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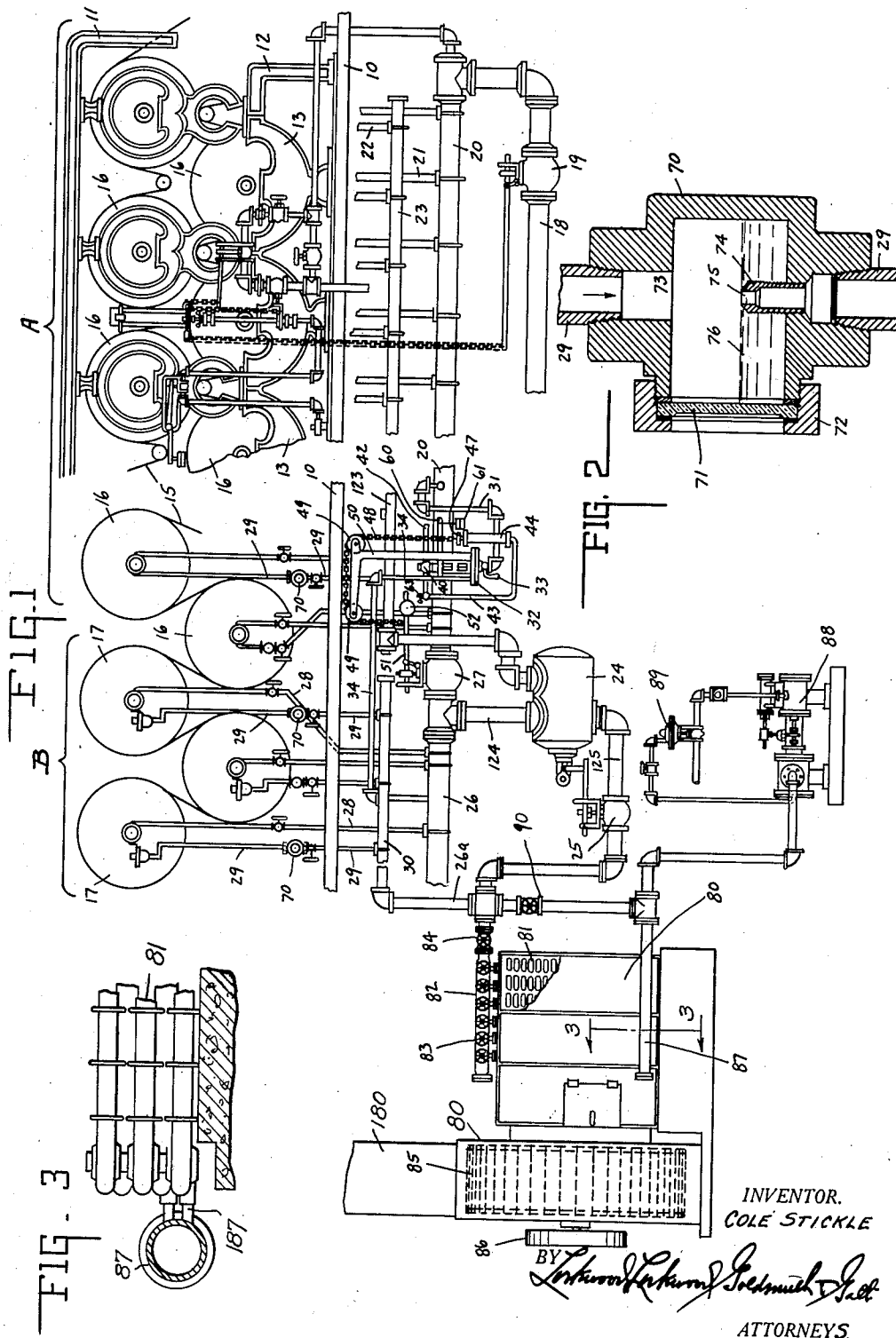
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Filed May 14, 1928

