Feb. 8, 1944. N. M. SIMMONS 2,341,335

HEATING SYSTEM FOR COMPOSITE PAPER BOARD MACHINES

Filed March 28, 1940 3 Sheets-Sheet 1

FIG. 1

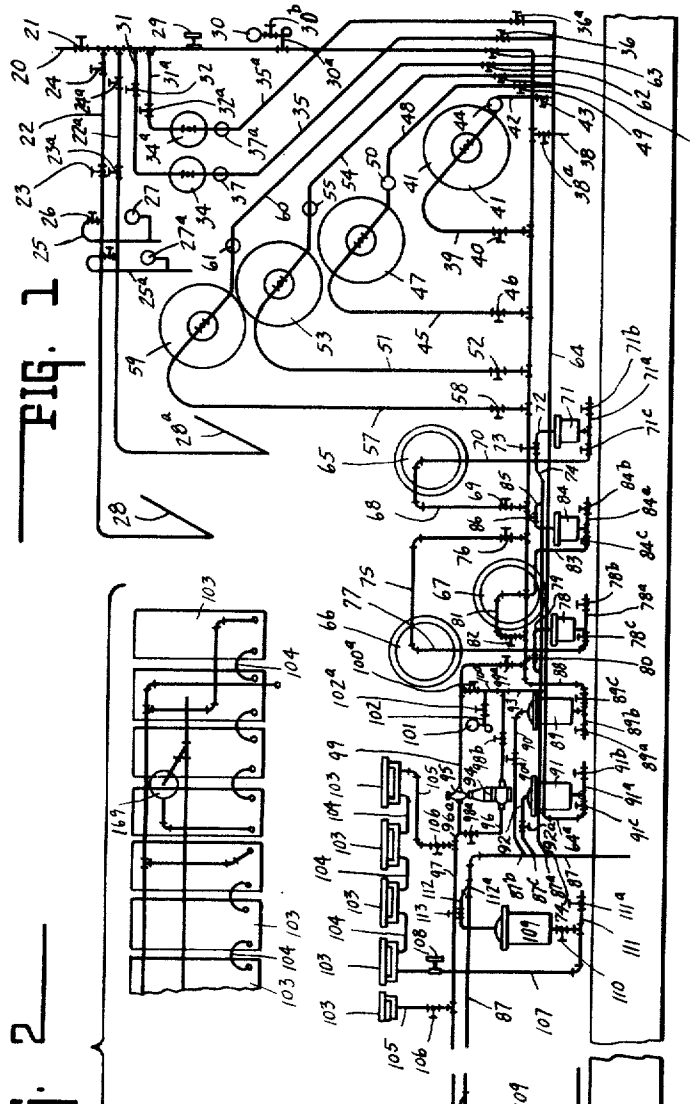


FIG. 2

FIG. 8

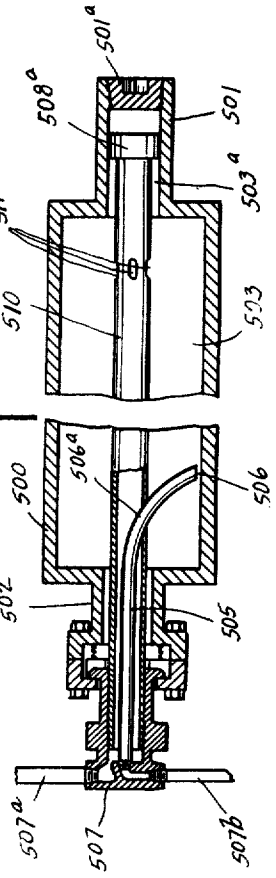
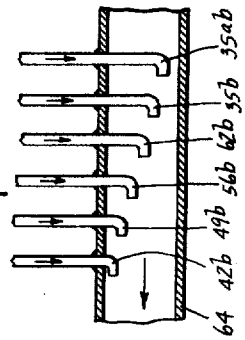


FIG. 3



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Filed March 28, 1940 3 Sheets-Sheet 2

