

[54] **MANUFACTURE OF CORRUGATED BOARD**

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[51] Int. Cl. B31f 1/00, B31f 1/26

[58] Field of Search. 264/119, 324, 281; 161/201; 156/462, 465, 200, 201, 202, 205

[56] **References Cited**

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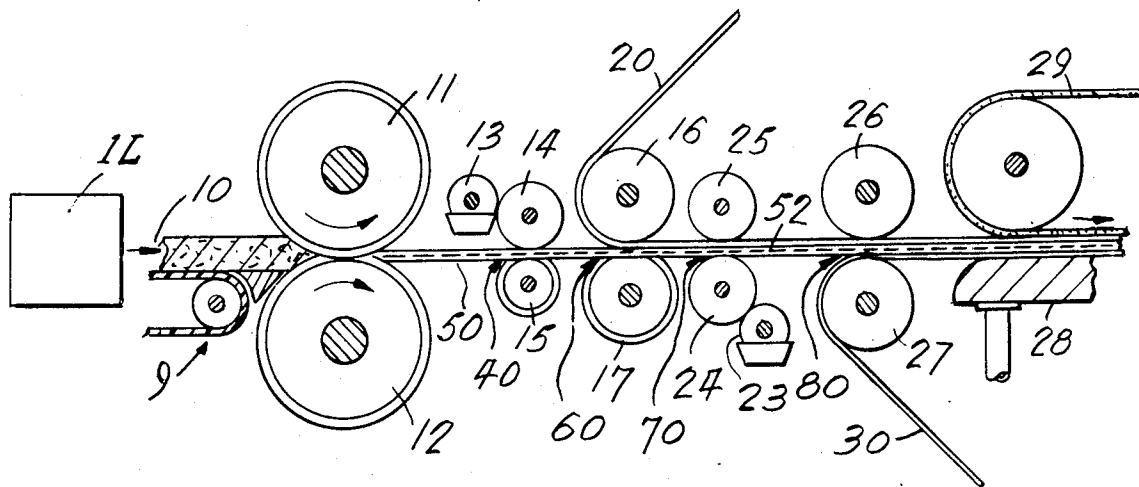
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[57]

ABSTRACT

Corrugated medium is made by passing a dry formed, substantially non-consolidated, fibrous web between corrugated rolls to corrugate the web longitudinally and to effect bonding of the fibres thereby to consolidate the web in corrugated form.

7 Claims, 2 Drawing Figures



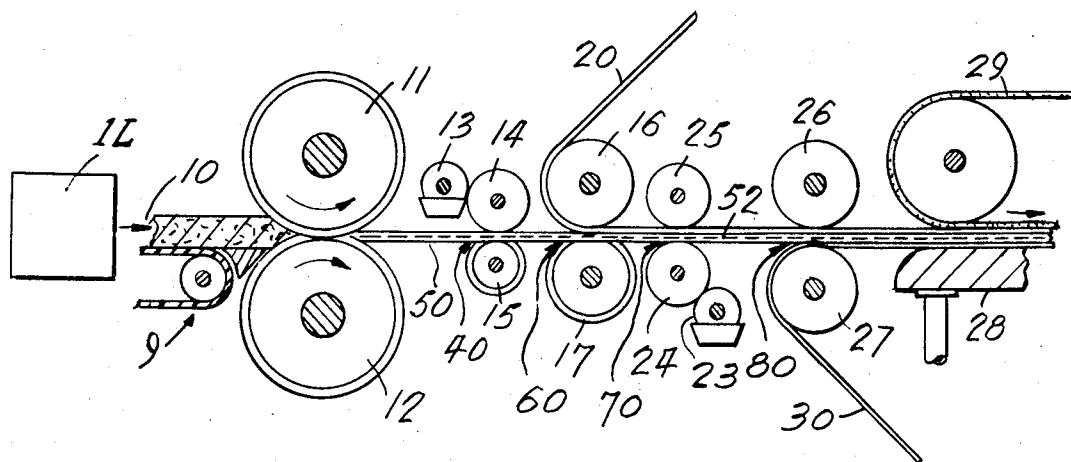


FIG. 1

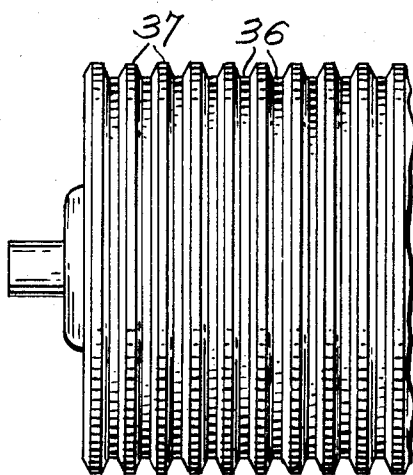


FIG. 2

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MANUFACTURE OF CORRUGATED BOARD

