

CORRUGATED PAPERBOARD PRODUCTION AND APPARATUS THEREFOR

This invention relates to improved methods of and apparatus for forming paper board structures in which two corrugated mediums are bonded together at their flute tips. A structure of this kind is disclosed in Australian Patent 567833 which is
5 incorporated herein by reference.

One apparatus for forming such corrugated board structures is disclosed in Australian Patent No. 609089 (11926/88) which is also incorporated herein by reference. Additionally there are variations of the basic apparatus as is currently disclosed in Australian Patent No. 615,053 which discloses the 4-roll apparatus
10 wherein one of the corrugating rolls functions also as a carrier roll which transfers the bonded mediums to the liner bonding zone and also US Patent No. 4,935,082 which replaces the carrier roll with the toothed belt. The invention as described and defined herein is equally applicable to the variations of the basic apparatus; wherein flute tip to flute tip bonding is required.

15 One of the major difficulties of producing a paper board structure wherein two corrugated mediums are adequately bonded together at their flute tips, is accurately aligning the peak of the flutes of the corrugated medium along the entire width of the corrugated mediums. The problem arises from the fact that pressure between the flute tips along their entire length causes misalignment thereof.

20 The present invention is predicated on the discovery that the problem of maintaining the corrugating rolls flute tip to flute tip arises from the fact that the entire board making apparatus can generally lack rigidity. It is thought that the lack of rigidity is mainly attributable to the lack of rigidity in the support frame and also in the corrugating rolls and shafts which twist during operation. Thus as a result of movement
25 of the corrugating rolls and the frame the flute tips of the rolls become misaligned.

The prior art has dealt with the problem of aligning intermeshing corrugating rolls as distinct from the problem of maintaining alignment of corrugating rolls which contact flute tip to flute tip. Indicative of the prior art is US Patent No. 4196046 which discusses the problem of aligning intermeshing corrugating rolls to adjust the clearance
30 between the flutes. The patent describes the use of a pair of meshing helical gears with an axial adjuster attached to one of the gears in order to adjust the clearances between the flutes of the intermeshing corrugating rolls. Since the clearance between the intermeshing rolls can be adjusted, wear and tear on the machine is reduced as well as fracturing of the paper web due to clearance deterioration.

It is an object of this invention to improve and overcome at least some of the problems of the apparatus disclosed in AU 609089 and variations of the same as previously discussed and discussed in Patents AU615,053 and US4,935,082 and thus improve the quality of the paper board product and the efficiency of the process.

5 This invention provides an improvement in the basic apparatus and also the variations of the same as previously discussed.

The invention therefore provides a corrugated board making apparatus capable of forming corrugated boards having two fluted mediums bonded together at the flute tips, comprising two pairs of corrugating rolls synchronised so that the two fluted mediums
10 are oriented for precise flute tip to flute tip bonding, wherein cooperating end gears are provided on the corrugating rolls which orientate the fluted mediums for flute tip to flute tip bonding.

In particular, the end gears are provided specifically on the corrugating rolls which co-operate tip to tip and bring the corrugated mediums together for tip to tip
15 bonding.

More preferably, a set of end gears is fitted to each end of the said corrugating rolls.

The provision of the co-operating end gears advantageously aids in maintaining identical surface speed at the tips of the flutes to be bonded, thus resulting in the precise
20 alignment of the corrugating rolls to each other. Thus the alignment of the flute tips of the respective corrugated mediums is achieved, which is essential in order to obtain consistent enhancement of board performance and maximum reduction in medium and liner weights. The benefits of providing this type of board structure are set out in Australian Patent No. 567,833.

25 End gears are preferably but not essentially fitted to each end of each pair of central corrugating rolls and consist of one full face gear and one split face gear to allow adjustment of backlash.

It is apparent that the prior art apparatus does not discuss or even suggest the possibility of using end gears in relation to the bonding together of corrugated mediums
30 at their flute tips which align and bond. The prior art is only concerned with the actual corrugating process and intermeshing corrugating rolls.

