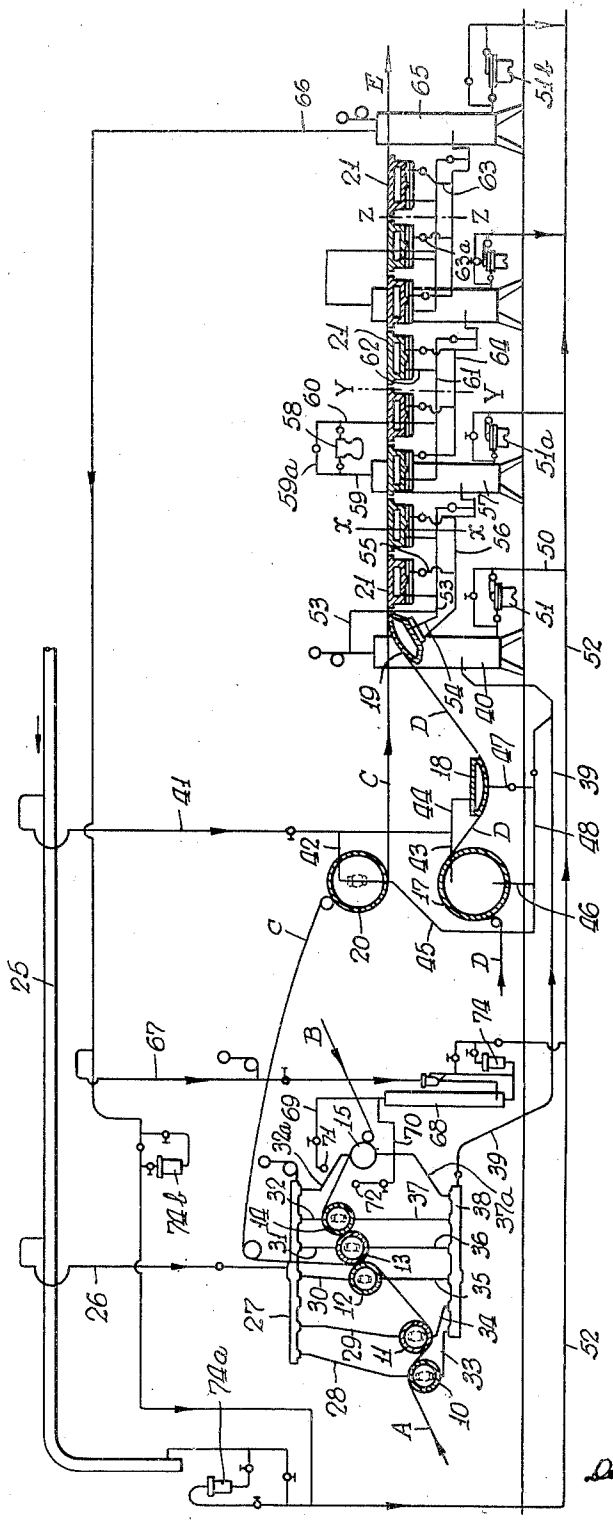
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HEATING SYSTEM FOR CORRUGATING MACHINES

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HEATING SYSTEM FOR CORRUGATING MACHINES

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This invention relates primarily to apparatus for the manufacture of corrugated board, and involves a new system of moistening, heating and drying the constituent sheets as they are advanced through the machine and assembled to form a final product.

In the manufacture of double faced corrugated paper from sheets of continuously advancing paper, the successive steps usually employed are to heat and moisten one of the sheets; pass it between heated corrugating rollers; apply adhesive to the crown of the produced corrugations; pass the corrugated sheet and a plain facing sheet between a smooth heated roller and one of the corrugating rollers, and under pressure to form a single corrugated sheet; apply adhesive to the opposite side of the corrugated sheet at the crowns of the corrugations; bring a second facing sheet into engagement with the adhesive-coated crowns; draw the assembly of three sheets under pressure over heated plates by the action of endless conveyor belts which apply pressure as well as traction; and deliver the stiff double faced corrugated sheet thus produced, to a suitable cut-off mechanism which cuts it into sections of the required length.

In a high speed apparatus of this type there are usually employed from 25 to 40 heated units, such as drums, rollers and plates, and steam is usually employed as the heating medium. The heating to be efficient should utilize the latent heat of steam, and the steam should be kept under such pressure in the several units as to give the desired heating temperature. The collection or retention of non-condensable gases in the system should be prevented, so far as possible, because they act as insulators and impair the ability of the steam to give up its heat. Therefore, such gases should be vented from or swept out of the units in which they might otherwise collect, and in such a manner as to prevent the simultaneous venting of any steam which might otherwise be utilized in heating the units, or some of the materials entering the units.

