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C. H. KLEIN ET AL

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APPARATUS FOR MAKING PRINTED CORRUGATED PAPER BOARD

Filed May 20, 1963

2 Sheets-Sheet 1

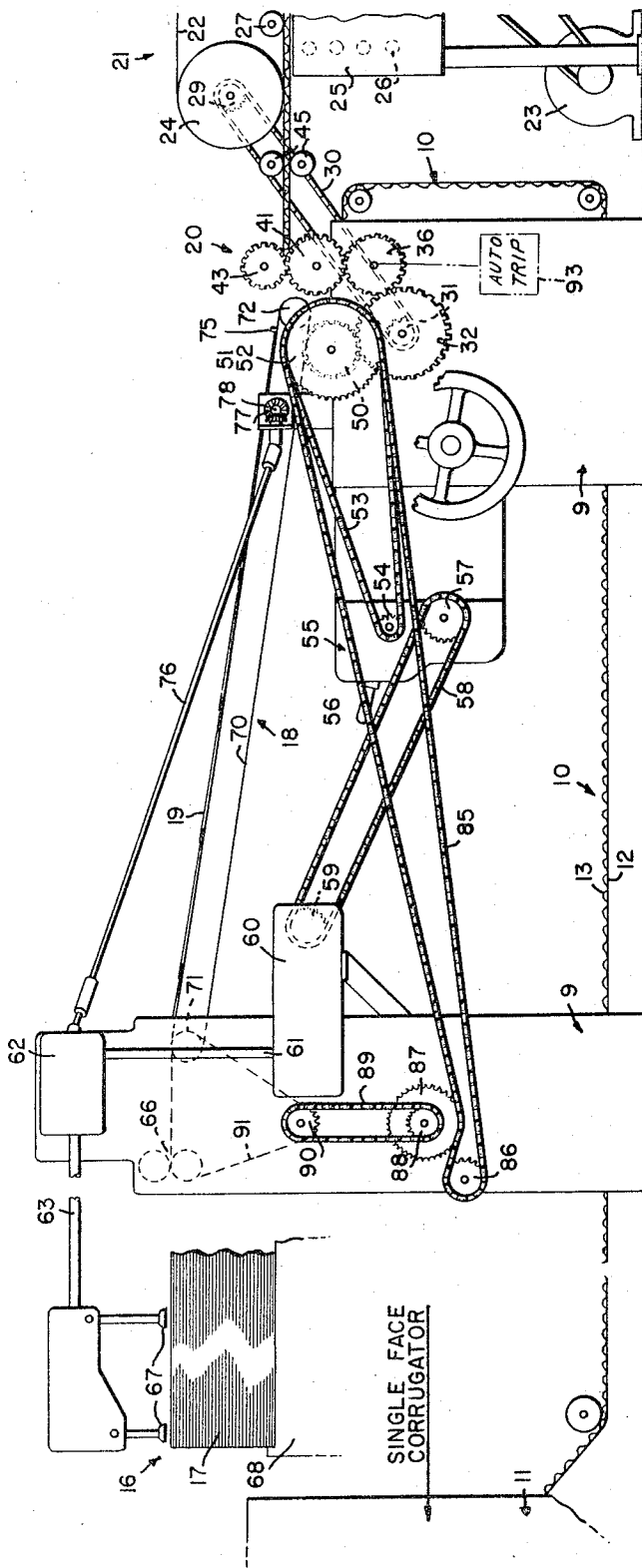


Fig. 1

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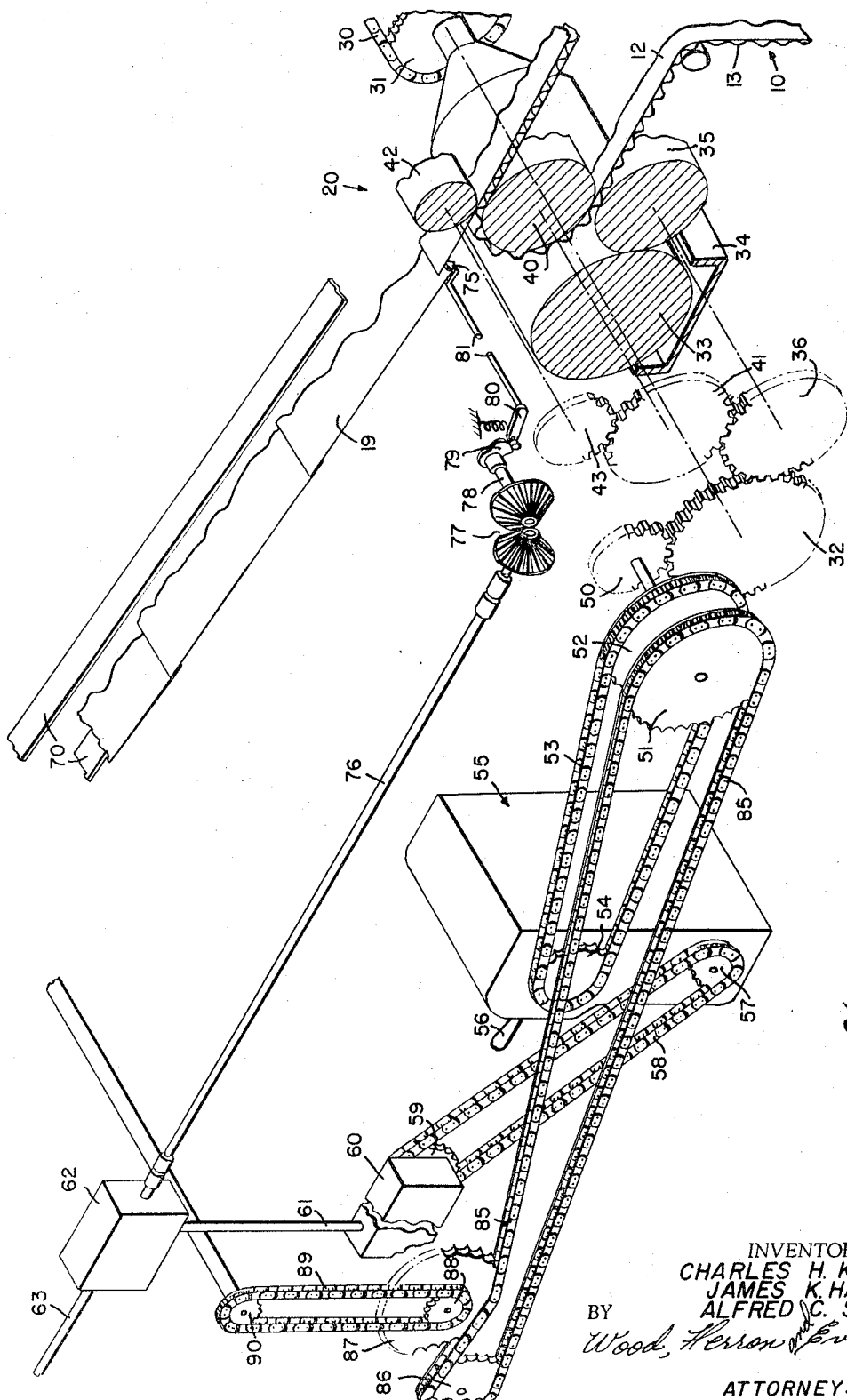
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APPARATUS FOR MAKING PRINTED CORRUGATED PAPER BOARD

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This invention relates to printed corrugated paper board, and more particularly the invention is directed to apparatus for manufacturing corrugated paper board in which one facing sheet is formed from a plurality of separate printed sheets.