The end gears are preferably abutting end gears and are preferably installed a short distance from the grooved face of each corrugating roll advantageously assisting in reducing the twisting of shafts. The use of abutting end gears allows the use of
35 conventional vacuum corrugating rolls with standard sized trunnions and minimises the

torsional deflection which generally occurs. By providing abutting end gears to both ends of the corrugating rolls the general rigidity of the apparatus and the reduction in the twisting of the shafts is further enhanced.

The end gears may be non-abutting end gears or can be fitted outside the vacuum
5 collectors and also outside the machine frames. Non-abutting gears can be used when the corrugating rolls have larger trunnions and thus the ability to resist the high torsional stresses arising from the point to point pressure occasioned during the tip to tip bonding process.

The end gears are preferably precision ground so that the intermeshing is
10 precise.

The end gears can be spur gears or helical gears.

The gears may be split. If there are gears provided at each end they are preferably split at each end. The split gear may then mate with a gear of larger face width on the other corrugating roll. This arrangement assists in taking up backlash and
15 allows transmission of at least 50% of the applied torque, thus preventing, further the twisting of the corrugating rolls and shafts.

When the helical gears are used as abutting end gears, the fitting of shims between the end faces of the corrugating rolls and the helical gears may be required when the helical gears are adjusted axially.

20 If helical gears are fitted to both ends of the roll, the helices on each gear can be opposing to ensure thrust forces cancel each other out. If helical gears are only fitted to one end, additional thrust bearing capacity may be required to counteract the axial thrust created by the helical gears and prevent twisting of the corrugating rolls and shafts out of tip to tip alignment.

25 A preferred embodiment of this invention will now be described with reference to the drawings:

Figure 1 shows a schematic view of a single facer unit of the kind disclosed in Australian Patent No. 609089.

Figure 2 shows a cross-section view of the corrugating rolls with abutting end
30 gears attached.

Figure 1 illustrates a single facer unit of the kind disclosed in Australian Patent No. 609089. The corrugating medium, 1 and 2, maintained on mill roll stands (not shown) and generally passed over a preheater (not shown) is fed onto one (Items 3 and 5) of a pair of corrugating rolls, 3 and 4 and 5 and 6. The medium, 1 and 2, is
35 corrugated and then adhesive is applied to at least one of the surfaces of 1 or 2, by an

adhesive station 7. The corrugated medium, 1 and 2, is then joined together flute tip to flute tip, when brought together by corrugating rolls 4 and 6. The two combined corrugating mediums are fed onto the carrier roll 12 and after glue is applied to the flute tips, they are transported to the bonding zone wherein the liner 9 is brought into
 5 contact with the flute tips and heat applied by heater 11. The carrier rolls 12 then transports the combined liner and mediums to a point where the product is fed into an inclined transport conveyor 14 for discharge on to the corrugator bridge.

In accordance with variations of the basic apparatus, it is noted that the carrier roll 12 can be substituted with a toothed belt.

10 Figure 2 illustrates an embodiment of the present invention, wherein end gears 15A and 15B and 16A and 16B are fixed to the corrugating rolls 4 and 6 of the single facer unit which are the corrugating rolls which align and bond the corrugated medium in flute tip to flute tip arrangement. This embodiment illustrates the use of the split spur gears 15A and 15B and 16A and 16B abutting the corrugating rolls 4 and 6. It
 15 should be noted that in order to maximise the rigidity of the apparatus and the reduction of twisting in the aligning corrugating rolls, end gears should be placed at each end of the aligning corrugating rolls. The end gears 15A and 15B and 16A and 16B in this embodiment fit within the space between the vacuum collector 17 and the corrugating rolls 6 and 4. It should be noted that if repetitive wear patterns on the corrugating rolls
 20 are not acceptable, space can be allowed so all four corrugating rolls may be able to move axially relative to each other. The vacuum collectors 17 and connections therefrom to the corrugating rolls 4 and 6 can pass through the end gears 15A, 15B, 16A and 16B to communicate with the corrugating rolls 6 and 4. The vacuum collectors 17 are spring-loaded by spring arrangement 19 to ensure a secure but resilient contact between the
 25 end gears (15A, 15B, 16A and 16B) and the vacuum collector system 17.