FIELD OF THE INVENTION

The present invention relates to the making of corrugated combined board of the type generally used in the manufacture of boxes and the like.

DESCRIPTION OF THE PRIOR ART

Corrugated paperboard (or, as it is called, corrugated medium) is generally made from a consolidated fibrous web (so-called corrugating medium), by passing such web through a corrugator. The corrugator consists essentially of a pair of rotating heated rolls having grooved or fluted surfaces, the surfaces meeting and cooperating substantially in the manner of gears. The consolidated fibrous web or paper, when passed between the corrugated rolls, adapts substantially to the configuration of the grooved surfaces and, under the influence of moisture, heat and pressure in the rolls, retains later, more or less permanently, the acquired corrugated shape. On leaving the nip of the corrugating rolls, the corrugated medium is conducted to a glue station where glue is applied to the crests of the corrugations and a first liner is applied to one side, and subsequently a second liner is applied to the other side of the medium.

While the art of thus making corrugated paperboard is well established and widely practiced, certain shortcomings of the process have long been recognized. The corrugating medium is generally, as above indicated, a paper-like sheet, i.e., a consolidated web in which the fibres are bonded together so that little freedom is left for movement of fibres relative to one another. When the web is passed between corrugator rolls the web is stretched as it is being pressed by the teeth of one roll into the corresponding cavities of the other roll. The stretch may be considerable and though the heat and moisture conditions in which corrugating is effected lend a certain plasticity to the web, it nevertheless can be ruptured at high machine speeds.

It has long been the desire of the packaging industry to be able to produce a linear corrugated web, i.e., a web with the corrugations running in the longitudinal direction of the web. Attempts to corrugate medium longitudinally have generally resulted in failure, there being no means available to produce commercially linear corrugated webs. The difficulty in the production of such webs is due to the reduction in width of the paper which occurs on corrugating linearly. Suitable means for forming these corrugations while permitting lateral movement of the web are very difficult to design. The heretofore proposed solutions to this problem so far have been tentative and limited to such slow speeds that industrial application has been ruled out.

It is the object of the present invention to provide a system of making a linear corrugated medium.

More particularly, it is the object of the present invention to provide a linear corrugated board wherein the machine direction of the liner or liners is aligned with the corrugations.

SUMMARY OF THE INVENTION

Broadly, the present invention relates to a method of forming a corrugated medium comprising forming a dry laid web of non-consolidated, interengaged fibres wherein the fibres are not substantially permanently bonded and are capable of moving relative to one another

when the web is subjected to sufficient stress, passing the web between a pair of corrugating rolls, the corrugations in the rolls being formed by alternate land and groove areas extending generally in the direction of travel of the web with the lands on one roll interengaging in the grooves of the opposite roll, consolidating the web as it passes between the corrugating rolls to form a longitudinally corrugated and consolidated web of bonded fibres.

BRIEF DESCRIPTION OF THE DRAWING

Further features, objects and advantages will be evident from the following detailed description of a preferred embodiment of the present invention when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a diagrammatic representation of an arrangement for forming a longitudinally corrugated web and laminating same to a pair of liners to form a board,

FIG. 2 is a partial view of the surface of a corrugating roll illustrated in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In carrying out the present invention a fibrous web is first formed, preferably by a so-called dry forming method, wherein e.g., the fibres are carried in a gaseous medium in which they are dispersed and individualized and are then laid from said carrying medium substantially uniformly onto a travelling screen, or similar forming surface, to form a web of requisite thickness or height. A convenient method and apparatus for the forming of such a web is disclosed in U.S. Pat. No. 3,482,287 to H.M. Flewelling. The web should be of a suitable thickness, or basis weight, to allow for the increase in the surface of the corrugated medium that will result from the passage through the corrugating rolls. Any suitable type or mixture of fibres, natural or synthetic, with or without added binders, may be used.