While the invention may have many applications, it has been originally developed as a solution to a problem in the manufacture of printed corrugated board cartons for packaging goods. Printed cartons manufactured from corrugated board are not of themselves new, but until the present invention, manufacturers of such corrugated board have had imposed on them limitations as to the sizes of the corrugated boards. The limitations arise from the known apparatus for manufacturing corrugated paper board and from the printing machines with which one of the facing sheets is printed. The manufacture of double-face corrugated paper requires three continuous webs which are fed into a corrugating machine. The machine corrugates one of the webs and adhesively joins it between the other two webs. The requirement of manufacturing corrugated board from three continuous webs confines the printing of the web to a web fed rotary press. Presses of that type are limited in that they can print only a single size display whose length must be no greater than the diameter of the printing cylinder. The box must be so designed so that its dimensions or multiples of its dimensions correspond to that single size. This severe restriction in manufacture of printed corrugated paper board has resulted in an extremely limited use of printed paper board cartons.

The present invention arises in part from the realization that the use of printed corrugated paper board cartons could be greatly expanded if one face of the board could be formed, at least initially, by printed sheets for there is no restriction, within practical limits, on the size of the printing on single sheets.

As an initial solution to the problem it was proposed to print single sheets, in a sheet fed press, to join the sheets edge to edge to form a single web which could be rolled and then to send that web through a corrugating machine in a known manner. This proposal resulted in a satisfactory product; however, the cost of joining the single sheets end to end increased the cost of the resultant product to the point that it was not fully competitive with other types of packaging cartons.

It has been an objective of the invention to provide apparatus for feeding printed sheets sequentially onto a moving single-face corrugated web to form a double-face corrugated board with printing on one surface of the board. The apparatus of the present invention can be used in combination with a known corrugating machine wherein a center sheet is corrugated and joined to a face sheet and that single-face web is thereafter fed into the apparatus of the present invention to receive the single sheets which form the other face of the corrugated board, the combination thereafter being passed through a drier. Alternatively, the single-face corrugated sheet can be first formed and then used in combination with the present invention as a supply roll.

It is still another objective to provide apparatus of the type described above which is adapted to handle sheets of any desired length within practical limits.

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The combination of the invention includes a supply of single-face web, a sheet feeder, a set of rolls into which the sheets and single-face web are fed to be joined and a movable stop for engaging the single sheets to assure proper registry to the sheets going into the set of rolls. Downstream of the rolls is an endless belt drier of the usual type employed with corrugating machines. In the preferred form of the invention power is applied to the endless belt in the drier. A non-slip drive system constituted by meshing gears and/or sprockets in chains transmits power from the drier to the sheet feeder and the stop. The drive system has a variable speed transmission interposed between the drier and the feeder and stop in order to selectively vary frequency of feeding of the sheets into the rolls and thereafter into the drier. Thus the invention contemplates the driving of the drier, the set of rolls, and the supply of single-face web at a predetermined fixed lineal speed and varying the speed of feeding of the single sheets, depending upon their length, in order to time the feeding of the sheets onto the single-face web.

The invention further contemplates the provision of a slight overlap of the single sheets to provide assurance that there will be no exposed surface of the single-face web with adhesive applied to it passing through the drier.

It is contemplated that the invention will be used in combination with a conventional corrugating machine. In such a conventional machine single-face corrugated paper is first formed with a facing sheet and with the corrugated sheet facing downwardly. Thereafter the second facing sheet is fed under the single face web and into a set of rolls where adhesive is applied to the corrugated sheet, the corrugated sheet then being secured to the second facing sheet to form double-face corrugated board. The double face is immediately fed into a drier in which the second facing sheet slides in contact with the surface of a heating table to provide the most efficient application of heat to the adhesive. This drying step is regarded as quite important to prevent warping or other distortion of the double face.

In accordance with the present invention, while a conventional corrugating machine is used, its direction is reversed from that of conventional practice so that the single face moves toward the drier with the corrugated sheet facing upwardly. The printed sheets are then fed from above the single face, as contrasted to conventional practice.

The several features and objectives of the invention will become more readily apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a diagrammatic side elevational view illustrating the invention, and

FIG. 2 is a diagrammatic perspective view of the drive system of the invention.