2 Sheets-Sheet 1



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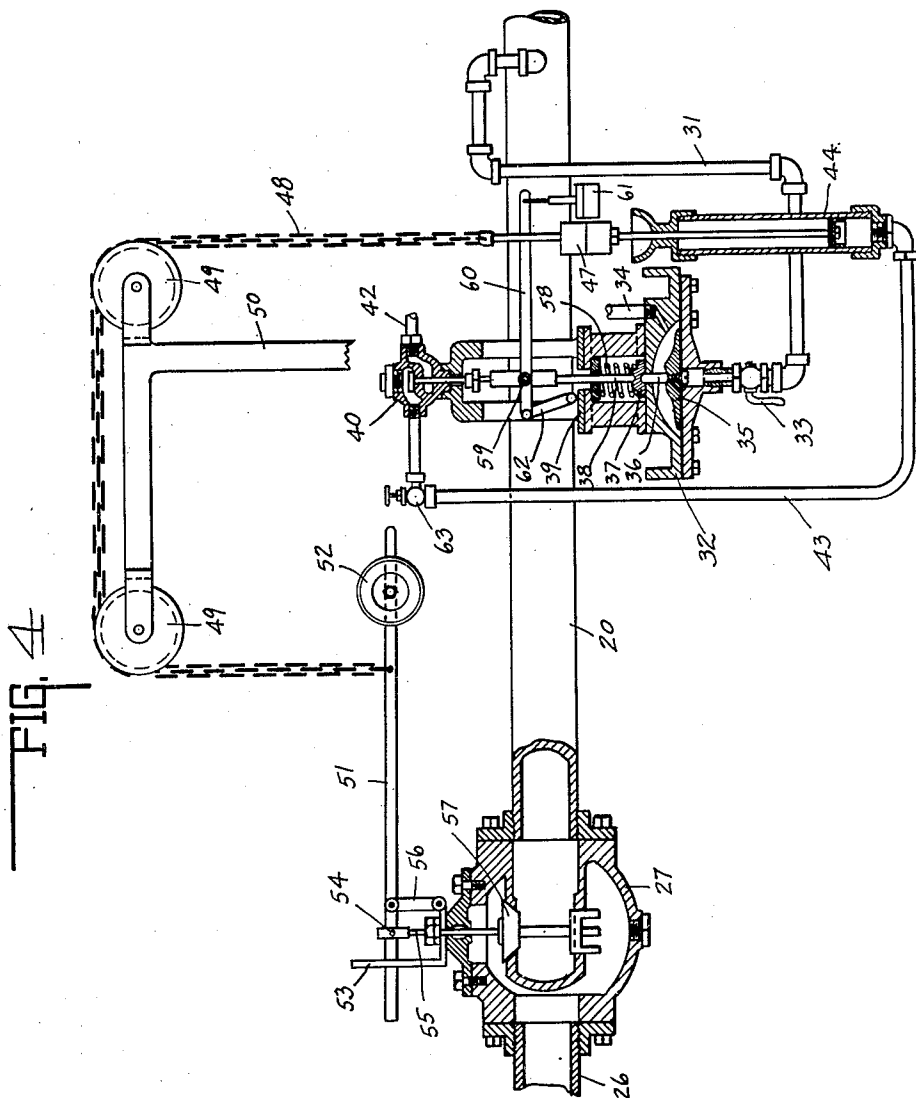
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INVENTOR.
COLE STICKLE.

BY *Lehman & Lehigh*
ATTORNEYS.

UNITED STATES PATENT OFFICE

COLE STICKLE, OF INDIANAPOLIS, INDIANA

AUTOMATIC STEAM CONTROL AND DIFFERENTIAL FOR PAPER MACHINES

Application filed May 14, 1928. Serial No. 277,603.

This invention relates to a differential pressure control mechanism for maintaining a given differential pressure between the blowing through section and the condensing section of a paper drying machine, of the character disclosed in my former application, Patent No. 1,674,845, patented June 26, 1928, for automatic steam control and differential for a paper machine.

10 The rapid circulation of steam through the dryers of the paper machine has become a matter of great practical importance to paper manufacturers. A blowing through system gives rapid circulation, providing a sufficient pressure is used and the system installed does not equalize. Rapid circulation has the advantage of a complete removal of air and condensation at all times which keeps the dryers as hot as possible and allows for maximum production.

To effect this rapid circulation of steam it is desirable to maintain a difference in pressure between the main section or dry end and the condensing section or wet end of the machine. The condensation and steam blows through the siphon into the discharge header of the main section. This line is connected with a large receiver header. The steam blows through and the vaporization from the discharge condensate enters the condensing dryers through the section of the steam header, as appears in my said former application. The condensing dryers are equipped with thermic vacuum traps discharging into a return header connected to a vacuum pump. This will prevent any steam going through and there will be no cooling water or spray required to consume steam in order to maintain a vacuum. The exhaust from the pump is piped from the machine header so that there is no loss from operating a vacuum pump. This construction maintains the difference in pressures between the sections of the paper machine headers, with any variation in the drying pressure. This difference in pressures between the two sections keeps the dryers perfectly drained. The present improvement on said prior apparatus is the combination therewith of means for restricting automatically the flow of steam from the

condensing section to the dry section, so that at no time could the pressure equalize in the two sections and at all times maintain a lower pressure in the condensing section. Said restricting means is preferably located in the connection leading from the header of the condensing section to the return header which communicates directly with the vacuum pump line.