The web may be slightly compacted, if desired, e.g., by passing it through a preliminary pair of rolls; however, the web must not be consolidated prior to passing through the consolidating and corrugating rolls, i.e., there should be, as yet, no permanent bonding between the fibres which is characteristic of a paper sheet. It is necessary that the fibres substantially retain a freedom of movement relative to one another so that the stresses occurring during the passage through the corrugating rolls can be taken up by the relative movement between and displacement of the fibres within the web.

Referring now to FIG. 1, a web 10 of dry formed material formed by a suitable dry former schematically indicated at 1L is delivered into the nip between a pair of circumferentially corrugated rolls 11 and 12 by a suitable means such as a belt conveyor schematically illustrated at 9.

From the combined consolidating and corrugating rolls 11 and 12, the consolidated corrugated web 50 passes into a glue applying station 40 composed of applicator roll 14 to which adhesive is applied by a roll 13 and a backing roll 15 which supports the web 50 in contact with the roll 14. In this glue applying station 40, the roll 14 applies adhesive to the upwardly extending tips of the flutes of the corrugated medium 50.

From the glue applying station 40 the web passes into a first liner applying station 60 where a liner 20 is applied to the glued flutes of the corrugated medium 50

by a roll 16. The web 50 is supported at this station 60 by means of a corrugated backing roller 17 which biases the medium 50 against the first liner 20.

After the first liner 20 has been applied to one surface of the corrugated medium 50, the single-face 52 so formed passes through a second glue applying station 70 where a roll 24, which picks up adhesive from roll 23 mounted in an adhesive pot, applies adhesive to the downwardly facing tips of the corrugations on the medium 50. A backing roll 25 holds the single face 52 to ensure contact between the bottom tips of the medium 50 and adhesive applying roll 24.

The single face 52 then travels to a second liner applying station 80 and is fed between a pair of rolls 26 and 27, and wherein a second liner 30 is applied to the glued downwardly extending tips of the medium 50 by means of the roll 27.

After the two liners 20 and 30 have been applied, the combined board is fed onto a hot plate or the like schematically illustrated at 28. The web is biased against the hot plate 28 by any suitable means, such as the belt 29. In the hot plate section 28, the adhesive is set to bond the first and second liners 20 and 30 to the corrugated medium 50. Depending on the adhesives used, the hot plate system may not be necessary.

The peripheral surfaces of the rolls 11 and 12 may take on various configurations but will be formed with a plurality of alternating grooves 36 and lands or crests 37, each extending circumferentially about each of the rolls. The lands 37 of roll 11 are received in the grooves 36 of the roll 12 and vice versa.

The present invention permits designing of the flute characteristics to correspond with the ultimate use to which the corrugated medium is to be applied.

In operation, a web 10 is fed to the nip between a pair of rollers 11 and 12 which are biased together under suitable pressures and are preferably maintained at elevated temperature so that the web 10 is deformed and consolidated as it passes between these rolls to form a bonded or consolidated corrugated medium 50. Adhesive is applied to the tips of the upwardly extending crests of the medium 50 via the roll 14 and a first liner 20 is applied to these tips of the corrugations. Thereafter, adhesive is applied to the tips of the crests at the opposite face of the corrugated medium 50 by the roll 24 and the second liner 30 is applied to the latter tips thereby to form a combined board which may then be passed on to a suitable hot plate or the like where the adhesive is set.

Temperature and pressure conditions in the nip formed between the rolls 11 and 12 for consolidation of the web to form a substantially permanently bonded corrugated medium may be varied. It has been found that a temperature within the range of about 130° to 270° C, with a pressure in the range of 500 to 6,000 lbs/lineal inch produces adequate bonding of the fibres at a speed of 25 ft/min. Under these conditions the moisture content should be in the range of about 1 to 10 percent. Generally it is preferred to operate with low pressure to ensure against excess deflection of the rolls. It is believed the temperature and/or the moisture content may be increased as the speed of the rolls increases.

The temperatures, pressures, and moisture content of the board may be varied for forming to produce different characteristic board, however, care must be taken to ensure that the board is not burned and that blisters

are not formed by too much water evaporating in the nip. It is believed that as the speed increases the temperature can also be increased as well as the water content which will improve the heat transfer between the rolls and the medium being formed.

It is generally preferred to operate at elevated temperatures and pressures, however, when the moisture content of the fibre mat exceeds about 25 percent, it is also possible to consolidate a cellulose fibre-containing web at room temperature simply using high pressure. However, great care must be taken in handling the consolidated web during drying is a satisfactory product is to be produced.

It is sometimes desirable to build special features into the medium; this can be done by the addition of special fibres or binders to the medium either before or after consolidation in corrugated form. The medium after corrugating, has both of its surfaces exposed making it possible to simply coat both exposed surfaces of the medium prior to laminating. This is substantially impossible with a conventional corrugator wherein the medium is never separated from the corrugating roll until it is laminated with the first liner to form a single face.

The following are several examples of mediums made under various forming conditions.

EXAMPLES

A laboratory corrugator was constructed essentially in accordance with FIG. 1, the rolls being approximately 4½ inches long and 6½ inches in diameter and having their surfaces machined to form straight sided linear grooves of the shape illustrated in FIG. 2. The flute spacing was in the range of a Standard B flute profile such as to produce 48 flutes per foot. The rolls were positively driven at the same speed and were heated prior to introducing web samples to be corrugated. The pressure between the rolls was adjusted as indicated in the Table.

A dry formed web was made using disintegrated corrugator scrap on the dry former of the type described in the said U.S. Pat. No. 3,482,287. The corrugator was run at a linear speed of 25 ft/min, the moisture content for the samples was maintained at 8 percent.

After forming, the medium was combined with a pair of 42 lb/M sq. ft. liners with the machine direction of the liners aligned with the longitudinal axis of the flutes to form a combined board equivalent to a 200 lb. test box as prescribed in Rule 41 of the Canadian Freight Specifications. In the results tabulated the test values have been adjusted to correspond to the values that would be obtained at the standard weight of medium, i.e., 26 lbs/M sq. ft.

TABLE

Roll Temp. °C	Roll Pressure p.l.i.	Flat Crush	Column Crush
		Adj. to Std. Wt. of Medium p.s.i.	Adj. to Std. Wt. of Medium lb/in
130°-150°	1500	41.4	52.2
	2500	38.5	47.4
	4000	45.1	55.8
170°-190°	1500	24.2	39.1
	2500	33.5	45.5
	4000	39.5	42.7
Commercial B Flute Test Sample		40+	33.5+

From the above Table it can be seen that the combined board containing linear corrugated medium is easily equivalent and, in most cases, exceeds the standard board in both flat and column crush.

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I claim:

1. A method of making a combined board including a corrugated medium and at least one liner which comprises dry forming a web of intermingled fibres which are capable of moving relative to one another within said web when subjected to forming stresses, pressing said web between a pair of rolls having flutes with their longitudinal axis extending circumferentially of the rolls thereby to form said web with corrugations extending longitudinally of said web and to press said fibres together and to consolidate said fibres into a corrugated web configuration and securing a liner to the tips of the corrugations on one side of said corrugated web.

2. A method as defined in claim 1 wherein said receiving comprises applying adhesive to the tips of the corrugations on said one surface of the medium and applying a liner to said tips to form a single face.

3. A method as defined in claim 2 comprising applying adhesive to the crests of corrugations on the opposite side of said medium and securing a second liner to said opposite side.

4. A method as defined in claim 1 wherein said rolls are heated.

5. A method as defined in claim 2 wherein said rolls are heated.

6. A method as defined in claim 1 wherein said corrugator rolls are at a temperature and pressure equivalent to a temperature of 130° to 270° C with a pressure in the range of 500 to 6,000 p.l.i. for a speed of 25 ft/min.

7. A method as defined in claim 2 wherein said corrugator rolls are at a temperature and pressure equivalent to a temperature of 130° to 270° C with a pressure in the range of 500 to 6,000 p.l.i. for a speed of 25 ft/min.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,773,587 Dated November 20, 1973

Inventor(s) Herbert Martin Flewwelling

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the Cover Sheet insert :

Foreign Application Priority Data

[30] July 8, 1970 Canada 087,713

Signed and sealed this 3rd day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents