted valve 18 as shown in Fig. 4. One side of the diaphragm is exposed to the pressure in the supply for this group of cylinders and the other side to the pressure in the exhaust from this group of cylinders whereby a substantially constant difference in pressure is maintained between said supply and exhaust.

This is necessary because as the parts are arranged the exhaust from the intermediate group of cylinders is not enough to supply the groups of cylinders at the wet and dry

ends of the machine and this reducing valve R' is employed to admit enough steam from steam supply pipe 14 into the line 19 to maintain a pressure therein, say of one
5 pound.

The discharge lines 20 and 200 are connected to a final discharge line 23. The exhaust line 19 is slightly graded downwardly from its center to its right and left ends and the final discharge line 23 is slightly graded downward from its ends to a pipe 24 which connects the system to an exhaust unit which preferably is the drier exhaust unit shown in my patent reissued June
15 26, 1923, No. 15,637, wet vacuum pumping apparatus. A single unit preferably only is employed. This unit has an air or gas exhaust pump 25 and a centrifugal liquid pump 26 as illustrated in Fig. 6. These
20 pumps are arranged to withdraw the condensate from the line 23 and to remove the air or gas therefrom and preferably to return the water to the hot well.

Float traps T' with thermostatic air vents which may be similar in construction to the trap T previously described are preferably arranged between the line 19 and the discharge pipes extending from the short lines 20 and 200. The function of the traps and
30 vents as arranged in all the locations described is to allow any liquid condensate to pass along and not block the supply of steam and to let any air which may accumulate in the system blow along.

By the system described it will be seen that the drier cylinders are always full of steam and free from air and condensate. It will be seen that a minimum of float traps is employed. It will be seen that there will be
40 a rapid elimination of air and condensate in starting the machine and that a minimum amount of steam will be used as there is no waste of steam or hot water. It will be seen that constant temperature conditions will be maintained in the drier cylinders which will be highest in the middle and graduated off to a lower temperature at the wet and dry ends of the apparatus regardless of the speed of the machine or the kind
50 of paper. This arrangement will allow the paper to be dried at a low temperature and will produce a superior quality of paper.

My improved system may be applied in many other ways to paper driers. For example, the grouping of the cylinders may be such that the pressure of steam may be reduced from the dry end to the wet end of the machine. Such an arrangement is shown in Fig. 2. In this system the cylinders are
60 divided into three groups, twelve at the dry end of the machine, twelve at the intermediate, and ten at the wet end of the machine. In this system the steam supply line 13 is connected to the supply pipes 10 of the left
65 hand group of cylinders and the exhaust

pipes 11 from these cylinders are connected to the exhaust line 19, to which the pipe 10 of the intermediate group of cylinders are connected. A steam pressure reducing valve R' is arranged between the lines 13 and 19,
70 as previously described. The exhaust pipes 11 from the intermediate group of cylinders connect to a second exhaust line 190, the supply pipes 10 of the right hand group of cylinders being connected to this line 190
75 and the exhaust pipes 11 therefrom being connected to a discharge line 230 connected to the exhaust unit. A steam pressure reducing valve R² is arranged between the main steam line 13 and the exhaust line 190. 80
Float traps T with atmospheric relief vents are arranged between the lines 19 and 190 and between the lines 190 and 230.

With this system traps need only be employed in the exhaust pipes of the right hand
85 group of drier cylinders near the wet end of the machine.

In this system the exhaust from the cylinders at the dry end of the machine is not sufficient to supply the line 19, the reducing
90 valve R' admitting steam thereto for this purpose, and the exhaust in the line 190 is not sufficient to supply the group of cylinders at the wet end of the machine, steam being admitted thereto to make up the supply
95 by the reducing valve R².

These reducing valves may be arranged so that for illustration fifteen pounds of steam pressure may be applied to the left
100 hand group of cylinders, seven and one half pounds to the intermediate group, and two pounds to the right hand group. Thus, the steam which comes off the exhaust from each group of driers is utilized in the next group of driers and on the last group the temperature is so low that the exhaust is practically
105 water.

Thus, whatever steam comes off from the exhaust from the first group of cylinders is employed in the second group of cylinders
110 and whatever steam comes off from the exhaust from the second group of cylinders is employed in the third group of cylinders and the exhaust from the third group of cylinders will be as at low pressure as possible,
115 as, even if it is under atmospheric pressure, it will be taken care of by the exhaust unit.

Thus, by the arrangements described steam is most economically employed, the
120 device is not apt to bind or water log and a fine grade of paper can be produced.

The steam pressures and their relative differences and also the grouping of the cylinders will be varied and designed for
125 different conditions, products or plants.

The arrangement herein shown and described may be greatly varied by a skilled mechanic without departing from the scope of my invention as expressed in the claims. 130

Having thus fully described my invention, what I claim and desire to secure by Letters Patent is:—

1. The combination with drier cylinders, of a steam heating system therefor comprising a line for supplying steam to a group of cylinders, a line for conducting the exhaust therefrom to another group of cylinders at subnormal pressure, and means for constantly supplying steam to this exhaust line to maintain a substantially fixed pressure or temperature therein.

2. The combination with drier cylinders, of a steam heating system therefor comprising a line for supplying steam to a group of cylinders, a line for conducting the exhaust therefrom to another group of cylinders at subnormal pressure, and means for constantly supplying steam to this exhaust line to maintain a substantially fixed difference in pressure between said supply and exhaust lines.

3. The combination with drier cylinders, of a steam heating system therefor comprising a line for supplying steam to a group of cylinders, an exhaust line for conducting the exhaust therefrom to another group of cylinders at subnormal pressure, and a pressure reducing valve between the supply line and the exhaust line to maintain a substantially fixed difference in pressure between said supply and exhaust lines by constantly admitting steam to said exhaust line.

4. The combination with drier cylinders, of a steam heating system therefor, a line for supplying steam to a middle group of cylinders, an exhaust line for conducting the exhaust therefrom at subnormal pressure to a group of cylinders at the wet end and to a group of cylinders at the dry end of the machine, and means for constantly supplying steam to this exhaust line to maintain a substantially fixed difference in pressure between said supply and exhaust lines.

5. The combination with drier cylinders, of a steam heating system therefor comprising a line for supplying steam to a group of cylinders, an exhaust line for conducting the exhaust therefrom to another group of cylinders at subnormal pressure, means for constantly supplying steam to this exhaust line to maintain a substantially fixed difference in pressure between said supply and exhaust lines, and a unit for withdrawing the condensate from the second group of cylinders.

6. The combination with drier cylinders, of a steam heating system therefor, comprising a line for supplying steam to a middle group of cylinders, an exhaust line for conducting the exhaust therefrom at subnormal pressure to a group of cylinders at the wet end and to a group of cylinders at the dry end of the machine, means for constantly supplying steam to this exhaust and to maintain a substantially fixed difference in pres-

sure between said supply and exhaust lines, and a unit for withdrawing the condensate from the groups of cylinders at the wet and dry ends of the machine.

7. The combination with drier cylinders, of a steam heating system therefor, comprising a line for supplying steam to a group of cylinders, an exhaust line for conducting the exhaust therefrom to another group of cylinders at subnormal pressure, means for constantly supplying steam to this exhaust line to maintain a substantially fixed difference in pressure between said supply and exhaust lines, and a trap between the exhaust line supplying the second group of cylinders and the discharge therefrom.

8. The combination with drier cylinders, of a steam heating system therefor, comprising a line for supplying steam to a middle group of cylinders, an exhaust line for conducting the exhaust therefrom at subnormal pressure to a group of cylinders at the wet end and to a group of cylinders at the dry end of the machine, means for constantly supplying steam to this exhaust line to maintain a substantially fixed difference in pressure between said supply and exhaust lines, and traps between the exhaust line supplying the groups of cylinders at the wet and dry ends of the machine and the discharge therefrom.

9. The combination with drier cylinders, of a steam heating system therefor, comprising a line for supplying steam to a group of cylinders, an exhaust line for conducting the exhaust therefrom to another group of cylinders at subnormal pressure, means for constantly supplying steam to this exhaust line to maintain a substantially fixed difference in pressure between said supply and exhaust lines, a trap between the exhaust line supplying the second group of cylinders and the discharge therefrom, and a unit for withdrawing the condensate from the discharge line of the second group of cylinders.

10. The combination with drier cylinders, of a steam heating system therefor, comprising a line for supplying steam to a middle group of cylinders, an exhaust line for conducting the exhaust therefrom at subnormal pressure to a group of cylinders at the wet end and to a group of cylinders at the dry end of the apparatus, means for constantly supplying steam to this exhaust line to maintain a substantially fixed difference in pressure between said supply and exhaust lines, discharge lines from the groups of cylinders at the wet and dry ends of the apparatus, steam traps between the exhaust supply and discharge lines of the groups of cylinders at the wet and dry ends of the apparatus, and a unit for withdrawing the condensate from the discharge lines of the groups of cylinders at the wet and dry ends of the apparatus.

11. The combination with drier cylinders, of a steam heating system therefor, comprising a line for supplying steam to a group of cylinders, an exhaust line for conducting the exhaust therefrom to another group of cylinders at subnormal pressure, means for constantly supplying steam to this exhaust line to maintain a substantially fixed difference in pressure between said supply and exhaust lines, and steam traps in the discharge pipes from the second group of cylinders.

12. The combination with drier cylinders, of a steam heating system therefor, comprising a line for supplying steam to a group of cylinders, an exhaust line for conducting the exhaust to another group of cylinders at subnormal pressure, a discharge line therefrom and a thermostatic air vent between the exhaust and the discharge lines, the thermostatic element thereof being exposed to the discharge, and means for con-

stantly supplying steam from said supply line to said exhaust line.

13. The combination with drier cylinders, of a steam heating system therefor, comprising a line for supplying steam to a group of cylinders, an exhaust line for conducting the exhaust therefrom to another group of cylinders at subnormal pressure, a discharge line therefrom, means for constantly supplying steam to the exhaust line to maintain a substantially fixed difference in pressure between said supply and exhaust lines, steam traps between the exhaust line conducting the exhaust to the second group of cylinders and the discharge line therefrom, and thermostatic air vents between the exhaust line and the discharge line having their thermostatic elements exposed to the discharge.

In testimony whereof I have hereunto affixed my signature.

IRVING C. JENNINGS.