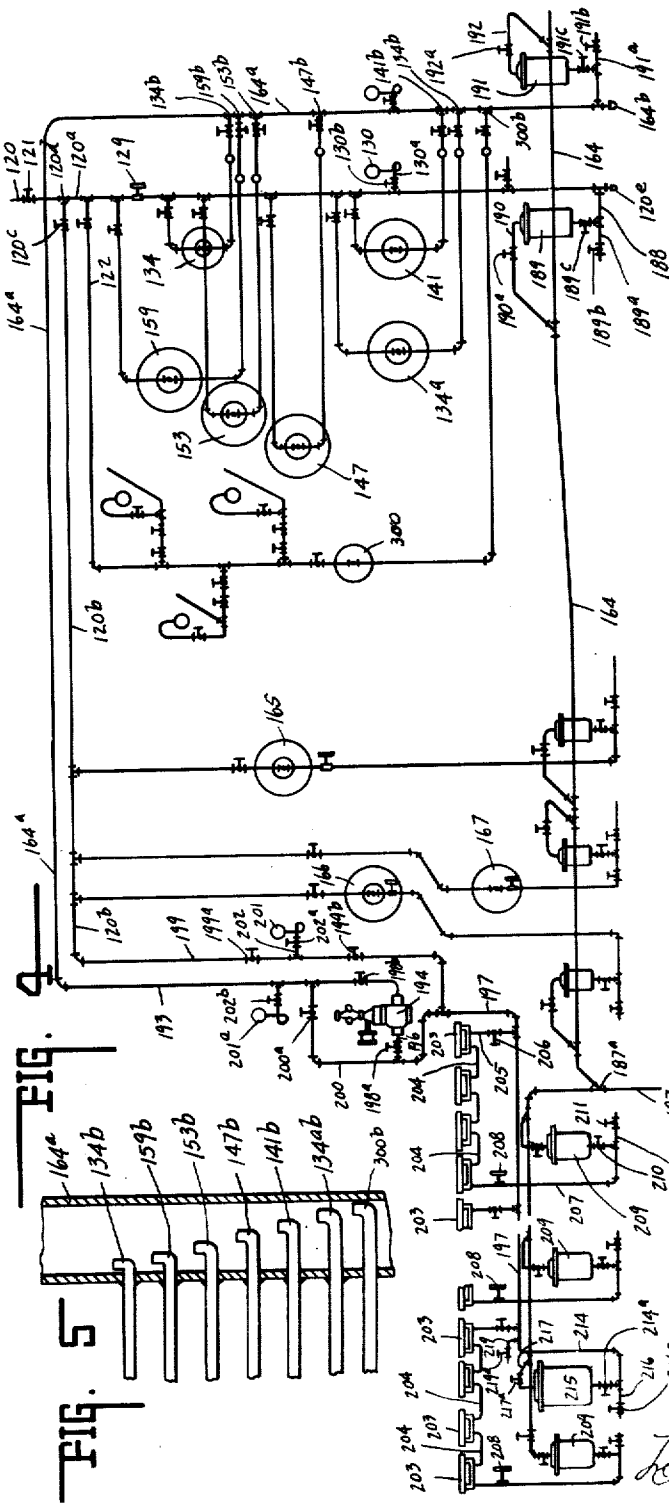


FIG. 4

FIG. 5

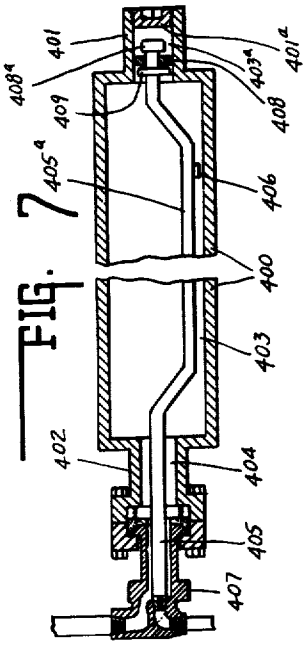


FIG. 7

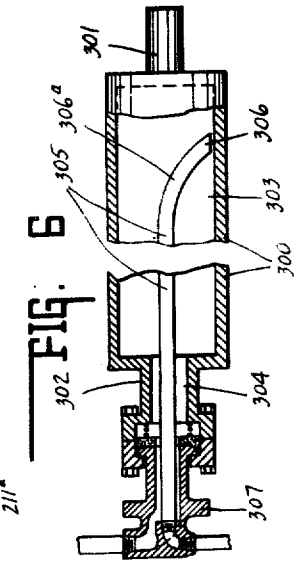


FIG. 6

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HEATING SYSTEM FOR COMPOSITE PAPER BOARD MACHINES

Filed March 28, 1940 3 Sheets-Sheet 3

FIG. 9

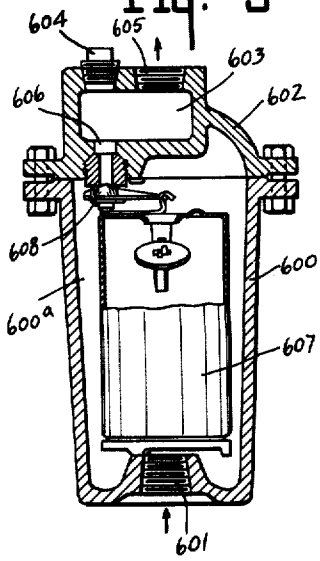


FIG. 10

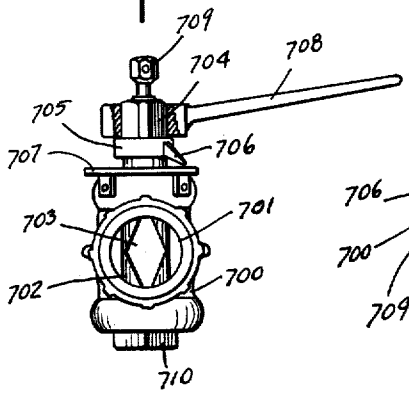


FIG. 11

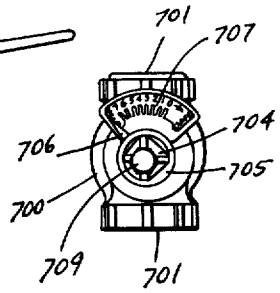


FIG. 12

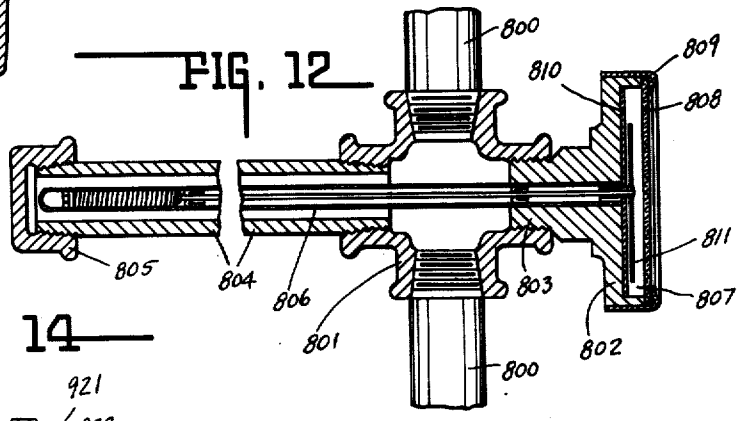


FIG. 14

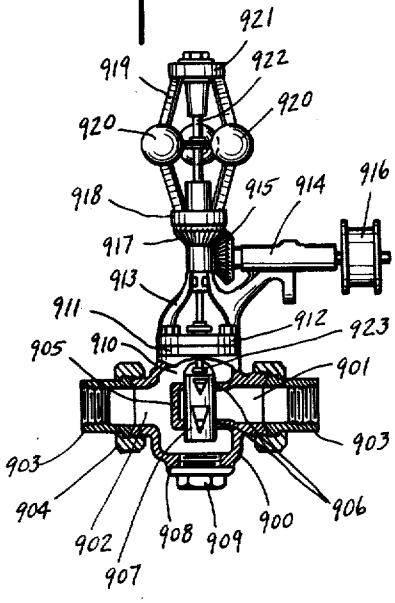
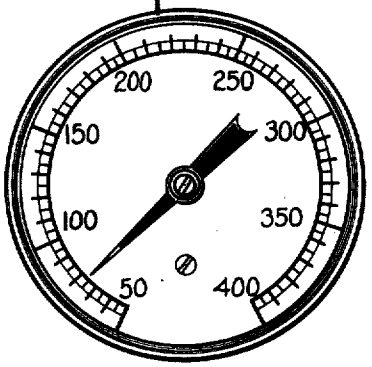


FIG. 13



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UNITED STATES PATENT OFFICE

2,341,335

HEATING SYSTEM FOR COMPOSITE PAPER-BOARD MACHINES

Noah M. Simmons, Indianapolis, Ind.

Application March 28, 1940, Serial No. 326,401

7 Claims. (Cl. 154—30)

This invention relates to a steam heating and showering system for corrugating machines.

In the manufacture of corrugated board two or more plies are utilized. One ply is always fluted and secured adhesively to another ply, called the liner. This is single face board. If the corrugated or fluted ply is between two plies or liners, it is double face board.