Another feature of the invention is the combination with a drying machine, and means for supplying steam thereto, of an air cooled condenser in the discharge line adapted to maintain the vacuum in said line for causing the desired drainage. The preferable type of such condenser is called in the trade a vapor vacuum blast coil. It is of the same general character as that which is more fully shown and described in my former Patent No. 1,609,672, patented December 7, 1926, for heat exchange apparatus. It utilizes the high temperature condensation from the dryers to heat and ventilate the machine drying room and at the same time to maintain a vacuum on the discharge line from the dryers. This completes an ideal drainage system for removing the air and condensation from the dryers.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims.

In the drawings Fig. 1 is a digrammatic illustration of a paper drying machine employing said improved combination, parts of the machine being broken away. Fig. 2 is a central vertical longitudinal section through a restricting valve employed in said machine, parts being broken away. Fig. 3 is a section on the line 3—3 of Fig. 1 of the parts of the device. Fig. 4 is an enlarged view showing the control valve with a portion thereof in central vertical cross section.

In the drawings there is illustrated a paper drying machine mounted upon the floor and employing a frame structure 11, 12, and 13 upon which a paper feeding roll 14 is mounted so that the paper may pass there-through over the drying roll 16 and 17. The drying rolls 16 are in the blowing through section of the machine indicated by the group

- "A" and the rolls 17 are in the condensing section of the machine indicated by the group "B." The steam plane, headers and control valves are principally placed below the floor
10. The steam, entering pipe 18 passes through an automatically controlled exhaust steam admission valve 19 into the steam header 20 of group "A" or the dry section. A plurality of pipes 21 lead from the steam header 20 to the drying cylinders or rolls 16 to supply the same with steam, and the steam returns through the pipes 22 to the return header 23. The admission of steam through the valve 19 is controlled in the usual manner
- 15 by suitable valve control means which need not be described specifically herein. The return header 23 communicates through pipe 123 with the receiving trap 24 leading to a vacuum pump, not shown.
- 20 The steam passes from the return header 23 of the "A" or drying group through the trap 24 by pipe 124 to the header 26 of the "B" or condensing group. Condensation water is drained from trap 24 through pipe
- 25 125, valve 25 and pipe 26a, by the vacuum pump which is not shown.
- The header 26 of the "B" or condensation group is in automatically controlled communication with header 20 of the "A" or dry
- 30 group through a differential pressure valve in the valve casing 27 which directly connects the two ends of the headers 20 and 26 which are in alignment with each other. The condensing section rolls 17 receive steam from
- 35 the header 26 through pipes 28 and discharge the same through the pipes 29 to the return header 30 which communicates directly with the vacuum pump line 26a.
- The valve, not shown, in the valve casing
- 40 27 is automatically controlled by the relative steam pressure existing in the steam headers 20 and 26. To that end the header 20 is connected through a pipe 31 with the lower side of the diaphragm housing 32, said pipe being controlled by valve 33. The header 26
- 45 is connected through a pipe 34 with the top of said diaphragm housing 32.
- Positioned in the housing there is a suitable diaphragm 35 separating the top and
- 50 bottom of the housing and operatively connected by a plunger 36 with a disk 37 which in turn operates a rod 38. The rod 38 extends upwardly through a suitable frame 39 terminating in a pilot valve housing 40 and
- 55 having positioned on the end thereof a valve member 41 for opening and closing the pilot valve. Communicating with the pilot valve housing 40 there is a conduit 42 leading from a source of pressure in the form of either
- 60 liquid, air or gas. Connected with the other side of the valve housing 40 there is a pipe 43 communicating with the lower end of a piston cylinder 44. Mounted in the cylinder 44 there is a piston 45 connected with the piston rod 46 upon which may be mounted the
- counterbalance weights 47. The upper end of the piston rod 46 is connected with a chain 48 adapted to pass over the pulleys 49 which are mounted upon a bracket 50, the other end of the chain being connected with a valve actuating lever 51.
- 70 Slidably mounted upon the lever 51 there is a weight 52 for normally maintaining said lever in lower position. The lever 51 extends through a guide arm 53 and is pivoted at 54
- 75 to a valve stem 55, and the lever is pivotally connected through a link 56 with the valve casing 27. The valve stem 55 extends into the valve casing 27 and has secured thereon a valve member 57 for opening and closing said
- 80 valve.
- For counterbalancing the movement of the diaphragm and pilot valve there is provided a compression spring 58 positioned between the disk 37, and a collar mounted on the frame
- 85 39, said spring surrounding the rod 38. Pivoted to said rod within the frame 39 at 59 there is a lever 60 having variable weights 61 suspended from one end thereof, the other end of said lever being pivotally connected
- 90 to said frame through a link 62.
- In the pipes 29 leading from the rolls 17 in the condensing section to the return header 30 which communicates with the vacuum pump line, there are restricting valves 70 for
- 95 restricting the flow of steam returning to said header 30. The restricting valves are preferably formed, as shown in Fig. 2, consisting of a cylindrical chamber connected with the upper and lower sections of pipe 29,
- 100 as shown, and having a lateral end closed by a glass window 71 held in place by a screw cap 72, whereby the interior of the casing is visible. The steam inlet port 73 discharges into a relatively large chamber and passes
- 105 therefrom through a threaded nozzle 74 extending vertically through the lower side of said casing 70 and connected with the lower section of pipe 29. The nozzle 74 has an appreciably reduced outlet port 75 as compared
- 110 with the inlet port 73 above. This restricts the passage of steam from the upper section of pipe 29 to the lower section thereof and such restriction is indicated by the condensation water 76 therein that lies in the lower
- 115 part of the chamber in casing 70 surrounding the nozzle 74 which extends up for some distance from the bottom of the chamber, as shown. If the apparatus is working properly, the condensation water 76 will accumulate
- 120 and stand, as shown, and the window 71 enables this condition to be observed. If there is an absence of condensation water it will show a condition of the apparatus in which the flow of steam is not being sufficiently restricted.
- 125 From the foregoing it will be observed that in operation, and assuming that it is desired to maintain a differential of pressure between the headers 20 and 26 of ten pounds
- 130