In some constructions groups of units, such as the three main rollers of the singlefacer, and separate groups of plates of the doublefacer, have been connected for the flow of steam therethrough in series, but in such an arrangement the steam flow and the heating effect will be

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progressively less in the units of each group due to steam condensation in each, and due also to the intermittent action of the traps.

In some constructions the several units have been connected in parallel between a steam supply pipe and a common return line, and with a trap at the outlet of each common return line. With this arangement there is difficulty in obtaining the proper steam flow in each unit to give the heat there required, a liability of short-circuiting some units, a low rate of flow in each unit, and a wasteful discharge of steam to the return line from many of the units.

In order to facilitate the proper corrugating of the paper in the singlefacer, it is desirable to moisten and heat it before it is corrugated, and for this purpose it has been common practice to deliver steam against the paper before it enters between the corrugating rollers. It is usual practice to deliver such steam directly from the main line to properly positioned nozzles, commonly known as showers.

Among the objects of the present invention are to overcome various objections to prior procedures, more effectively utilize the steam employed, better distribute the heating in accordance with the needs of the various units of the apparatus, avoid the necessity for traps through which steam or gases flow, prevent the loss of steam with vented gases, and provide a system in which all of the steam delivered is utilized. Other objects and advantages will be pointed out hereinafter, or will be apparent from a study of the apparatus illustrated.

In my improved system I need not employ any steam return line, and need not vent any non-condensable gases from the system along the line of steam flow. The steam is delivered through all of the units to be heated, with the different types of units connected in series, and condensate is trapped and withdrawn from the steam line after leaving each unit, or each small series of units. The units are connected in such order that the ones to be heated to the highest temperature receive the steam first, and the ones requiring the least heat receive it last. The residual steam, after leaving the last unit, is discharged to the atmosphere through nozzles, commonly known as showers, for moistening and heating one or more of the sheets to be incor-

porated in the product, and all of the non-condensable gases are discharged from the system and into the atmosphere with the steam used for such moistening and heating.

Thus all of the steam delivered from the boilers is used up in the system, there is a high rate of flow through the entire system, the non-condensable gases are prevented from collecting in any of the units, and the condensate from the several units may flow back for re-use in the boiler, and without impeding the delivery of steam to the units.

My improved system is very economical in the use of steam, as it requires only a small number of pounds of steam per 1000 square feet of product produced. It permits of the operation of the machine at very high speed, and the production of corrugated board in which the tendency to subsequent warpage is greatly reduced, due to the controlled and efficient heating of the units, and prevents the collection of any non-condensable gases in any of the units, by the sweeping action of the rapid flow of steam therethrough.

Broadly considered, my improved system involves delivering the high pressure steam through the rollers of the singlefacer, then through the plates of the doublefacer, at a pressure readily adjusted to suit the characteristics of the materials being used, generally in series and in the direction of movement of the sheets; then from the delivery end of the doublefacer back to the opposite end of the machine where it together with all non-condensable gases which may be included, is discharged to the atmosphere and against the sheet or sheets to be processed, before the latter pass between the corrugating rollers, or in some cases against the facing sheets before these enter the machine, and where such facing sheets may require such treatment. Condensate formed in the several units is trapped at a plurality of points along the line, so that it does not interfere with the rapid flow of steam through the system.

As specific features, the steam may be passed through the rollers of the singlefacer in parallel; may be passed in parallel through the plates of successive groups, but through the groups in series; and the steam, after leaving the doublefacer, may be heated if necessary before being sprayed against the sheet to be corrugated.

In the accompanying drawing the main portions of a machine for making double faced corrugated board are shown diagrammatically, but where there are employed a plurality of similar units, only one or a few of such units are shown. It applies particularly to the plates of the doublefacer, and on the drawing the lines *x—x*, *y—y* and *z—z* indicate places from which parts of the machine are omitted. It also applies to the singlefacers where two or more are employed in making a product having two or more corrugated sheets with intermediate plain sheets and outside facing sheets.

The parts of the machine which are of conventional form and the function thereof will be described first, and without reference to my improved system.