To flute the corrugated ply, since the paper sheet stock is brittle, it is customary to moisten the same before forming the ply into corrugated form. The corrugated or fluted sheet is dried to expel excess moisture and usually while supported on a roll which has a surface complementary to the flute arrangement in the ply. An adhesive is applied to high points or ridge and the liner is then applied thereto and held thereto. The previously roll seated flutes then have their ridges coated with adhesive and a second liner is applied thereto forming double face board.

Heat is then applied to dry and set the adhesive and further dry out the board. If single face board is fabricated, the second adhesive application and second liner is omitted. If the heat for drying be insufficient the adhesive will not set up and when the board passes through the slitter, the knives thereof turn up the edges of the liner and this amount of "turned up" stock is wasted. If the heat for drying be excessive, the board will have imparted thereto an initial warp difficult to remove and which may be sufficient to prevent utilization commercially of said warped board.

From the foregoing, therefore, the importance of dryer (plate) control will be self evident and when proper drying is effected, there will be substantially no wastage or inferior (warped) board.

There should be for proper board maufacture, a definite correlation between showering (tempering) and paper speed. Paper speed is determinable by machine speed, and that in turn is determinable by curing (drying).

Present practice in board production is to observe the finished board as produced and vary the speed of production and amount of showering to obtain as near perfect board as possible.

The present invention is directed to a control such that for varying machine speeds, the curing is correspondingly and automatically varied. For varying machine speeds, showering (tempering) must be varied. This is a function of both time and amount of moisture applied to the sheet to be tempered.

The present invention by reason of its control, et cetera, permits the machine to operate at maximum efficiency at all times and at full capacity.

The present invention has the further advantage that instead of requiring about four hours to bring such a machine up to proper operating condition, such condition can be attained in about one hour, thereby making available about three hours of production, not otherwise available.

The chief object of the invention, therefore, is to provide a corrugating machine with a system for heating and showering but more particularly the former, whereby the several advantages previously mentioned are obtainable.

The chief features of the invention consist in elimination of trapped air and condensate by rapidly circulating the heating medium (steam), automatically controlling the curing in relation to machine speed and by sequentially connecting the corrugating and curing heating systems, as well as preventing an undue amount of live steam entering the main return line.

Other objects and features of the invention will be set forth more fully hereinafter, such as the ejector type of roll and drum discharge, the speed responsive control device, the bypass arrangement, or arrangements, heating plate connections, trapping arrangements, the thermometers and mountings therefor, the roll and drum steam supply constructions and the individual control valves.

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 piping diagram in conventional elevation of a corrugating machine to which the invention has been applied.

Fig. 2 is a top plan view of the heating plates and the piping connected thereto in conventional piping diagram. In Figs. 1 and 2 intermediate portions of the plates or curing mechanism have been broken away or omitted to reduce the showing.

Fig. 3 is an enlarged sectional view through the ejector type discharge of the several rolls and drums to the initial return line.

Fig. 4 is a view similar to Fig. 1 and of a modified form of the invention.

Fig. 5 is an enlargedd longitudinal sectional view of the ejector discharge initial return line construction embodied in the modification shown in Fig. 4.

Fig. 6 is a longitudinal, sectional view through one form of preheating drum.

Fig. 7 is an enlarged, longitudinal, sectional view through one form of corrugating or pressure roll.

Fig. 8 is a similar view of a modified form of roll or drum.

Fig. 9 is a sectional view through a trap satisfactory for inclusion in the system.

Fig. 10 is an elevational view looking at a diamond port valve suitable for inclusion in the system.

Fig. 11 is a plan view thereof.

Fig. 12 is a central sectional view through a temperature gauge or thermometer and the method of mounting the same, which has been found satisfactory in the system.

Fig. 13 is a front elevation thereof.

Fig. 14 is an enlarged, central sectional view of the speed responsive control valve.

In Fig. 1, the numeral 20 indicates a main supply line from the boiler of a suitable capacity sufficient to supply steam at the desired temperature and pressure and in the desired amount. The numeral 21 is the main control valve to the machine heating and showering system. It preferably is of diamond port character with a lever handle of indicating type and the valve is of the lubricated, throttling type adapted to handle pressures up to 150 lbs. per square inch.

A line 22 is connected to this line 20 by a suitable T-connection and included in said line 22 is a similar valve 23. Also included in said line 22 is an auxiliary main control valve which is of the wide open and cutoff type, the same being indicated by the numeral 24. A branch from said line and indicated by 25 is controlled by a valve 26 similar to the valve 23 and it includes a pressure gauge 27 which is capable of indicating temperatures up to 450° F. The line 22 controlled by valve 23 leads directly to the shower indicated conventionally by the numeral 28. A similar set of shower connections is illustrated and the parts thereof are indicated by similar numerals with the subscript *a*.

It will be apparent that when it is desired to operate the showers that the valves 24—24*a* are opened wide and that the valves 23—23*a* are each adjusted so that only the desired amount of steam may pass into the showers and the temperature of that steam may be visually determined by the thermometers.

In machine operation whenever it is desired to shut down the machine, the motive power is disconnected and the main valve 21 is closed. If, however, it is desired merely to shut down the showers for some reason or other, the gate-valves 24—24*a* only are closed without disturbing the valve adjustment on valves 23—23*a*. With the gate-valve wide open, should the condition of the paper require additional or less tempering, the valves 23 and/or 23*a* are then adjusted as required and this position by means of the indicating handle, to which reference will be had more fully hereinafter, is indicated by a mark the operator places on the valve so that in the event it becomes necessary to shut off the throttling valves 23 and 23*a*, they may be readily closed and their normal open position, as required, may be readily reestablished by moving the handle to the operator-indicated position. This reduces the non-productive time of the machine when bringing it into operative condition.

The discharge of steam from the shower mechanism in the showers is of conventional character and there is no return since the moisture is applied to the paper sheet passing through the showers and is absorbed thereby, this constituting tempering as is well known in the industry, and since there is a continuous flow of steam, there is little or no air trapping and little or no condensate formed in the shower supply.

The supply line 20 is provided with a thermometer 29 of the character previously described, and more fully set forth hereinafter and also a pressure gauge structure 30 which is controlled by a valve 30*b*, similar to valves 21 and 23. This gauge is adapted to indicate pressure up to 200 lbs. per square inch.