In the drawings and written description of the invention, for the sake of clarity much of the detail has been omitted for it forms no part of the present invention and its addition to the description would serve only to obscure those distinctive features of the invention. For example, the sheet feeder has been illustrated only diagrammatically. Sheet feeders are in common use and have been known for years and there is no assertion of an invention in the sheet feeder per se.

Referring now to the drawings, all of the elements of the apparatus are mounted on supporting structure which is referred to generally as the base 9. The apparatus employs a supply of single-face web 10, the supply being indicated at 11. The supply may be constituted by a corrugating machine of known design or alternatively it may be constituted by a roll of previously formed single-face corrugated paper. The term "single-face" or "single-

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face corrugated paper" is used to designate that paper which has a facing sheet 12 to which is adhesively secured a corrugated sheet 13. The term "double-face" or "double-face corrugated paper board" is used to designate that paper board which comprises two facing sheets such as sheet 12 the facing sheets having a corrugated sheet such as sheet 13 sandwiched between them.

The corrugating machine indicated at 11 has its direction reversed, as compared to conventional practices, so that the single face formed there will move toward the double facing apparatus with the corrugated sheet 13 facing upwardly.

Adjacent to the supply of single-face web 11 is a sheet feeder 16 which is adapted to feed sheets from a stack 17 individually and sequentially onto an endless conveyer 18. The single-face web 10 and the sheets indicated at 19 from the stack 17 are fed into a set of rolls illustrated at 20 where they are joined together and thereafter fed into a drier 21, driven by a belt 22, where the adhesive, previously applied to the web 10, is dried and a relatively rigid double-face board is formed. After passing through the drier, the double-face paper board is cut to proper size through apparatus commonly used in corrugating and which forms no part of the present invention.

An electric motor 23 forms the power supply for the entire apparatus. The electric motor may be connected to the downstream end of the drier 21 to drive belt 22 which passes around a drum 24. The belt bears against the double-face paper board to hold it in engagement with a heating table 25 having heating elements 26 disposed therein.

Because the freshly applied adhesive which joins the sheets 19 to the single-face web is on the side of the paper board remote from the heating table 25, one or more hold-down rolls 27 may be employed to provide assurance that the belt 22 forces the double-face board into engagement with the heating table so that there is no cushion air between the paper board and the table which might tend to insulate the paper board from the heat in the table.

A sprocket 29 is fixed to the drum 24 and rotates with that drum. A chain 30 connects the sprocket 29 to a sprocket 31 which is fixed to a main drive gear 32. Referring to FIG. 2, the main drive gear has a pick-up roll 33 fixed to it, the pick-up roll passing in a trough 34 containing starch or other suitable adhesive. The pick-up roll 33 is in engagement with an applicator roll 35 to effect a transfer of the adhesive from the surface of the pick-up roll to the surface of the applicator roll. The applicator roll is driven by a gear 36 which is fixed to it and in meshing engagement with the main drive gear 32.

Above the applicator roll is a pressure roll 40 around which the single-face web 10 passes with the corrugated sheet 13 exposed in order to pick up adhesive from the applicator roll 35. The pressure roll 40 is driven by a gear 41 fixed to it and in meshing engagement with the gear 36.

An upper pressure roll 42 is located immediately above the pressure roll 40 and is driven by a gear 43 which is in meshing engagement with the gear 41. The sheets 19 are fed between the upper pressure roll 42 and the single-face web 10 passing around the pressure roll 40, the sheets being joined to the single-face web at that point. The thus formed double-face board is passed between two rolls 45 and into the drier 21.