The singlefacer includes a pair of heated drums **10** and **11**, a pressure roller **12**, a pair of corrugating rollers **13** and **14**, and in some cases a heated drum **15**. The facer sheet A passes around the heated drums **10** and **11**, and then between the pressure roller **12** and the corrugating roller **13**. The other sheet B passes over the heated drum **15** which frequently houses one of

the shower pipes, under another steam shower pipe, and then between the corrugating rollers **13** and **14**. Glue is applied to the crowns of the corrugations of the sheet B while the latter is in the corrugating roller **13**, and the resulting single faced sheet C is delivered to the doublefacer. The facer sheet D is passed around a heated drum **17**, thence under a heated plate **18** and over a second heated plate **19**, where it comes into contact with the single faced corrugated sheet C after the latter has passed over a heated tension drum **20** and a suitable glue applier, not shown.

The doublefacer includes a large number of heated plates **21**, over which the double faced corrugated sheet E is pulled at high speed, while pressure is applied to hold the sheets together during the setting of the glue. Such pulling and pressing means including a conveyor belt above the sheet E and the plates **21**, and a second conveyor belt below the sheet E and beyond the plates. As these conveyors, the glue applying means, the drive for the rollers and drums, and such other mechanical elements, form no portion of the present invention and are not involved in my improved heating system, and may be of conventional form, they have not been illustrated.

In carrying out my invention in the specific form illustrated, high pressure steam, which may have a temperature in the general range of 330° F. and 380° F., is delivered from the boiler through a steam main line **25**, which is preferably mounted overhead, and to the single facer end of the machine. A branch line **26** leads from the main line to an inlet manifold **27** above the singlefacer. From this manifold the steam passes through parallel lines **28**, **29**, **30**, **31**, **32**, and **32a** to the interiors of the drums **10**, **11** and **15** and the rollers **12**, **13** and **14**. From these it flows through parallel lines **33**, **34**, **35**, **36**, **37**, and **37a** to an outlet manifold **38** disposed at a lower level than said drums and rollers. From this manifold it, together with any condensate, flows through a line **39** to a separator **40**, preferably disposed adjacent to the intake end of the doublefacer.

Steam is also drawn off from the main line **25** through a line **41** and through branch lines **42**, **43** and **44** to the interior of the heater drums **20** and **17**, and the heater plate **18**. From these the steam, together with any condensate, flows through parallel lines **45**, **46** and **47** to a line **48** joining the line **39** leading to the separator **40**. Thus the several heated drums, rollers and plates which engage the sheets A, B and C have steam passed therethrough in parallel, and all of the exhaust steam, non-condensable gases and condensate from these units pass to separator **40**, from which the condensate is withdrawn through a line **50** including a trap **51**, to a condensate return line **52**.

In the doublefacer there may be a large number of heater plates **21**, and these are preferably divided into groups with the steam passing in parallel through the plates of each group and in series through the groups of the plates, and with condensate withdrawal from the line between successive groups. The number of plates in each group may be one or more, and the number of groups may be one or more, and the different groups may have different numbers of plates. The exact arrangement will depend on the size of the machine, the number of elements used, and the average rate of steam consumption in these elements, but will in any case be such that the

steam flow will be maintained at a sufficiently high rate to prevent non-condensable gases from departing from the steam to form films or pockets of any appreciable size.

As shown, the steam, after having heated the units of the singlefacer, and after having all condensate removed at the separator **40**, but still including any non-condensable gases which may have been in the steam, is taken from the top of the separator **40**, through a line **53**, and conducted through branches **54** to the plate **19**, and to the plates **21** of the first group of plates, at the intake end of the doublefacer. From these plates it passes through branches **55** to a line **56** leading to a separator similar to separator **40**, and with a trap **51***a* for withdrawal of condensate to the line **52**.

The steam is delivered to the units of the singlefacer under pressure, which may be 100 to 175 pounds, but this pressure and the corresponding temperature, drop somewhat in passing through said units and the associated drums, and drop further with corresponding drop in temperature while passing through the first group of the doublefacer plates. Less heat is normally required in the remaining groups of plates of the doublefacer, and therefore a pressure reducer **58** is provided in the line **59** leading from the top of separator **57**. This pressure reducer may be of various different types, but is preferably a Spence regulating valve which may be set to drop the pressure, for instance, to 40 pounds. The customary means are of course provided for the regulation of this pressure reducer so that the operator may deliver steam therefrom to the remaining plates of the doublefacer under any reduced pressure and reduced temperature that may be desired to suit the materials being run, and so as to produce board of better quality and with less tendency to subsequent warpage. For operation under conditions requiring maximum heat a by-pass line **59***a* to render this pressure reducing valve inoperative is provided.