An auxiliary supply line 31 is controlled by a diamond port valve 32 and leads to an upper preheating drum 34. The discharge therefrom is indicated by line 35 and it is controlled by a valve 36 and included in said line is a thermometer arrangement 37 of immersion indicating dial type, and to which reference will be had more fully hereinafter. There are two upper preheating drums illustrated and numerals similar to those previously employed with the subscript *a* indicate the steam circuit for the second drum.

Included in the line 20 and near the bottom, there is a waste connection 38 controlled by a valve 38*a*. This discharges to any suitable waste arrangement. The line 20 includes a plurality of T's, to the branch portions of which are connected supply lines. One branch line 39 includes a valve 40 similar to the previously described diamond port valves and discharges to a lower preheating drum 41, the discharge therefrom being indicated by the numeral 42, including cutoff valve 43 and said discharge line 42 includes the thermometer 44.

Another branch supply line from line 20 is indicated by the numeral 45 and includes a control valve 46 that discharges to the pressure roll 47. The discharge 48 therefrom includes the valve 49 and the thermometer 50.

Another branch supply line 51 from the main supply 20 is controlled by the throttle valve 52 and discharges to a lower corrugating roll 53 and the waste line 54 therefrom includes a thermometer 55 and the shutoff valve 56.

Another branch supply line 57 includes the control valve 58 and said line discharges to the upper corrugating roll 59 and the waste line 60 therefrom includes a thermometer 61 and also includes a control valve 62. Between the shower and upper preheating roll supplies and the lower preheating drum pressure roll and corrugating rolls supplies, there may be interposed valve 63, see lower right hand portion of Fig. 1.

An initial line 64 is illustrated more clearly in Fig. 3. Each of the several branch discharging lines 31, 31*a*, 39, 45, 51 and 57, finally discharge into the line 64, as shown in the lower right hand corner of Fig. 1 and more particularly in Fig. 3. Herein each of said discharge lines terminates in an ejector tube having the downstream directed tip, the same being indicated by the same numeral as the initial return line with which it is in communication but with the subscript *b*. It will be observed—see Fig. 3—that no ejector tip is masked by any adjacent tip. The arrows indicate the several directions of flow. While herein these tips are shown positioned in a common, longitudinal plane and are progressively staggered with relation to each other from one side to the opposite side of conduit 64, these ejector tips may be positioned so that they are spiralled, as it were, in position and attain the same effect, which is prevention of blanking of the discharge at each ejector tip.

It will be noted that the individual discharge lines previously described, all discharge downwardly and due to the ejector action on the tips

thereof, there is a definite suction action produced in each discharge line 35, 35a, 42, 48, 54 and 60, which serves to insure the proper rapidity of steam flow through each of the rolls, drums and the like, which suction serves to carry with it air normally pocketed therein or water condensate collected therein. Thus, each of the branch supplied devices is subjected to live steam throughout its individual heating arrangement so that the theoretical maximum heating action always will be obtained therefrom when desired unless throttled down.

The present practice is such that these several individual heating devices comprise arrangements that normally have a portion that "air pockets" or in which water condensate collects and, therefore, these areas, in which the aforesaid results, are very much colder than the other portions of the device, with the result that non-uniform heating of the paper, to which these devices are subjected, results. The present invention, therefore, insures the desired and contemplated efficiency and uniform heating of the paper from these several devices.

In Fig. 1 of the drawings, the numeral 65 indicates a preheating drum of the double backer of the corrugating machine. The numeral 66 indicates the top roll of the double backer. The numeral 67 indicates the lower roll of the double backer. A line 68 takes off from line 20 and is controlled by valve 69 and discharges to drum 65. The discharge therefrom, indicated by line 70, discharges to the lower end of a trap 71, having a waste 71a controlled by a waste valve 71b. Air and condensation passes through the trap construction, hereinafter to be more fully described, and discharges by the line 72, controlled by a valve 73, to a return line 74.

A supply line 75 from the main 20 is controlled by valve 76 and discharges to the upper roll 66 of the double backer and the line 77 therefrom discharges to the lower end of the trap 78 having the waste line 78a controlled by the valve 78b. Line 79 from said trap 78 is controlled by the valve 80 and discharges air and condensation to the return line 74 before mentioned. Double backer devices are usually operated at much lower pressures and temperatures than that of the prior described devices shown in the right hand portion of Fig. 1, hence, the return from the double backer devices is not utilized for plate heating.

In like manner, a line 81 controlled by a valve 82 supplies steam from the main supply 20 to the lower roll 67 of the double backer and the discharge 83 therefrom discharges to the lower end of a trap 84 having a discharge line 84a controlled by an outlet valve 84b and this trap discharges air and condensation by line 85 to the auxiliary return 74, such discharge being controlled by the valve 86.

In addition to the valves mentioned, in connection with the traps 71, 78 and 84, each is provided with an inlet valve similarly numbered, but designated by the subscript c. The numeral 87 indicates a main return and it will be noted that line 74, to which all of the aforesaid traps discharge, is connected thereto at 87a.

The main supply line 20 at its end discharges by line 88 to the lower end of a trap 89 having the waste line 89a controlled by valve 89b. The inlet to said trap is controlled by valve 89c. This trap discharges by the line 90 controlled by valve 90a to the main return line 87 at 87b. The line 64, which is the initial return line, discharges as at 64a to a trap 91, the intake thereto being controlled by valve 91c, the waste therefrom being indicated at 91a and the latter being controlled by valve 91b. This trap discharges by line 92 controlled by the valve 92a to the main return 87, as indicated at 87c. Observe that all traps heretofore mentioned have individually controlled waste lines and also discharge to main line 87.

It will be apparent, therefore, that these traps, previously described, remove the air and water from the various steam lines and thus there is no condensate binding and the steam may freely flow through the system to the trap and the condensation and air are discharged into the main return. The trap 89 is a high pressure steam trap and the trap 91 is of like character, and the same also applies to the traps 71, 78 and 84. Lines 70, 77 and 83 are all copper pipe, bent to fit the control valve and thermometer return connection from the respective unit being heated and discharge to the respective designated trap.

Reference now will be had to the middle portion of Fig. 1. The main discharge or initial return line 64 communicates with a branch 93 which connects to the intake side of a reverse acting steam supply governor structure, indicated generally by the number 94, and including the centrifugally operable weights 95 and the outlet 96. This centrifugally operable valve may be suitably connected so as to be operable in synchronism with and by the machine. At least, it is responsive to machine operation and herein said structure is shown as being belt driven, see Fig. 4, and, it may be added, with the power take-off driving from the double backer drive.

This governor is so arranged that its valve opens automatically as the speed of the machine increases, and this supplies additional steam to the line 97 controlled by the governor valve. When the speed of the machine decreases, the governor valve is correspondingly operated to reduce the steam supply. This steam supply is utilized for the heating or curing portion of the corrugating machine and thus predetermined curing action always is obtained regardless of the speed of the machine, the heat supply being automatically varied by the governor control. Whenever the governor valve automatic action is "cut out" the curing action is not always constant, that is in the amount required for proper curing and warpage results.

Reference will be had more fully hereinafter to the detailed construction of this speed governor valve illustrated in Fig. 14.

The line 96, from initial return line 64, joins 96a to the main supply 97 which supplies steam to the heating or curing mechanism. Valves 98a and 98b are interposed in the line 96—93, including valve 94 and at opposite sides of said valve. A line 99 has free connection to line 97 at one end and connects to the main supply line 20 at the opposite end and includes the control valve 99a therein. Note that in Fig. 1 the governor weights are illustrated upon line 99 making the latter appear discontinuous which, however, is not the case for line 99 also connects to line 97 (as line 96) at 96a.

A branch line 100 herein is shown connecting line 99 and line 93 and it is controlled by the valve 100a. A pressure gauge 101 is connected by line 102 to this cross connection and is controlled by the valve 102a. Thus, line 99 constitutes a high pressure bypass around the governor valve controlled by valve 99a, while line 100, controlled by valve 100a, constitutes a lower pressure bypass around the governor valve, these two bypasses

being in multiple with each other. The purpose of said bypasses is to insure an adequate amount of steam for the curing mechanism.

With this arrangement, therefore, the desired major portion of the steam supply required for curing may be supplied without control and the variable amount essential for control then may be supplied through the governor arrangement connections. The amount of steam so supplied by the bypasses may be regulated so that the aforesaid condition results. If desired, the majority, or major portion, of the steam supply may be governor controlled and only a minor portion may be of fixed supply type supplied by either or both of the bypass arrangements.

Considerable flexibility is therefore possible together with very close regulation during operation, the major control being of manual character and the close control being of automatic character to thereby insure perfect curing.

Inasmuch as the lower pressure line constitutes, as it were, the discharge from the various drums and rolls as illustrated, there is insured a continuous flow of discharge from said last mentioned elements, since the steam therefrom is required for curing mechanism heating. Should operating conditions be such that an insufficient amount of low pressure supply be available, this may be supplemented by high pressure steam through the high pressure bypass arrangement so that if the mechanism ahead of the curing mechanism requires a supply such that there is insufficient heating capacity available in the discharge from the mechanism ahead for curing mechanism heating, this may be made up by the high pressure supply. The certainty and flexibility of control and supply and especially the automatic coordination of the same to machine operation will be readily apparent from the brief description heretofore set forth regarding the speed control valve connections and the bypass arrangements.

The plates can be heated and desired temperature maintained on plates or any group of plates by admitting steam through either of the bypasses when the machine is not in operation. This eliminates any lag in production, for the plates can be initially heated independently of machine operation and while the before mentioned devices also are being heated up for operation. Thus plates and devices can be simultaneously brought to operating temperature even though the machine, while operating insofar as curing is concerned, is automatically controlled rsponsive to machine speed.

This speed control is the automatic variable. The manual variables are introduced by valves 99*a* and 100*a* by the operator noting the character of the paper sheets used, their moisture content, and the caliper of the board then supplied to the plates. Minor control variations required are automatically applied. Major control variations naturally are manually applied and the former is continuous in machine operation, while the latter is infrequent, for example, as when a change over in board caliper is desired, or when a new paper roll is applied to the corrugator.

Reference now will be had more particularly to the left hand portion of Fig. 1 and Fig. 2, and therein is illustrated conventionally the curing mechanism in the form of a plurality of successively arranged heating plates over which the completed board passes to the discharge and slitting end of the corrugating machine. Any suitable number of heating plate structures may be employed, and herein the curing mechanism is illustrated as of the type where the board passes thereover. It may be of the type wherein the board passes therebetween and that is, the plates may be positioned above and below the board or whenever desired, in the latter arrangement, either the upper plates or the lower plates may be cut off.

The invention also applies not only to the aforesaid, but to a curing mechanism wherein the plates are positioned solely above the board. It will be remembered from the previous description that line 87 constitutes the main return and that line 97 constitutes the steam supply to the curing mechanism, line 97 being selectively and automatically supplied by line 93, 96, 98 and 100 as aforesaid.

In the left hand portion of Fig. 1, there is illustrated a plurality of identical plate structures, indicated by the numeral 103. Herein these several plate structures are grouped together in fours, the first group being shown in full, the second group being indicated merely by a portion of the first plate thereof, the last group being fully illustrated and the last plate of the second last group being partly illustrated. Thus, the partial illustration of the first unit of the second group and the partial illustration of the last unit of the second last group may be illustrations of the end units of the same group or of different groups and these different groups may be of adjacent character or these two groups may be separated by one or more intervening groups, depending upon the number of plates embodied in the curing mechanism.

In corrugating machines, it is customary at the present time, to provide somewhere in the neighborhood of twenty heating plates which, by reason of the present connections, would be arranged in five groups. The standard connections for these plates is to connect the inlets of all the plates to a common supply line and usually a high pressure main and all the discharges connect to a common return line. The foregoing is conventional practice.

The result of such connections is that, as steam is supplied to the several plates to be utilized for curing purposes, and all may not be utilized, the air trapped therein air-binds the plate and the steam condensed therein water-binds the plate, so that it has been actually determined that with the standard connections to these heating plates, the opposite ends of the plates may be at different temperatures and some differ very markedly to-wit, as much as 100° F. Some plates are at a high temperature and others, due to the binding of either character, may be at a very low temperature.

The present invention by connecting these plates in series, insofar as grouping is concerned, insures rapid and positive circulation of the steam, eliminating condensation or water-binding and eliminating air pocketing or air-binding. With this invention applied to these standard plates, a high degree of regulation and control insofar as curing is concerned, may be obtained therefrom. Poor curing operation usually is compensated for by slowing down the machine. With the present invention, this condition does not occur so that the machine may run at maximum capacity. In standard practice, if the machine be run at the maximum capacity, there usually results undercuring, with the results as stated in the forepart of this description.

As conditions vary, it will be quite evident

from the following description that the curing action of the plates can be easily controlled and regulated to effect proper curing under maximum production. The several plates which are to be connected in series are joined together, that is, the discharge from one is connected to the intake of the other and by means of soft copper piping of expansion loop formation and indicated by the numeral 104.