pressure, the proper weight 61 is placed on the arm 60. The downward pressure exerted thereby on the rod 30 against the diaphragm 35 will act as an auxiliary pressure to the steam pressure passing through the pipes 34 from the header 26, in this instance such auxiliary pressure being the equivalent of ten pounds. The differential pressure of ten pounds, in addition to the pressure from the header 26, will accordingly neutralize the pressure exerted from the header 20 through the pipe 31, which will maintain the pilot valve 41 in closed position, which, in turn, will prevent the operation of the piston 45 and accordingly the valve member 57, whereby the valve 57 will be closed. In order to maintain such differential of pressure, upon a decrease of pressure occurring in the header 26 due to the closure of the valve 57, the diaphragm 35 will be forced upwardly by the pressure through the pipe 31. This will open the pilot valve and cause pressure to be exerted in the pump for moving the piston 45 upwardly, permitting the lowering of the lever 51, which will open the valve 57. Steam will pass therethrough into the header 26 in which the pressure will be raised sufficiently to cause the diaphragm 35 to be forced downwardly, which will close the pilot valve 41, so that the piston 45 may be forced downwardly by the weights 47 and the lever 51 accordingly elevated, so as to close the valve 57. The lowering of the piston 45 is permitted by the escape of fluid through the pet cock 63, which remains slightly open. This control of the valve 57 will thereby cause any variation from the desired differential of pressure to either open or close said valve and accordingly maintain such differential substantially constant.

Through the automatic control of the valve 57 and by manipulation of the weight 61, said valve will maintain a given difference in pressure between the sections of the paper machine headers, with any variations in the drying pressure. This difference in pressure between the two sections provides a rapid circulation of steam through the dryers of the machine, whereby the dryers are perfectly drained.

The steam returning from the rolls 17 in the condensation section of the machine, however, should preferably always be restricted by the restricting valve 70, as shown in Fig. 2, and the nozzle should be changed in order to provide a nozzle with a port of sufficient dimension with relation to port 73 as to always provide for such restriction of the passage of the steam. Hence, this restricting valve is adjusted to suit the expected steam pressure employed and the other changes and conditions in the operation of the machine. Employment of such restriction valves in said machines im-

proves its operation so much as to almost revolutionize the work of the machine.

An air cooled condenser and associated parts are added to the paper machine at the lower left-hand portion of Fig. 1. It is of peculiar type and consists in an air chamber 80 with a suction fan 85 mounted in the left-hand end of said chamber for drawing air through the chamber. Said fan is driven by a pulley 86 and associated means not shown.

