FIG. 2
PRIOR ART

FIG. 3
PRIOR ART

INVENTOR
WALTER C. MORRISON

BY

Sandel, Gondek, Goldhammer

ATTORNEYS
ABSTRACT OF THE DISCLOSURE

A single facer machine is disclosed having bowed flutes on the corrugating rollers. The curvature of the bow of the flutes is chosen so that the middle portion of the flutes is disposed from a line interconnecting the ends of a flute by a distance caused by one pitch of the flutes. This results in the crest of the flutes always being in engagement with a smooth pressure roll, thereby substantially decreasing the high sound level of such machines.

The present invention is directed to a corrugator, and more particularly, to a single facer machine which is constructed in a manner so as to materially and substantially reduce the high sound level of such machines when in operation. A single facer machine is utilized in the manufacture of single face corrugated paperboard. In a conventional single facer machine, two corrugating rollers have intermeshing flutes which deform a smooth paperboard web medium so as to provide it with transverse corrugations.

The paperboard web medium remains on the flutes of one of the corrugating rollers until it moves past a glue applicator roll which coats the crests of the corrugations with a bonding agent. Parallel to the fluted rollers, there is provided a smooth surface pressure roll for pressing a liner web against the coated crests of the flutes in the first-mentioned paperboard web medium.

The pressure roll is held juxtaposed to the periphery of the lower corrugating roller by a yieldable force-exerting means such as spring, hydraulic cylinders, pneumatic cylinders, etc. The lower corrugating roller is generally connected directly to the drive means such as a speed reducer and an electric motor. Conventionally, the upper corrugating roller is driven by the lower corrugating roller due to the mesh of the flutes on said rollers. Also, the pressure roller is conventionally driven by a gear train from the lower corrugating roller.

The surfaces of the corrugating rollers are provided with identical equally spaced flutes. The flutes are commonly referred to as being an A, B, C, or E flute, depending upon the depth of the flute and the number of flutes per foot of manufactured paperboard.

As the corrugating rollers rotate, the distance between the center of the lower corrugating roller and the center of the pressure roller fluctuates. This is caused by the geometry of contact between a corrugating roller and a smooth surface roller. Thus, the radius to the crest of any flute on the corrugating roller is greater than the radius to a line tangent to two adjacent flute crests. Consequently, the arc of the periphery of the pressure roller alternately moves into the space between adjacent flutes and retreats as the crest of the flute moves into position on the common centerline of the lower corrugating roller and the pressure roller. Conventionally, both corrugating roller and the pressure roller are made from hardened steel for wear resistance. Such material has high resonance.

The periodic variations in the distance between the centers of the lower corrugating roller and the pressure roller are caused by the tips of the flutes on the lower corrugating roller pushing the hardened surface of the pressure roller against the spring or fluid pressure bias on the pressure roller. This rapid impingement produces a high level of sound which under high speed operations may be 110 to 120 decibels. Such high levels of sound are deleterious to the hearing acuity of persons nearby and are a source of sound pollution over a wide area.

Heretofore, attempts have been made to attenuate the high sound level by providing sound absorbing barriers near the single face machine, mounting the machines on resilient pads, stacking rolls of paper in the vicinity of the machine, providing ear protectors for the operators, etc. The use of ear protectors by the operators has not been readily accepted.

The results of the attempts heretofore to attenuate the sound level have been negligible because the sound generating source in the machine has remained unchanged. The high sound level of the single facer has heretofore been considered an unalterable by-product of the paperboard corrugating process which must be tolerated. In recent years, the operating speeds of such machines have increased whereby the sound levels have correspondingly increased.

Another problem common to corrugated board manufacture is the defect in paperboard known as high-low. In this defect, erratic corrugations are lower than adjacent ones which result in a lowering of board quality or a complete rejection of the corrugated paperboard. This defect is believed to be caused by irregular vibration of the corrugating rollers at high operating speeds. Generally, the maximum speed of the corrugator is not the designed speed, but rather the speed at which high-low board is produced.

In the present invention, the flutes of the corrugating rollers are bowed across the length of the roller. The curvature of the bow is so designed that a portion of a crest of a flute on the lower corrugating roller is always in contact with the pressure roller via the web mediums therebetween. In this manner, repetitive impingement between lower corrugating roller and the pressure roller is avoided, thereby removing the principal sound generating means in the single facer machine and also removing the principal source of erratic vibration. Other advantages of this invention include a reduced noise level due to the meshing engagement of the corrugating rollers. Also a straighter tracking of the web medium is attained due to the bowed flutes.