The intake line or supply line to the first plate of the group is indicated by the numeral 105. It is controlled by the valve 106 adjacent its connection to the supply line 97. The discharge from the last series connected plate of the group is indicated by the numeral 107 and included in said line 107 is the thermometer 108. The other end of said line discharges to the lower end of a high pressure trap 109, the latter having a control valve 110 ahead of the same and controlling the supply thereto. The waste line 111 therefrom is controlled by the cutoff valve 111a. The discharge 112 from the trap 109 is controlled by a valve 113 and the line 112 discharges at 112a to the main return line 87. The units of each group are similarly and individually connected and the groups are similarly connected to supply line 97 and main return line 87 as shown in Fig. 1.

The end of the supply line 97 is connected by a line 114 to the lower end of a trap 115 and this connection is controlled by valve 114a as well as valve 115a. The waste line 116 from the trap is controlled by valve 116a. The discharge line 117 from said trap is connected to the main return line 87. Thus, accumulation of condensate in the several supply lines and at the ends thereof, which would result in water-binding or air-binding, at the ends is eliminated so that all units receive steam in proper condition.

It is also to be observed that each of the traps has its discharge line connected to the common return line or header through a Y-connection, the direction of the discharge to the header being in the direction of the flow of the steam in that header or toward the boiler plant, thus facilitating the discharge to the return and insuring rapidity of circulation of the steam through the machine.

While herein the plates are shown grouped in fours, any other grouping may be employed that is satisfactory. It has been determined, however, that four is a convenient number and each unit of four is able to obtain, without excessive size of conduit, proper steam supply for proper heating or curing purposes. A lesser number merely results in the requirement, for example, that the steam supply be throttled down excessively and that a larger number of valves and traps and Y-fittings, et cetera, must be employed without any additional advantage being obtained from utilizing this modification.

It is often highly desirable to clean the machine and various valve controlled hose outlets are provided. One of the same is indicated at 119 and the valve controlling same is indicated at 119a. It also will be apparent that the valve 38a controlling line 38, hereinbefore described, may in addition to being a waste connection, constitute a machine cleaning connection.

Reference now will be had to Fig. 4 which illustrates a modified form of the invention, and inasmuch as the curing mechanism in this form of the invention is substantially the same as that illustrated in Figs. 1 and 2 no plan view of the former is shown. In this form of the invention numerals similar to those previously employed but increased by 100 designate like or similar parts, it being noted that the numerals for the first form of the invention begin with 20 and end with 119, inclusive, and in this form of the invention, the numerals start with 120. Thus, the numeral 120 indicates the main supply line.

The numeral 121 indicates the main control valve and the line 120 is branched as at 120a, one branch 120b controlled by valve 120c being positioned overhead relative to the machine and the other branch 120d being downwardly directed and being capped at the lower end as indicated at 120e. This lower end is provided with a trap 189, the supply line 188 thereto including the control valve 189c and the waste 189a being controlled by valve 189b. The return from this trap, indicated by line 190, is controlled by valve 190a and the line 190 discharges, in the present instance, to the return line 164 and by a Y-connection, for reasons previously assigned.

It will be noted that the numeral 134 indicates a small preheat drum, 159 the top corrugating roll, 153 the intermediate or middle corrugating roll, 147 the pressure roll, 141 the preheat drum and 134a the larger preheat drum. The numeral 165 indicates the upper preheat drum on the double backer, 166 the top roll thereof, and 167 the bottom or lower roll thereof. Each of these last mentioned rolls and drum is individually connected by upwardly directed risers to the auxiliary main steam supply 120b, as shown, and the discharges therefrom individually discharge to traps, each of which in turn have waste discharges and which traps also discharge to the return line 164 by Y-connections. Indicating thermometers and control valves of diamond port character are utilized in the various connections.

No specific mention will be made of the several connections other than to point out they are in multiple between the line 120b and the line 164 and numerals increased by 100 are applied to these several parts, the primary numerals of which have heretofore been employed and designate corresponding parts with reference to the form of the invention shown in Fig. 1.

In corresponding manner, each of the piping arrangements to the several drums and rolls other than those last described, take off from the main supply line 120a and the several discharges therefrom connect to a discharge or return line 164a which rises vertically and then passes overhead with reference to the machine. The lower end of this header 164a is capped as at 164b. The end of this line is provided with a trap 191 which has its discharge connected to the line 164 and is provided with a control valve 191c, a waste or drain line 191a controlled by the cutoff valve 191b. The line 192 is the usual discharge from said trap 191 and is controlled by the valve 192a.

Each of the discharges from the last mentioned group of rolls and drums, as stated, discharges to the vertical riser 164a, as shown in Fig. 4, and these several discharges are of jet character and constitute ejector functioning discharges, as shown clearly in Fig. 5, wherein the numerals of each discharge with the subscript b designate the ejector tip.

As shown in Fig. 5, these ejector tips are positioned in spaced relation relative to each other and longitudinally of the direction of flow, and they are so arranged that no tip is blanked by an adjacent tip or any other tip, and if desired, the arrangement shown in Fig. 3 may be em-

ployed or the tips may be arranged annularly or angularly spaced apart or in spiral relation. The several roll and drum discharges therefor in the present embodiment of the invention, functionally are the same as that disclosed in Figs. 1 and 3, and the same action is obtained in the second embodiment as obtains in the structure disclosed in said Figs. 1 and 3.

In view of the detailed description relative to the embodiment illustrated in Figs. 1 to 3, inclusive, no further detailed description is believed necessary except to point out that insofar as the double backer rolls and drums are concerned, and the corrugating and preheating rolls are concerned, steam supply thereto is downwardly in each instance and at right angles to the intake, and then the discharge therefrom is outwardly therefrom and downwardly, the latter portion being at right angles. This arrangement, it will be obvious, does differ from that shown in Fig. 1, except insofar as the preheating drums 34 and 34*a* are concerned, and to this extent the present form of the invention is similar to the form of the invention in connection with preheating drums 34 and 34*a*.

Line 122 from the supply main 120*a* leads to the shower mechanism in this embodiment of the invention, and it will be noted that these showers are in multiple as were the showers previously described, except that in this form of the invention all the showers are connected to a single supply line 122 in turn connected to the main supply whereas in the previous form of the invention, the showers were individually connected to said main. This form of the invention also illustrates the addition of a guide roll 300 for the sheet to be showered and this derives its heat supply from the common connection to the showers, as shown, and then returns or discharges to the line 164*a* and if desired, this discharge may be provided with a trap discharging to the line 164 and with the usual drain line control valves. Only the take-off from line 122 to roll 300 is illustrated, the aforementioned return being omitted in view of description given and comparable illustrations of other returns. By making connections in the same manner any condensation in steam supply 122 will pass on by steam outlets and shower down through the guide roll 300 to line 164*a* in turn maintaining a ready supply of dry steam at valved outlets and showers.

The supply line to the several heating plates of the curing mechanism is herein designated by the line 197 and the main return is designated by the line 187 and it will be noted that the line 164 discharges by a Y-connection to this line 187 at 187*a*. Since the system of connections for the curing plates is substantially that previously described with reference to Figs. 1 and 2, no further reference will be had thereto, but reference now will be had to the bypass arrangements, and speed governor valve control shown in Fig. 4.

Referring to Fig. 4, it will be noted that line 197 is the steam supply line to the curing plates and the line 199 is connected at one end thereto and at the opposite end to the auxiliary main or high pressure line 120*b*. This is suitably valve controlled as at 198*a* and 199*b* and interposed between said valves is a branch 202 controlled by valve 202*a* and leading to a pressure gauge 201. The line 164*a*, which is the discharge line from the corrugating and preheating rolls and drums, is connected by line 193 to line 187 by way of the speed governor control valve 194 and the discharge 196 therefrom is controlled by valve 198*a*. The supply thereto is controlled by valve 198*b*, as before mentioned. This line 193 may include a pressure gauge also designated by the numeral 201*a*, and the supply thereto is suitably valve controlled by the valve 202*b*. A low pressure bypass is indicated by the numeral 200 and it is controlled by the valve 200*a*.

It will be noted that as between the two modifications, that in the present form of the invention, there is included a supply to the curing plates which is derived from the discharge from the corrugating rolls and preheating drums and this supply is controlled by the speed controlled throttle valve and that this low pressure supply is provided with a bypass arrangement, and also there is provided a high pressure bypass arrangement.

In the present form of the invention, it will be noted there is a pressure gauge included in the main low pressure supply and one in the high pressure bypass supply and none in the low pressure bypass arrangement whereas in the form shown in Fig. 1, there is no gauge shown in the low pressure supply or the high pressure supply but the gauge is shown in the low pressure supply bypass arrangement. It, of course, is evident that gauges may be included in each of the three supply arrangements mentioned or in any one or any two thereof.

Since the curing plates derive steam from the line 197 and the main return is by way of line 187, no further description is believed necessary since in the present embodiment of the invention, see Fig. 4, the curing mechanism is shown substantially identical to that in Figs. 1 and 2 of the first form of the invention, wherein line 97 constitutes the supply and 87 constitutes the main return.

Reference now will be had to several details of construction and these are set forth in the several figures beginning with Fig. 6.

In Fig. 6 of the drawings, there is illustrated in conventional, central section, a preheating drum and the cylindrical body portion thereof is indicated by the numeral 300 and one bearing is indicated by 301. The opposite bearing is tubular and is indicated by the numeral 302. The drum is hollow or chambered, as indicated at 303. Steam is supplied for heating purposes through the tubular channel 304 and thus enters the drum at the left hand end, as shown in Fig. 6. Within the drum is ½" hard, copper return tube, indicated by the numeral 305 and its free and open end terminates adjacent the solid end or bearing 301, such open end being indicated by the numeral 306. The end portion is turned, as indicated at 307, so that the mouth 306 of this return line is close to the drum periphery and more particularly the low side of the drum. So that, the entering steam will discharge through the drum and force the air therefrom on initial heating and then the water condensation formed by reason of that heating and subsequent maintenance of the heated condition of the drum also will discharge through this line 305. It is to be understood the fixture 307 is stationary and thus steam supply and the steam return as well as the venting or return tube are stationary while the drum is rotatably mounted.

In Fig. 7 there is similarly illustrated in conventional manner, a supply and return arrangement for the corrugating and pressure rolls,

In this form of the invention it will be noted that the numeral 400 indicates corrugating and/or pressure roll body portion including the chamber 403 and having a tubular end 401 which is closed as at 401a. This tubular end 401 is chambered as at 403a and a support member 408 is included therein. The opposite end of the drum includes the tubular bearing portion 402 which provides a steam supply space or passage 404 and extending therethrough and into the chamber is the return line 405. The steam supply and return line are suitably associated together as at 407.

Herein the return line 405 includes an offset portion 405a and near the remote end thereof is the intake portion 406. The free end of this pipe is capped as at 408a and the retainer element 409 is included upon the pipe opposite the cap, the support for the pipe being the apertured partition 408. The structure 407 and pipe 405 are stationary.

In Fig. 8 there is illustrated a modified form of the invention and this form may be utilized for any of the preheating rolls and drums just as either of the two preceding forms may be utilized in any of the preheating rolls and drums. In this form of the invention the numeral 500 indicates the roll or drum, 503 the chamber therein, 501 one bearing, 502 the opposite bearing. There is a recess arrangement in bearing 501 and the same is indicated at 503a. Herein a relatively large tube is positioned therein and is indicated by the numeral 510. It has four discharging openings 511 near end 501 and the end of this tube 510 is capped as at 508a which serves as a support for that tube within the recess 503. The end of the tubular bearing 501 is closed as indicated at 501a. The numeral 507 indicates a fixture similar to that previously designated and 507a indicates the steam inlet and 507b indicates the steam outlet. The tube 510 has free communication with inlet 507a and thus steam is supplied in the present instances at the remote end of the drum or roll, with reference to the connection arrangements. Since it is supplied at the remote end, the return is positioned at the adjacent end of the roll or drum and herein the same includes a smaller copper return tube 505 bent as at 506a and terminating in the inlet opening 506 adjacent the drum periphery and this extends downwardly so it terminates near the bottom of the drum.

In Fig. 9 there is illustrated a conventional type of trap and herein the numeral 600 indicates the body portion with the inlet opening 601 at the bottom. A cap structure 602 closes the top of the trap chamber. It includes in independent chamber 603, access to which is had by means of a plug 604 if desired, and a trap outlet opening 605. An opening 606 in the cap structure 602 provides a communication between chamber 603 and chamber 600a in the body portion 600. Mounted in chamber 600 is a bucket arrangement 607 and the same is connected to a valve arrangement 608 which controls the passage 606 in the conventional manner.

Figs. 10 and 11 illustrate a conventional diamond port valve and herein the body portion is indicated by the numeral 700 and the same includes inlet and outlet openings tapped for conduit reception and indicated by the numeral 701. The valve member is indicated generally by the numeral 702 and includes a diamond port 703 therein. The valve member 702 includes an externally exposed stem portion 704 which mounts an indicating collar 705 with a pointer 706 adapted to indicate valve positioning with reference to a scale 707 carried by the body portion of the valve.

The operating mechanism includes a handle 708 associated with the squared portion of the stem 704. A screw bolt 709 carried by the valve stem is a means for forcing lubricant contained in the valve body outwardly so that the valve is continuously lubricated until the bolt member has fully advanced into the valve stem, whereupon it is removed, the valve stem lubricating chamber repacked and the lubricating pressure applying bolt repositioned. The valve body closes one end of the valve and a plug 710 closes the opposite end thereof. The valve body is normally retained in seated relation by a spring, not shown.

Figs. 12 and 13 illustrate the thermometer or temperature gauge and its method of mounting. In said figures, the numeral 800 indicates a conduit including a cross connection 801. The gauge body portion 802 includes a threaded portion 803 which is threaded into one of the two transverse threaded portions of the cross fitting. The opposite opening of the cross fitting receives a nipple 804 of the desired length and this is closed by a cap 805.

Projecting axially into this capped nipple arrangement and from the portion 803 is the thermally responsive structure 806 which has an indicating element 811 thereon. The chamber 807 is formed by the transparent closure 808 and the retaining member 809. The dial member 810 is carried by the body portion 802 in the chamber 807. Thus, the temperature of the steam in the conduit 800 is visually indicated at all times.

Reference now will be had to Fig. 14. In this figure there is illustrated a valve body portion 900 and the inlet opening is indicated at 901 and the outlet opening at 902. Complementary connections for connecting piping thereto are indicated by the members 903 and the rings 904. This body portion includes a partition arrangement 905 which has two openings 906 in axial alignment and the same receives a valve member 907. The two openings 906 are in alignment and the valve body includes an opening 908 in alignment therewith closed by a plug 909. This valve body 900, opposite the plug 909 and the aligned openings 906, includes an opening 910 defined by anchoring flange 911.

There is suitably carried by this flange 911 another flange 912 and the arms 913 therefrom suitably support a lateral bearing arrangement 914 and mounted therein is a shaft that at one end mounts a bevel gear 915 and at the opposite end a pulley 916. This pulley is belt driven from some part of the machine, usually the double backer mechanism, and, therefore, this gear is driven at a speed proportionate to the machine speed.

Meshing with the gear 915 is another gear 917 and a collar 918 connected therewith includes elongated flexible members 919 with counterweights 920, the members being connected together as at 921. As these members rotate, the collar portions 918 and 921 have movement toward and away from each other and thus the central portion 922 has axial movement with reference to the axis of the gear 917. This structure 922 is suitably connected as at 923 to the valve 907. Thus, as the speed of the machine

varies, the valve position is varied. The faster the machine operates, the more valve opening is provided and vice versa. Thus, the heating plates are properly heated at all times to have the desired heat or curing capacity for the amount of board fabricated and passing thereover and to be properly cured. Overcuring and undercuring, therefore, incident to speed variation of the machine is prevented.

The present system also contemplates the controls, to-wit, the valves and the thermometers and gauges, all being positioned, together with the cleaning hose outlets, on the side of the machine adjacent which the operator usually has his station.

The several traps insure discharge of air and condensation from the several supply lines, plates, rolls, drums, et cetera, when trapped, and to the return line, or lines, thus insuring live steam in said supply lines and rapid circulation through the steam heated devices.

Previous to this system, a standard corrugating machine has had some portions of the device improperly heated and to an extent of 100° F. The previous underheating (local in character) results solely from water and air locking in some portion of a steam heated element. The present invention eliminates unequal, insufficient as well as excessive heating of elements, permits maximum operation, reduces "warm up" time and is automatically controlled for substantially perfect board fabrication.

While the invention has been illustrated and described in great detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character.

The several modifications described herein as well as others which will readily suggest themselves to persons skilled in this art, all are considered to be within the broad scope of the invention, reference being had to the appended claims.

The invention claimed is:

1. A heating system for a corrugated board machine including steam heated rolls, drums, and plates in combination with a steam supply and a steam return, of means independently connecting each of the rolls and drums to the supply, independent discharges from the rolls, drums and plates, trap means connecting certain of the drum, roll, and plate discharges to the return, means connecting the discharges of other certain of the rolls and drums directly to the plates for the series heating of the latter, and a corrugated board machine speed responsive control device in said last mentioned connecting means for automatically regulating curing plate heating as required by the rate of board formation by the machine.

2. A heating system as defined by claim 1, characterized by the addition of a controlled bypass around the control device for the purpose described.

3. A heating system as defined by claim 1, characterized by the addition of a controlled bypass from the steam supply to the plates and around the control device for the purpose described.

4. A heating system as defined by claim 1, characterized by the addition of a controlled bypass around the control device, and a second controlled bypass from the steam supply to the plates and around the control device for the purpose described.

5. A heating system as defined by claim 1, characterized by the addition of a controlled bypass around the control device, and a second controlled bypass from the steam supply to the plates and around the control device for the purpose described, said controlled bypasses having a common connection to the connecting means including the control device and downstream of that control device.

6. In a corrugating machine having the usual steam heated corrugating and pressure rolls and heating drums, and heating plates for curing the paper board, the combination with a steam supply, of means supplying steam in parallel relation to the several rolls and drums, controls for each of the parallel supply means, means supplying steam to the plates, a machine speed responsive governor valve arrangement for regulating the steam supply to said plates, the exhaust steam from the rolls and drums constituting the steam supply to certain plates, trap means for the various steam supplies, a bypass around the governor valve in the plate supply means and from the roll and drum exhausts, another bypass around the governor valve from the first mentioned supply to the plate supply means, and valve means in each bypass line for manual control thereof.

7. In a corrugating machine having the usual steam heated corrugating and pressure rolls and heating drums, a steam shower arrangement in parallel therewith, and heating plates for curing the paper board, the combination with a steam supply, of means supplying steam in parallel relation to the several rolls, drums and shower arrangement from said supply, controls for each of the parallel supply means, means supplying steam to the plates, a machine speed responsive governor valve arrangement upstream of the last mentioned means for regulating the steam supply to said plates, the exhaust steam from certain of the rolls and drums constituting a steam supply to certain plates, trap means for the various steam supplies, a bypass around the governor valve in the plate supply means and from the roll and drum exhausts, another bypass around the governor valve from the first mentioned steam supply to the supply plate means, valve means in each bypass line for the manual control thereof, each exhaust from the said certain rolls and drums including an ejector tip connection to the means supplying steam to the plates, and a return line from the shower steam supply means to the plate steam supply means and upstream of the several tip connections thereto and upstream of the governor valve control thereof.

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