In the air chamber 80 there is located a series of coils 81 in the form of horizontal flat tubes or chambers for receiving the heated water and steam that comes through a header 82 from pipes 26a and 125. Said header is controlled by a valve 84, whereby it can be entirely or partially shut off, as desired, and a valve 83 is located in the header for each set of coils for controlling the admission thereto of the hot water and the steam.

The flat chambers constituting the coils are surface cooled by the cold air moved by the fan and the heat taken from the coils and water and steam therein by said air blast is discharged through a suitable outlet 180, extending preferably from the portion of the chamber 80 in which the fan 85 is located, and is thereby returned to the room in which the machinery is located for keeping it suitably heated and ventilated.

The flat chambers of the coils 81 permit in each of them separation of the steam and water, as they are horizontal and there is a large steam liberating space in the upper portion thereof. This permits the hot water to be re-evaporated into the steam liberating space, and the cool air condenses all this steam and creates and maintains a partial vacuum.

The water is removed from the condenser coils or chambers through the discharge header 87 with which the lower chamber in each coil is connected by a small outlet pipe 187, as shown in Fig. 3, and is carried away by a pump 88 and is preferably returned to the boilers. The pump has the usual type of controller 89. Pipe 26a extends down to pipe 87 and has a shut-off or control valve 90 between the header 82 and pipe 87.

Hence, this air cooled condenser performs two functions, maintaining the partial vacuum desired and supplying the machine and paper drying room with dry warm air.

The air-cooled condenser, and particularly the type shown herein, has proven to be a complete success in connection with paper drying apparatus. It made it possible to drop the temperature of the condensate from 240 degrees F. to 175 degrees F. at the discharge to the vacuum pump. This results in creating a vacuum of about 15" over the surface of the water in the heater, and maintains the same vacuum on the return line from the dryers. When one realizes that the heater has nearly 1000 square feet of steam liberat-

ing surface over which a vacuum of 15" is maintained, and condensation boils freely at 175 degrees F., it is obvious that with the discharge from the dryers it is possible also to condition sufficient air to heat and ventilate the machine room.

Heretofore, a vacuum has been maintained on the discharge line of the paper machine by the use of a jet of cold water or spray in a spray chamber before discharging into a vacuum pump. That is called in the business "a jet condenser". The present invention results in a direct saving over the former practice.

Instead of the flat tubes in the coil as above set forth, any tube or coil suffices which does not completely fill with water, so that an appreciable vacuum can be formed and maintained throughout the entire structure and entirely back to the return line of the paper machine, and there will be no water seal formed between the vacuum chamber and the return header of the paper machine, as that would prevent the removal of air from the machine.

The cold air from the fan coming in contact with the radiating surface condenses the steam and creates a partial vacuum. The steam from the condensate keeps the top of the construction hot, and then condensate takes its latent heat from the surrounding water, similar to the effect of a cooling tower. The air is a cooling medium and it goes back into the building for heating or drying purposes at about 100 degrees F. This shows a decided saving over methods heretofore employed, of handling high temperature condensation and heating air for ventilation purposes, as it utilizes the high temperature condensation from the dryers to heat the air in the machine room, and it maintains the vacuum of 15" on the return discharge header from the dryers which results in a direct saving of the steam used for drying the paper and the like. Since every inch of vacuum maintained on a compound condensing engine is a saving or more than 1%, each inch of vacuum maintained in the foregoing apparatus is worth as much in the direct transfer of the heat units. By vacuum is meant a pressure below atmospheric pressure.

The invention claimed is:

1. The combination with a drying machine having a blowing through section, a condensing section, and a differential pressure control means for maintaining a given differential pressure between said two sections, of means for restricting the steam flow, which means is externally visible while in operation substantially as set forth.

2. The combination with a drying machine having a blowing through section, of a condensing section, a steam supply header and a return header for each of said sec-

tions, pipes leading from each of the rolls in the condensing section to the return header of said section, and a restricting valve construction in said pipes having a casing with an inlet port, and a removable nozzle therein having an outlet port reduced in size as compared with the inlet port.

3. A mechanism substantially as set forth in claim 2, with said inlet port being in the upper part of the casing and the removable nozzle inlet being above the bottom of the casing to provide a chamber for retaining condensation water up to the inlet of the nozzle.

4. A mechanism substantially as set forth in claim 2, with a window in one end of said casing which enables the valve condition to be visible while the device is in operation.

In witness whereof, I have hereunto affixed my signature.

COLE STICKLE.