Steam from the pressure reducer **58** passes through a line **60** to a line **61**, from which branches **62** in parallel deliver steam to the heater plates **21** of the next group, and the steam from these may pass through branches **63** in parallel to a line **64** to the separator and condensate trap at the end of this group of plates. The parallel discharge branches **63** preferably have flow regulators **63***a* to facilitate the regulation of flow and secure the desired distribution through the plates. There may be as many groups of plates with intermediate separators and traps as desired, and the steam from the final plates goes to a separator **65** similar to the separators **40** and **57**, and with a similar condensate draw-off trap **51***b*. It will thus be seen that the highest temperature steam is used in the singlefacer and the pre-heaters, slightly lower temperature steam is used in the first plates of the doublefacer, and the lowest pressure steam is used in the final plates.

From the final separator **65** the residual steam, together with all non-condensable gases which may have been in the original steam, is taken off through the line **66** and conducted back to the singlefacer. Here it passes through a line **67** to a heater **68**, thence through branches **69** and **70** to nozzles **71** and **72**, which latter may frequently be located in a recess of heater drum **15**. These nozzles are disposed on opposite sides of the sheet B and in advance of the point where said sheet engages the corrugating roller **14**. The heater **68** may be of any suitable type, but is preferably an electric heater, so that the temperature of the exhaust steam from the delivery end of the doublefacer may be raised to a suitable temperature, ranging as high as 500° F., before being sprayed onto the sheet B. The steam from line **67** preferably passes to the bottom of the heater, and any condensate may be drawn off through suitable trap **74**. The condensate from the trap may be delivered to the line **52**. In case there is any condensation in the main steam line **25**, or in the line **66**, it may be drawn off through similar suitable traps **74***a* and **74***b* and delivered to the line **52**.

It is important to note that in my improved system there is no vent for non-condensable gases along the line of flow of the steam, and that all such gases are swept through the system and discharged therefrom with the steam spray nozzles at **71** and **72**. Where the facing sheets also require some spraying with steam there will be additional nozzles suitably located. It will also be noted that there is no steam return line, that all of the steam delivered through the main line **25** is used up in the system, and all condensate formed along the line is separated and returned through the line **52**.

It will also be noted that the steam under the highest pressure and at the highest temperature is delivered to the elements which require maximum temperature, namely the several preheaters and the rollers of the first unit; that the steam is then delivered to the doublefacer; and that steam at the lowest temperature and lowest pressure employed is used in maintaining the temperature of the completed sheet or board at the delivery end portion of the doublefacer, where it acts primarily to prevent cooling of the sheet rather than to raise the temperature thereof.

It will also be noted that the stream ultimately used in the nozzles adjacent to the corrugating rollers is first circulated through the machine, thus increasing throughout the machine the rate of stream flow, which in turn makes it possible to effectively sweep out the objectionable non-condensable gases. Furthermore it should be noted that since these nozzles are discharging steam continuously while the machine is in operation there is continuous flow through the machine. This not only aids in sweeping out non-condensable gases but also aids materially the efficient removal of condensate and makes possible a much quicker and more accurate control of the steam pressure and temperature of all but the first group of plates in the doublefacer.

Pressure gauges are employed at the various separators, and if desired at other places in the line of flow, in order that the operator may observe and control the temperature and pressure of the steam delivered to the various units.

It will be understood that if two or more corrugated sheets are employed with intermediate plain sheets to make a thicker and stiffer product, a plurality of singlefacers may be employed and connected in parallel by steam lines drawn from the main supply line **25**, and all delivering their exhaust steam to the line **39** which goes to the separator **40**.

It will further be understood that where no doublefacer is used, as for instance where single faced board only is produced, or where for various reasons it is not considered feasible to alter the steam and drainage system of a doublefacer, this system of circulating the shower steam through the heated elements of a corrugator can

be applied to the singlefacer only. Similarly the system can be applied only to the doublefacer, the shower steam for a singlefacer operating in conjunction with such doublefacer circulating through the double facer only.

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

1. A heating system for a corrugated board machine, including a singlefacer having steam heated rollers and drums and a doublefacer having steam heated plates, in combination with a steam supply line, a condensate return line, means for conducting steam from said supply line through said rollers and drums, thence through said plates, and thence as jets against at least one of the sheets delivered to the machine for moistening the sheet to be corrugated, separators for condensate at spaced points along the line of steam flow, and traps for withdrawing condensate but not gases from said separators, and delivering it to said return line.