The end gears need not always abut the corrugating rolls and this is dependent on the diameter of the corrugating rolls with larger diameter shafts. In larger diameter rolls, which can be used when flutes of greater height and lower flute pitch are required, the end gears need not abut the rolls and can be even housed outside of the main housing.
 30 Furthermore, when vacuum is not used to assist in retaining and carrying the cardboard on the corrugating roll and the alternative fingers are used, it is possible to separate the end gears away from the corrugating rolls, since larger rolls can be used.

In order to produce a particular flute, for example that disclosed in Australian Patent No. 567833, the diameter of the corrugating rolls and shafts may be limited in

order to produce the desired flute pitch and depth. In these cases it may be necessary to abut the end gears in order to maximise the rigidity of the apparatus.

Furthermore, the face width of split spur gear 16A is extended to assist in taking up backlash and allow transmission of the applied torque. Generally the face width of the end gears is governed by the braking torque required which as a general rule is at least three (3) times the drive torque created. End gear 16A and 16B is driven by its cooperation with end gears 15A and 15B and drives the carrier rolls 12 via a ring gear (not shown) attached to the carrier roll 12. Similarly the end gears can drive a toothed belt if used.

10 The end gears 15A and 15B and 16A and 16B may be fixed to the shafts of the corrugating rolls 4 and 6 by any locking assembly, for example multi-taper lock sleeves, item 21. The only requirement of the locking assembly is that the gears are precisely retained in position to transmit high peripheral forces without circumferential movement.

15 To secure the split gears 15A and 15B to each other fixing screws 20 may be used which also allow for adjustment of the gears relative to each other in order to reduce backlash. Similarly fixing screws 20 can also be incorporated on split gears 16A and 16B. The end gears 15A, 15B, 16A and 16B depending on their proximity to the corrugating rolls may have a shroud (not shown) shielding the board being processed and preventing entanglement of the board in the rotating end gears.

It is noted that whilst the end gears must be applied to at least the corrugating rolls which are directly involved in flute-tip to flute-tip bonding, end gears can be applied to other rolls such as carrier rolls, or toothed belt mechanisms.

The frame 18 may also be reinforced and/or improved in order to increase frame rigidity and thus generally greater apparatus rigidity.

The above improvements to existing machinery, aid and assist in providing a better board product, and produces the board product more efficiently resulting in reduced machine wear and raw material use.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A corrugated board making apparatus capable of forming corrugated boards having two fluted mediums bonded together at the flute tips comprising at least two pairs of corrugating rolls synchronised so that the two fluted mediums are oriented for precise flute tip to flute tip bonding wherein
co-operating end gears are provided on the corrugating rolls which align the fluted mediums for flute tip to flute tip bonding.
2. The apparatus of claim 1 wherein the end gears are only attached to the corrugating rolls which meet tip to tip and bond the fluted medium in flute tip to flute tip.
3. The apparatus of claims 1 or 2 wherein a set of end gears are provided at each end of the corrugating rolls.
4. The apparatus of any one of claims 1-3 wherein the end gears are abutting end gears.
5. The apparatus of any one of claims 1-4 wherein the end gears are spur gears or helical gears.
6. The apparatus of any one of Claims 1 to 5 wherein at least one end gear is split.
7. The apparatus of Claim 6 wherein the split end gear co-operates with a wider face gear so as to assist in taking up backlash.
8. A method of forming improved corrugated boards having two fluted mediums bonded together at the flute tips wherein



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the two fluted mediums are aligned for flute tip to flute tip bonding by synchronised corrugating rolls which meet flute tip to flute tip and wherein said corrugating rolls have co-operating end gears thereon.