With respect to a single bowed flute, a straight line connecting the ends of the flute will be spaced from the midpoint of the flute by a distance corresponding preferably to a single pitch of the flutes. The spacing between said line and the midpoint of the bowed flute may be greater than a single pitch on B or E-flute, if desired.

It is an object of the present invention to provide a single-facer machine structurally interrelated in a manner so as to substantially reduce the noise level when the machine is operating.

It is another object of the present invention to provide a single facer machine wherein the pressure roller has a fixed axis of rotation with respect to the axis of rotation of the lower corrugating roller.

It is another object of the present invention to provide a single facer machine which is structurally interrelated in a manner so as to obviate the principal source of erratic vibration and thereby materially reduce the occurrence of high-low flutes on single-faced paperboard.

It is another object of the present invention to provide a less noisy method of making single facers paperboard in a manner which is simple, inexpensive and reliable.

Other objects will appear hereinafter.
For the purpose of illustrating the invention, there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not to be limited to the precise arrangements and instrumentations shown.

FIG. 1 is a side elevation view of a single facer in accordance with the present invention, partly in section.

FIG. 2 is a diagrammatic illustration of the corrugating rollers and pressure roller in a prior art machine.

FIG. 3 is a diagrammatic illustration of the corrugating rollers and pressure roller in a prior art machine.

FIG. 4 is a diagrammatic illustration of the corrugating rollers and pressure roller in accordance with the present invention.

FIG. 5 is a partial perspective view of a corrugating roll on a reduced scale.

FIG. 6 is a side elevation view of a corrugating roller in accordance with the present invention.

FIG. 7 is a view taken along the line 7—7 in FIG. 6. FIG. 8 is a view taken along the line 8—8 in FIG. 6. FIG. 9 is an enlarged illustration of a portion of the end of a corrugating roller.

Referring to the drawing in detail, wherein like numerals indicate like elements, there is illustrated a single facer machine designated generally as 10. The machine 10 is constructed in accordance with the present invention and includes many features which are known to those skilled in the art. A typical single facer is disclosed in U.S. Pat. 3,390,040.

The paperboard web medium 12 to be corrugated is passed over a tensioning roller, a web trimmer, and a second tensioning roller in a conventional manner. Thereafter, it passes in contact with a preheating roller 14 and then passes beneath a steam shower 16 which provides moisture to render the medium 12 more pliable for corrugating. Thereafter, the medium 12 is fed between corrugating rollers 18 and 20.

The corrugated medium is retained on the roller 20 by a plurality of crests 22 at spaced points therealong. A bonding agent, such as starch which may be rendered to act as an adhesive when gelatinized, is applied to the crests of the corrugations by an applicator roll 24 which rotates in an adhesive pan 26.

The liner 28 extends around preheater rolls and then around a pressure roller 30. The liner contacts the bonding agent on the flutes so as to combine the corrugated medium with the liner into a single face board. The various rollers and other components of the single facer machine 10 are supported by side frames 32 and 34.

Force is exerted on the upper corrugating roller 18 so as to bias it against the lower corrugating roller 20 by means of hydraulic cylinders on each side frame of the machine 10. The two corrugating rollers 18 and 20 are hollow and heated by steam. The pressure roller 30 is adjustable toward and away from the roller 20 so as to adjust the proper nip. It will be noted that the axes of the rollers 18, 20 and 30 lie approximately along a straight line.

In FIGS. 2 and 3, there is illustrated the corrugating rollers and pressure roller of a prior art single facer machine such as that disclosed in the above-mentioned U.S. patent. It will be understood that the representation of the flutes on the corrugating rollers 18' and 20' is diagonal. The medium 12' to be corrugated is bonded to the liner 28' in a manner described above to form a single faced board 36'. In FIG. 2, the flute crests on roller 18' are designated as 38 and the valleys of the flutes are designated as 40. On roller 20', the flute crests are designated as 42 and the valleys of the flutes are designated as 44. In FIG. 2, one of the flutes on roller 20' is aligned with the axes of the rollers 18', 20' and 30'.

The structure shown in FIG. 2 is illustrated in FIG. 3 with the roller 20' rotated with respect to FIG. 2 by an amount corresponding to one-half the pitch between adjacent flutes. As a result thereof, it will be noted that the distance X-Y in FIG. 3 is less than the distance X-Y in FIG. 2. The constant changing of the distance X-Y in FIGS. 2 and 3 at a highly repetitive rate has been ascribed by many to the cause appearing heretofore.

In FIG. 4, there is illustrated the elements of the present invention corresponding to the elements shown in FIGS. 2 and 3. In FIG. 4, the flute crests on roller 18 are designated as 46 and the valleys as 48. On roller 20, the flute crests are designated 50 and the valleys 52. As shown in FIG. 8, pitch between adjacent flutes is designated by P. In order to maintain the distance X-Y in FIG. 4 constant, the flutes 46 and 50 on the rollers 18 and 20 are bowed. Thus, a straight line interconnecting the ends 50E of a single flute is spaced from the midpoint 50M of the flute by a distance corresponding to at least one pitch. As a result thereof, the corrugating roller 20 always has a portion of one flute spaced from the periphery of the roller 30 by the desired nip. This avoids the constant change of the distance X-Y which corresponds to the dimension 54 in FIG. 9 associated with the prior art and the principal cause of the high noise level.

The difference between flutes on the periphery of the corrugating rolls of this invention and corresponding rolls of the prior art is that the flutes on the prior art corrugating rolls are cut straight across whereas the flutes of the present invention are bowed. The bowed flutes of the present invention are produced by rotating the corrugating roller through an arc equal to one flute pitch as the flutes are cut. The rotation of the corrugating roller is clockwise for one-half the length of the roller and counterclockwise for the remainder. The effect of this oscillating rotation is to form bowed flutes on the corrugating rollers. Rotation of the corrugating roller is synchronized so that the maximum displacement of the bowed flutes occurs at the axial midpoint of the roller.

The corrugating rollers 18 and 20 match one another in the sense that the flutes are meshed whereby roller 20 may rotatably drive roller 18. The rollers 18 and 20 may be provided with the four commercial sizes known as A-flute, B-flute, C-flute and E-flute or custom flutes. The rollers for A-flute board, for example, have flutes approximately 0.185 inch deep and produce paperboard having approximately thirty-four flutes per foot. The flutes in A-flute rollers have a bow displacement at their center of approximately .36 inch deep, irrespective of the length or diameter of the roller.

A typical single facer machine produces single facer board having a width of 87 inches. From an 87-inch wide web of single faced paperboard, there is usually an operation which longitudinally splits the web into several separate webs. An 87-inch wide strip of single faced paperboard has the midpoint of the flute 50M spaced from a straight line interconnecting the ends 50E by a distance equal to one flute pitch. As a result thereof, the single faced paperboard produced by the machine 10 of the present invention is of acceptable quality which may be processed on the machines utilized heretofore on single faced paperboard, single faced paperboard will have fewer occasions of high-flow defects, and will be made on a machine which is substantially quieter than those previously described.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. A corrugating machine for making corrugated paperboard comprising spaced apart side frames, a rotatable first roller, a rotatable second roller parallel to said first roller, a smooth surfaced pressure roller parallel to said
first and second rollers, the periphery of said pressure roller being juxtaposed to the periphery of said first roller, the peripheries of said first and second rollers being provided with parallel flutes, each flute on said first and second rollers being symmetrically bowed so as to have a mid-point spaced from a straight line parallel to the roller axis and interconnecting the ends of the flute by a distance of approximately one pitch of the flutes, and the flutes on said first and second roller being in meshing engagement.

2. A machine in accordance with claim 1 wherein the flutes on said first and second rollers are selected from the group consisting of A-flute, B-flute, C-flute and E-flute.

3. A machine in accordance with claim 1 wherein the axis of said first roller and the axis of said pressure roller are a constant distance from one another during operation of the machine while being spaced from one another by a nip for accommodating a corrugated web medium and a liner therebetween.

4. A machine in accordance with claim 1 wherein the axes of said pressure roller and said first and second rollers form a line inclined with respect to the vertical.

5. A single facer corrugating machine comprising first and second corrugating rollers having flutes in meshing engagement, one of said rollers being juxtaposed to a pressure roller having a smooth peripheral surface, and means including bow shaped flutes on said first and second rollers for reducing the noise attendant to operation of said rollers while producing single faced paperboard wherein said means includes said flutes having a single bow with the mid-point of the length of the flutes being spaced from a straight line interconnecting the ends of a flute by a distance corresponding to at least one pitch of the flutes.

6. A machine in accordance with claim 5 wherein said pressure roller and said first roller have a constant nip therebetween.

References Cited

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent</th>
<th>Date</th>
<th>Inventor</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,826,239</td>
<td>3/1958</td>
<td>Villoresi</td>
<td>161—133</td>
</tr>
<tr>
<td>2,916,080</td>
<td>12/1959</td>
<td>Villoresi</td>
<td>156—471</td>
</tr>
</tbody>
</table>

ROBERT F. BURNETT, Primary Examiner
W. E. HOAG, Assistant Examiner

U.S. Cl. X.R.

72—181; 156—205, 596