2. The combination of a singlefacer having steam heated corrugating rollers, a doublefacer having steam heated plates, means for supplying steam to said rollers, means for separating condensate but not gases from the steam delivered from said rollers, means for delivering steam from said separating means to said plates, means for separating condensate but not gases from the steam delivered from said plates, and means for heating at least one of the sheets delivered to said singlefacer, by the steam and gases delivered from said last mentioned separating means.

3. In combination, a singlefacer, a doublefacer, a moistener for at least one of the sheets delivered to said singlefacer, and means for delivering steam to said singlerfacer, said doublefacer, and said moistener in series, and in the order above named.

4. In combination, a singlefacer having a plurality of rollers and drums, moistening and heating means for at least one of the sheets delivered thereto, means for delivering steam through said rollers and drums in parallel, separating means for removing condensate but not non-condensable gases from the steam leaving said drums and rollers, and means for delivering to said moistening and heating means said last mentioned steam from said separating means.

5. In combination, a singlefacer having a plurality of rollers and drums, moistening and heating means for at least one of the sheets delivered thereto, means for delivering steam through said rollers and drums, separating means for removing condensate but not non-condensable gases from the steam leaving said drums and rollers, and means for delivering to said moistening and heating means said last mentioned steam from said separating means.

6. A machine for processing sheet material, including a plurality of elements over which the material passes in series, means for delivering steam through said elements in series in the path of movement of the material, and means for moistening said material at the material intake end of the machine, by exhaust steam discharged from an element at the delivery end of the machine.

7. A machine for processing sheet material, including a plurality of elements over which the material passes in series, means for delivering steam through said elements, and means for moistening said material at the material intake end of the machine, by exhaust steam discharged from an element at the delivery end of the machine.

8. A machine for making double faced corrugated paper, including a series of plates over which the paper passes, means for passing steam through said plates generally in the direction of movement of said paper, means for separating condensate but not non-condensable gases from the steam discharged from said plates, and means for moistening and heating a sheet delivered to said doublefacer by said last mentioned steam and gases.

9. A machine for making double faced corrugated paper, including a series of plates over which the paper passes, means for passing steam through said plates, means for separating condensate but not non-condensable gases from the steam discharged from said plates, and means for moistening and heating a sheet delivered to said doublefacer by said last mentioned steam and gases.

10. A machine for making corrugated paper having at least one facing sheet, said machine having a plurality of hollow heating members acting in series along the path of movement of the paper, means for delivering steam to said members, and means for discharging against at least one sheet entering the machine exhaust steam and non-condensable gases from a heating member adjacent to the delivery end of the machine.

11. In combination, a singlefacer, a doublefacer, a moistener for at least one of the sheets delivered to said singlefacer, means for delivering steam to said singlefacer, said doublefacer, and said moistener in series, and in the order above named, and means for separating condensate but not non-condensable gases from said steam between said singlefacer and said doublefacer and between said doublefacer and said moistener.

12. In combination, a singlefacer, a doublefacer, a moistener for at least one of the sheets delivered to said singlefacer, means for delivering steam to said singlefacer, said doublefacer, and said moistener in series, and in the order above named, and means for separating condensate from said steam between said singlefacer and said doublefacer and between said doublefacer and said moistener, whereby all non-condensable gases in the delivered steam are swept through said singlefacer and said doublefacer, and discharged at said moistener.

13. In combination, a singlefacer having a plurality of rollers and drums, moistening and heating means for at least one of the sheets delivered to said singlefacer, a doublefacer having a plurality of groups of plates, means for delivering steam through said rollers and drums in parallel, a condensate separator through which the steam is delivered from said rollers and drums, means for delivering steam from said separator through said groups of plates in series and through the plates of each group in parallel, condensate separators through which the steam passes between each group of plates, and means for delivering steam, together with all non-condensable gases from the last of said separators to said sheet heating and moistening means.

14. In combination, a singlefacer having a plurality of rollers and drums, moistening and heating means for at least one of the sheets delivered to said singlefacer, a doublefacer having a plurality of groups of plates, means for delivering steam through said rollers and drums in parallel,

a condensate separator through which the steam and non-condensable gases are delivered from said rollers and drums, means for delivering steam and gases from said separator through said groups of plates in series and in the general direction of the movement of the product through the doublefacer, a condensate separator through which the steam and gases pass from the last group of said series, and means for delivering said steam and gases from said last separator to said moistening and heating means.

WALTER J. GOETTSCH.

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