The main drive gear 32 is in engagement with a gear 50 which is fixed to a double sprocket 51, 52. A chain 53 from sprocket 52 passes over a sprocket 54 which forms the input to a variable speed transmission 55 having a gear changing lever 56. The output of the variable speed transmission is connected to a sprocket 57. A chain 58 connects the sprocket 57 to a sprocket 59 on a gear box 60. The gear box 60 is connected by a drive shaft 61 to another gear box 62. The output of the gear box 62 is connected by a shaft 63 to the sheet feeder 16. As the shaft 63 rotates, the sheet feeder lifts sheets 19 from the stack 17 individually and feeds them into a set

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of pull-in rollers 66. The sheet feeder of the illustrated embodiment includes a plurality of suction cups 67 which engage and lift the sheets and the sheet feeder moves toward the right as viewed in FIG. 1 to advance the sheets into the pull-in rollers 66. The sheets 17 are mounted on a table 68 which rises slowly as the supply of sheets in the stack 17 is depleted.

The operating cycle of the sheet feeder is timed to permit a slight (approximately two-inch) overlap of the discharged or downstream sheets with the incoming or upstream sheets as illustrated in the drawings.

The sheets passing through the pull-in roller are carried toward the set of rollers 20 by the endless conveyer 18. This endless conveyer is formed by a series of spaced parallel endless tapes 70 which pass over rollers 71 and 72. At the end of the conveyer 18 is a movable stop 75 which is operated by a shaft 76 connected to the gear box 62. As best illustrated in FIG. 2, the shaft 76 is connected to a pair of bevel gears 77 to drive a cam shaft 78. A cam 79 on the end of the cam shaft is engaged by a spring loaded follower 80 which is fixed to rotatable shaft 81. The stop 75 is fixed to the rotatable shaft and is caused to move into and out of engagement with the stream of sheets 19 as the cam 79 is rotated.

Since the shaft 76 to the movable stop and the shaft 63 to the sheet feeder are both driven through the gear box 62, their movement will be in properly timed sequence. The timing of their sequence is dependent upon the setting of the variable speed transmission 55 which is operated by the lever 56. The setting will be made in accordance with the length of the sheets 19, the timing being such that the average lineal speed of the sheets 19 is identical to the lineal speed of the single-face web 10 with a uniform overlap of the sheets 19 as they are fed into the set of rollers 20.

In the illustrated form of the invention the variable speed transmission has 16 speed changes which permit the use of the apparatus with 16 different lengths of sheets, the length of the sheets changing by approximately three inches with each change in the transmission. In addition to or as a substitute for the variable speed transmission 55 of the apparatus a provision may be made for change gears in the gear box 60 or in the gear box 62, the change gears providing an even finer adjustment of the speed of operation of the feeder 16 and the stop 75. For minimum waste and maximum utility of the machine the variation of the feeder 16 and stop 75 should be such as to accommodate sheets which vary in length by increments of one-fourth inch.

The conveyer 18 is driven by the sprocket 51 which is connected by a chain 85 to a sprocket 86. The chain engages a sprocket 87 to which is fixed a sprocket 88. A chain 89 connects the sprocket 88 to a sprocket 90. The sprocket 90 drives a belt 91 which is in driving engagement with one of the pull rollers 66 and with the roller 71 which drives the conveyer belt 18. The size of sprocket 90 preferably is adjusted to drive the conveyer 18 at a slightly faster lineal speed than the lineal speed of the web 10.

The applicator roll 35 is mounted for vertical movement with respect to the remaining rolls in the stack and is operated by an automatic hydraulic trip 93. That trip is energized to move the roll and its gear 36 into engagement with the roll 40 and gear 41. However, when there is a failure of the sheets 19 properly to feed onto the conveyer belt 18, a sensing device not shown, such as an electric eye, will cause the operation of the automatic trip to drop the roll 35 out of engagement with the single-face web 10. Thus there will be no inadvertent application of adhesive to the belt 22 of the drier 21 in the event of failure of sheets 19 to form the second face on the corrugated board.

The operation of the invention is as follows:

The motor 23 drives the belt 22 of the drier drawing the double-face board into the drier. The belt 22 drives the roll 24 which in turn drives the main sprocket 32

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through the chain 30. The automatic trip mechanism 93 has been actuated to bring the applicator roll 35 up into engagement with the web 10 to apply adhesive to the corrugated sheet 13 of the web 10. The web 10 passes over pressure roll 40 and there receives sheets 19 passing sequentially from the conveyer 18 into the set of rolls 20.

The sheet feeder 16 picks individual sheets 19 and feeds them into the pull-in rollers 66 from which they are transferred onto the conveyer 18. The frequency of the sheet feeder cycle is determined by the length of the sheets to be fed, the proper frequency being set by the adjustment of the variable speed transmission 55.

The sheets 19 being fed onto the rollers 20 are engaged by the movable stop 75 which releases each sheet 19 at the instant that the overlap between sheets is approximately one-half inch or less. That overlap should be maintained to provide assurance that no adhesive will be exposed to the belt of the drier. The released sheet is drawn in-between the single-face web 10 and upper pressure roller 42 and then passes into the drier 21.

If the sheet feeder should fail to operate or if for any other reason there should be a jam of sheets on the conveyer 18, the automatic trip mechanism 93 will cause the applicator roller 35 to drop down out of engagement with the web 10. Thus though the web continues to pass into the drier it does not pick up any glue such as will cause the drier belt 21 to become fouled.

It should be understood that there can be variations in the physical orientation of the elements and changes in the elements or mechanisms themselves without departing from the scope of the present invention. For example, the mechanism which is shown as operating the stop 75 could be replaced by a solenoid actuated stop energized by a switch operated by the cam 79 or energized by a cam on the shaft 63. Further, while the drive for the apparatus is predominantly chain and sprocket in the illustrated form of the invention, there can be a substitution of a shaft and gear drive system without departing from the invention. It is important, however, that any drive be of a non-slip type in order to maintain a perfect relationship of the speed of feeding sheets with respect to the linear speed of the single-face web and the drier.

We claim:

1. Apparatus for making double-face corrugated paper having one face formed of discrete sheets of printed paper, said apparatus comprising,
 - means forming a supply of a single-face web having a corrugated surface,
 - means for applying adhesive to the corrugated surface of said web,
 - a set of rolls for adhesively joining said printed sheets sequentially to the corrugated surface of said single-face web,
 - means for feeding said web into said rolls with said corrugated surface facing upwardly,
 - means for feeding printed sheets sequentially into said rolls with said sheets overlying said corrugated surface,
 - a stop mounted adjacent said rolls for movement into and out of the path of said sheets to time the entry of said sheets into said rolls,
 - drive means for rotating said rolls, and
 - means including a variable speed transmission connecting said drive means to said sheet feeding means and said movable stop.
2. Apparatus for making double-face corrugated paper having one face formed of discrete sheets of printed paper, said apparatus comprising,
 - means forming a supply of a single-face web having a corrugated surface,
 - means for applying adhesive to said corrugated surface,
 - a set of rolls for adhesively joining said printed sheets

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sequentially to the corrugated surface of said single-face web,

means for feeding said web into said rolls with said corrugated surface facing upwardly,

means for feeding printed sheets sequentially into said rolls with said sheets overlying said corrugated surface,

drive means for rotating said rolls, and

means including a variable speed transmission connecting said drive means to said sheet feeding means.

3. Apparatus for making double-face corrugated paper having one face formed of discrete sheets of printed paper, said apparatus comprising,

a set of rolls for adhesively joining said printed sheets sequentially to the corrugated surface of a single-face web,

means forming a supply of single-face web feeding into said rolls with an upwardly facing corrugated surface,

means for applying adhesive to said corrugated surface, a belted drier adjacent said rolls receiving said web with said sheets joined thereto,

a power supply driving said belted drier,

a sheet feeder sequentially discharging single sheets toward said rolls and over said web,

an endless conveyer between said sheet feeder and said rolls conveying said sheets to said rolls,

a stop mounted between said conveyer and said rolls for movement into and out of the path of said sheets to time the entry of said sheets into said rolls,

a variable speed transmission,

means connecting said power supply to the input of said variable speed transmission, and

means connecting the output of said variable speed transmission to said sheet feeder and said stop mechanism.

4. Apparatus for making double-face corrugated paper having one face formed of discrete sheets of printed paper, said apparatus comprising,

a set of rolls for adhesively joining said printed sheets sequentially to the corrugated surface of a single-face web,

means forming a supply of single-face web feeding into said rolls with an upwardly facing corrugated surface,

means for applying adhesive to said corrugated surface, a belted drier adjacent said rolls receiving said web with said sheets joined thereto,

a power supply driving said belted drier,

a sheet feeder sequentially discharging single sheets toward said rolls above said web with a slight overlap of each downstream sheet over the adjacent upstream sheet,

an endless conveyor between said sheet feeder and said rolls conveying said sheets to said rolls at a lineal speed slightly greater than the lineal speed of said single-face web,

a stop mounted between said conveyer and said rolls for movement into and out of the path of said sheets to time the entry of said sheets into said rolls,

a variable speed transmission,

means connecting said power supply to the input of said variable speed transmission,

means connecting the output of said variable speed transmission to said sheet feeder and said stop mechanism.

5. Apparatus for making double-face corrugated paper having one face formed of discrete sheets of printed paper, said apparatus comprising,

a corrugating machine for manufacturing a web of single-face corrugated paper having a corrugated surface,

means for applying adhesive to said corrugated surface, a set of rolls for adhesively joining said printed sheets

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sequentially to the corrugated surface of a single-face web,
 means for feeding said web into said rolls with said corrugated surface facing upwardly,
 a belted drier adjacent said rolls receiving said web with said sheets joined thereto,
 a power supply driving said belted drier,
 a sheet feeder sequentially discharging single sheets toward said rolls with said sheets overlying said corrugated surface,
 an endless conveyer between said sheet feeder and said rolls conveying said sheets to said rolls,
 a stop mounted between said conveyer and said rolls for movement into and out of the path of said sheets to time the entry of said sheets into said rolls,
 a variable speed transmission,
 means connecting said power supply to the input of said variable speed transmission, and
 means connecting the output of said variable speed transmission to said sheet feeder and said stop mechanism.

6. Apparatus for making double-face corrugated paper having one face formed of discrete sheets of printed paper, said apparatus comprising,
 a corrugating machine for manufacturing a web of single-face corrugated paper having an upwardly facing corrugated surface,
 means for applying adhesive to said corrugated surface,
 a set of rolls for adhesively joining said printed sheets sequentially to the corrugated surface of said single-face web,
 means for feeding printed sheets sequentially into said rolls with said sheets overlying said corrugated surface, a stop mounted adjacent said rolls for movement in and out of the path of said sheets to time the entry of said sheets into said rolls,
 drive means for rotating said rolls, and

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means including a variable speed transmission connecting said drive means to said sheet feeding means and said movable stop.

7. Apparatus for making double-face corrugated paper having one face formed of discrete sheets of printed paper, said apparatus comprising,
 means forming a supply of a single-face web having a corrugated surface,
 means for applying adhesive to said corrugated surface,
 a set of rolls for adhesively joining said printed sheets sequentially to the corrugated surface of said single-face web,
 means for feeding said web into said rolls with said corrugated surface facing upwardly,
 means for feeding printed sheets sequentially into said rolls with said sheets overlying corrugated surface,
 a stop mounted adjacent said rolls for movement in and out of the path of said sheets to time the entry of said sheets into said rolls,
 drive means for rotating said rolls, and
 means including a variable speed transmission connecting said drive means to said sheet feeding means and said movable stop to provide a small overlap of sheets fed into said set of rolls.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,306,805

February 28, 1967

Charles H. Klein et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, line 7, for "Ohio" read -- Delaware --; column 5, line 13, for "viriable" read -- variable --; line 53, for "adresively" read -- adhesively --; column 8, line 16, before "corrugated" insert -- said --.

Signed and sealed this 7th day of November 1967.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents