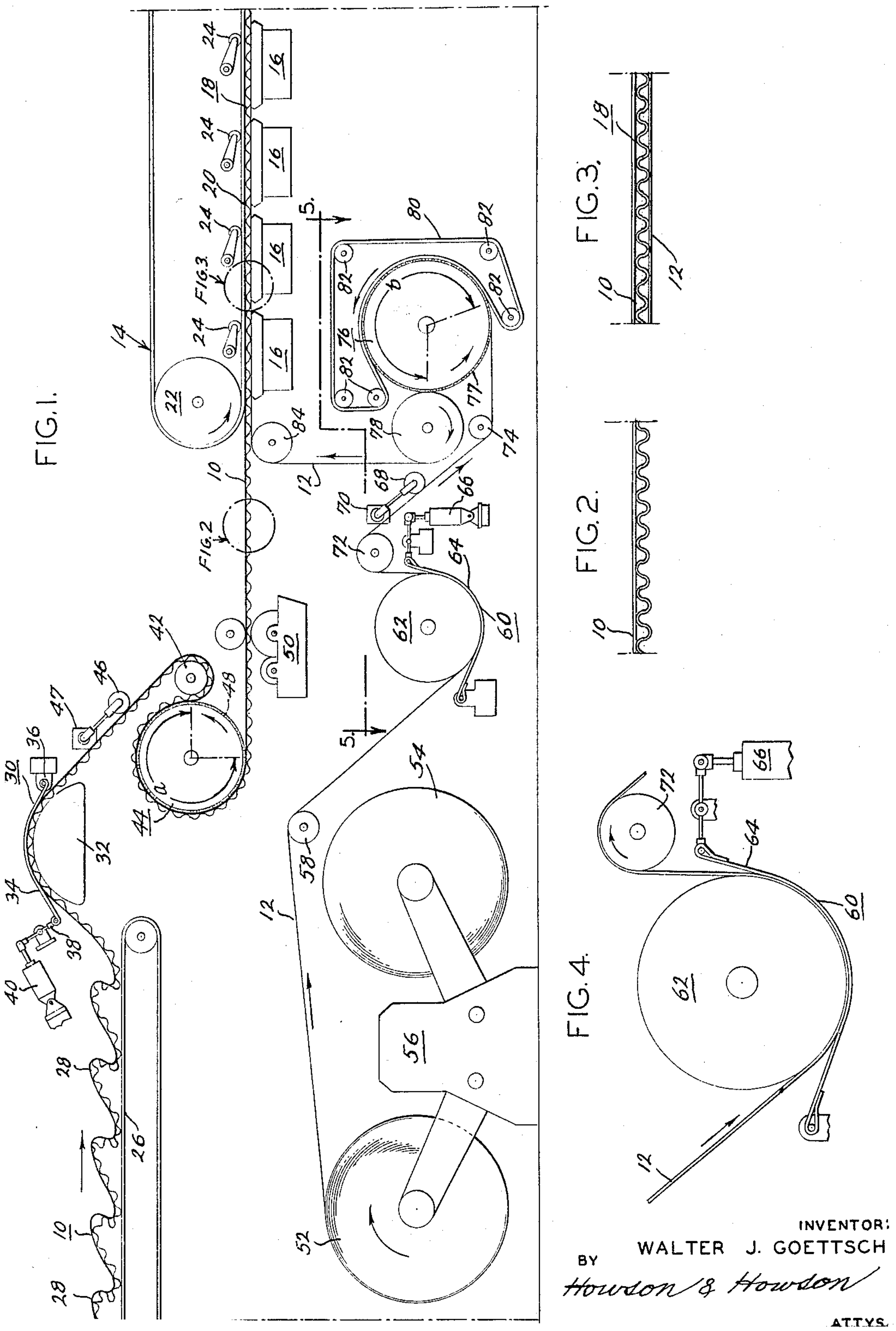
APPARATUS AND METHOD FOR PRODUCING CORRUGATED PAPERBOARD

Filed Aug. 16, 1963 2 Sheets-Sheet 1



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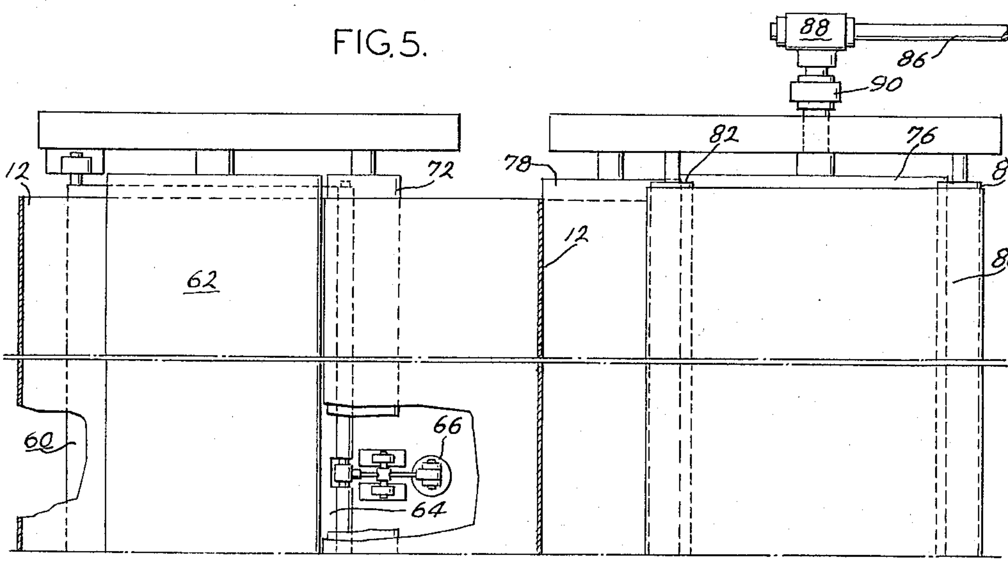
Filed Aug. 16, 1963 2 Sheets-Sheet 2

FIG. 5.



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United States Patent Office

3,282,764
Patented Nov. 1, 1966

3,282,764

APPARATUS AND METHOD FOR PRODUCING CORRUGATED PAPERBOARD

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Filed Aug. 16, 1963, Ser. No. 302,596
5 Claims. (Cl. 156—292)

The present invention relates generally to the production of corrugated paperboard and more particularly to an apparatus and method for improving the feeding-metering function of a double facer machine.

The bulk of the corrugated paperboard currently manufactured is known as "double faced" corrugated paperboard and consists of an inner corrugated or fluted member sandwiched between outer facing sheets or liners. In the usual operation this is made in steps by first combining the corrugated member with one liner to form what is known as "single faced" corrugated paperboard. This product is then combined with a second liner to form double faced corrugated paperboard, the combining operation taking place in apparatus known in the art as a double facer machine. As will be discussed in more detail below, such a combining unit may also be employed to produce "double wall" or "triple wall" or other varieties of corrugated board, although it is generally termed a double facer machine.

A double facer typically includes a pair of endless belts between which the single faced web and liner are combined in biased relationship with adhesive therebetween and advanced through heating and cooling regions. The double facer belts, normally made of cotton or synthetic fabric, or a combination thereof, provide the following functions:

(a) blanketing the several board components so that they are held in proper arrangement to effect efficient bonding;

(b) absorbing and then discharging some of the excess water content of the board components and the adhesive applied thereto;

(c) pulling and conveying the combined board components through the machine; and

(d) equalizing to some degree the heat and moisture content of the board components before discharging the board.

A primary function of the belts heretofore has been the pulling and conveying of the board in accurate timed relationship with additional machines placed downstream from the double facer in the path of travel of the web which automatically and continuously perform different operations on the web. Such additional machines in the usual installation include a slitter-scorer and a rotary cut-off machine, the structure and operation of which are well known in the art. Since the double faced paperboard emerging from the double facer machine is a relatively stiff product, successive slitting, scoring and blanking operations are generally carried out sequentially. In order to achieve a uniformly dimensioned blank at the rotary cut-off machine, the feed of the double faced board must be as uniform as possible in relation to such cut-off machine. Any variation in the rate of feed, such as might be caused by slippage of the belts relative to their drive pulleys or relative to the board will result in sheet length variation. In practice, the double facer, slitter-scorer and the rotary cut-off machine are all driven from a common line shaft which in turn is driven by a single drive motor.

The principal result desired of this invention is the reduction of sheet length variation at the cut-off, which is presently a source of considerable waste. Although

the driving of the double facer and cut-off machine from a common line shaft might be considered a solution to the problem of sheet length variation, the fact is that the double facer does not provide a reliably uniform feed due to the above-described slippage with the result that blanks produced in subsequent operations are not dimensionally uniform. Methods and apparatus have been developed to compensate for such feed variations but are complicated, expensive, and do not correct the cause of the difficulty.

It is accordingly a primary object of the present invention to provide a method and apparatus which will advance a board through a double facer and attendant auxiliary equipment at a uniform speed which will at all times be completely synchronous with cut-off speed.

Another object of the present invention is to provide a method and apparatus which will increase the efficiency of a double facer machine, permitting a reduction in its size and cost.

An additional object of the present invention is to provide separate tensioning and feed means for the double faced board components to permit an overspeed of the double facer belts with respect to the double faced web with the resultant production of a higher quality double faced board.

Additional objects and advantages of the invention will be more readily apparent from the following detailed description of an embodiment thereof when taken together with the accompanying drawings in which:

FIG. 1 is a schematic elevational view showing the manner in which a single faced web and liner are individually tensioned and fed into a double facer machine by apparatus in accordance with the present invention;

FIG. 2 is an enlarged elevational view of the single faced web following passage through the tensioning and feed means and the glue machine and prior to combination with the liner in the double facer machine;

FIG. 3 is an enlarged view showing the single faced web and the liner combined in the double facer machine;

FIG. 4 is an enlarged view of the liner tensioning device; and

FIG. 5 is a view along line 5–5 of FIG. 1 showing the manner in which the liner feed roll is connected to the common line shaft which drives the double facer, slitter-scorer, and rotary cut-off machine.

The main factors causing non-uniformity of the double facer feed have been the inability of the belts to overcome the variations in tensions of the component webs entering the double facer, the frictional resistance pulling the board over the hot plates, and in addition the difficulty in maintaining the upper and lower double facer belts at the same drive speed. Due to the lengths of the belts and the variations in belt conditions and tensioning arrangements, it is extremely difficult if not impossible to obtain an equal drive speed of the opposed belts. However, as will be more fully discussed below, small differences in belt speeds are no longer of critical importance with the improvement of the present invention.

The present improvement in brief includes means for tensioning, metering and feeding component webs into a double facer at a predetermined uniform rate. Heretofore, in making double faced board, the liner has been pulled from a supply roll on a mill roll stand over various idler rolls and through one or more preheaters to the double facer machine by the double facer belts. Similarly, the single faced web has been pulled through a glue station and into the double facer by the double facer belts. The uncontrolled variations in the tensions of the web components pulled into the double facer by the belts caused variations in the feed rate of the double faced board, which condition was aggravated by non-uniform double facer belt speeds. The present method and apparatus for introducing the web components to a double facer provide a uniform web tension and feed rate as described below.

Referring to the schematic view of FIG. 1, the flow paths of a single faced web **10** and a liner **12** are shown leading into the infeed end of a double facer machine **14**. The double facer machine illustrated is of a well known type such as that disclosed in U.S. Patent 2,993,527. Only the infeed end of the heating section of the double facer is included in the drawings.

The double facer elements shown include hot plates **16** over which the combined double faced web **18** is conveyed and biased by the upper double facer belt **20**. This upper belt extends the entire length of the double facer, passing over roll **22** at the infeed end of the machine. Idler pressure rolls **24** bearing downwardly on the lower run of the upper double facer belt maintain the web in continual sliding engagement with the hot plates to effect a uniform setting and curing of the web adhesive. The web on passing from the illustrated heating section to the cooling section (not shown) is engaged on its lower surface by a lower double facer belt which is co-extensive with the upper belt in the cooling section of the machine.

Considering first the flow path of the single faced web **10**, the web is received from a single facer machine by bridge conveyor **26** on which is permitted to accumulate in waves **28** to permit flexibility of operation of the single facer and double facer machines. Either one of the machines may thus be stopped for a short interval without affecting the operation of the other machine.

In order to provide the desired back tension, the web is passed through a drag assembly **30**. The assembly includes a stationary curved bridge **32** having a curved surface of sufficient radius to prevent damage to the web. A heavy cotton or synthetic plastic belt **34** is adapted to bias the moving web against the curved bridge surface. The belt **34** is secured at one end to stationary support **36** and at the other end is attached to tensioning lever **38** actuated by tensioning cylinder **40**.

The web after passing through the web drag assembly **30** passes over idler roll **42** and around feed roll **44**. Positioned between the drag assembly **30** and the idler roll **42** is dancer roll **46** connected to pressure control **47** which automatically controls the tension of the web by actuating cylinder **40** in a well known manner.

The surface of feed roll **44** is covered with a heat resistant synthetic rubber or plastic cover **48** to permit preheating of the web as well as to increase the traction of the roll. Means are provided (not shown) for heating the feed roll **44** in the customary manner. The angle "*a*" indicating the amount of circumferential contact between the feed roll and the web should be as great as possible to provide maximum traction without slippage.

The single faced web **10** passes from feed roll **44** into a glue machine **50** which supplies adhesive to the exposed corrugated crests of the web. The web then passes into the double facer machine where it is combined with the liner **12** to form a double faced web **18**.

The liner **12** is drawn from the mill rolls **52** and **54** mounted for rotation on mill roll stand **56**. The liner web passes over bridge roll **58** and into drag assembly **60** which provides the desired back tension to the liner web in a manner similar to that of previously described drag assembly **30** and includes stationary roll **62**, belt **64**, and cylinder **66** controlled by dancer roll **68** and fluid pressure control **70**. The dancer roll bears against the liner web run extending from the idler roll **72** to the idler roll **74**.

The liner web passes around feed roll **76** and pinch roll **78**, the latter being disposed in such a manner as to maintain the web in contact with the feed roll over an extended angle "*b*" of the feed roll circumference. Feed roll **76** like feed roll **44** is provided with a heat-resistant rubber cover **77** and internal heating means (not shown). A threading belt **80** on rolls **82** facilitates the threading of a web around the feed roll **76**. The liner web after passing over the feed roll and around the pinch roll, passes over idler roll **84** and then into the double facer machine.

The sectional plan view of FIG. 5 shows the manner in which feed roll **76** is driven by line shaft **86** to which it is coupled by gear box **88**. A clutch **90** is provided to permit disconnecting of the feed roll from the main drive. Feed roll **44** is similarly driven by line shaft **86** to insure a uniform feed of both component webs.

For operation, the single faced web **10** and the liner **12** are initially threaded through the various web control elements in the manner illustrated. The drag assemblies **30** and **60** are pre-set to provide the desired web tensions and feed rolls **44** and **76** are engaged with the line shaft **86**.

In operation, the feed rolls **44** and **76** draw the single faced web **10** and the liner **12** respectively from the bridge conveyor **26** and the mill roll **52** into the drag assemblies **30** and **60**. The dancer rolls **46** and **68** regulate cylinders **40** and **66** to maintain the desired back tension of the webs so that the feed rolls will meter a uniform web flow into the double facer machine. The webs are preheated in the feed rolls, adhesive is applied to the fluted portions of the single faced web in the glue machine **50**, and the single faced web and liner are brought together at the infeed end of the double facer machine. Because of the positive feed of the webs by the feed rolls **44** and **76** both of which are driven at the same rate by the line shaft **86**, the webs are positively presented at the infeed end of the double facer machine. As a result, the conveying force required in the double facer machine to advance the composite web is relatively small, and need be very little more than that required to overcome the frictional drag of advancing the double faced board through the double facer.

For this reason and particularly for the reason that the individual webs are accurately metered by the drag assembly and feed roll arrangements, the double facer machine may be more efficiently designed. For example, it is now possible to shorten considerably the length of the machine with a consequent saving in cost as well as space occupied since less belt length is needed to gain the reduced tractive force required on the web. A further advantage is the permissible use of conveying and blanketing means which more readily permit discharging moisture vapor from the double faced board to the atmosphere. Such conveying and blanketing means could for example be wire mesh or metal slat conveyor belts. In addition, the present arrangement permits more effective application of forced air such as that provided by the air lift arrangement disclosed in the pending U.S. patent application S.N. 182,499, filed March 26, 1962, assigned with the present application to a common assignee.

A primary advantage of the individual web tensioning and metered feed arrangement is the permissible driving of the double facer belts at a higher speed than that at which the single faced web and liner are fed into the machine. Variable speed drive means may be provided to vary this overpeed up to as much as 20 percent over the speed of the incoming single faced web and liner, although the optimum overspeed will depend upon the type of web being run and the belt material used. With cotton or synthetic belts the desired overspeed would probably range between 0.5 percent to 5 percent of the web speed. With metal belts or conveying means the overspeed would preferably be higher, for example, 10 percent of the web speed.

The overspeed keeps the board smooth and taut as it travels through the double facer, improves the appearance of the board and provides a better surface for subsequent operations. The overspeed also inhibits shrinkage, thus reducing "washboarding" and warpage. It will also reduce weaving of the web from side to side which in turn reduces the amount of side trim necessary at the slitting and scoring station. The overspeed furthermore provides a pull on the webs which insures that there will be no slippage at the feed rolls as long as the proper back tension is provided by the drag assemblies.

The metered web feed arrangement, which provides a uniform flow rate of the component webs entering the double facer machine, insures a uniform flow of double faced board from the double facer machine and thus maintains uniformity of blanks formed in the scorer-slitter and rotary cut-off operations occurring successively in timed relationship with the double facer machine. The elaborate and expensive mechanisms previously required to compensate for irregular feed rates of the double facer are thus no longer required for the production of uniform blanks.

Although in the embodiment illustrated a metered feeding of both a single faced web and liner are shown, normally the metered feeding of the outer liner alone will produce the desired result.

The tensioning devices or drag assemblies of the illustrated embodiment are helpful in maintaining a metered web feed but may not be necessary in every installation. Such tensioning devices may be omitted when the feed roll or other web feed arrangement employed provides a satisfactory web metering action without tensioning of the web.

In the combining of a liner with more than one single faced web to form double wall or triple wall board, or in combining two single faced webs to form "wall and a half" board, feeding and metering of one or more of the single faced webs in combination with or in place of the feeding and metering of the outer liner may be effected.

Minor changes in details of construction can be effected by those skilled in the art without departing from the spirit and the scope of the invention as defined in and limited solely by the appended claims.

I claim:

1. Apparatus for producing corrugated paperboard of improved quality comprising a double facer machine for combining component webs into a double-faced web, feed means disposed adjacent said machine to positively feed and meter at least one of said web components in said double facer machine, said feed means including a feed roll around which said web component extends in intimate circumferential frictional contact, a cut-off machine for cutting double-faced web into unit lengths, means connected to said feed means and the cut-off machine for synchronously driving said feed means with the cut-off machine, and additional means for operating the double facer machine at a speed exceeding the web component speed provided by said feed means so that the web component is kept taut between the feed means and the double facer machine.

2. Apparatus in accordance with claim 1 including means for producing a back tension on the web component before it contacts the feed roll.

3. Apparatus in accordance with claim 1 wherein said feed roll is in intimate circumferential frictional contact with the web component for approximately 180° of the circumferential surface of the feed roll, and a second feed roll in intimate circumferential contact with the other web component for positively feeding and metering the other web component into the double facer machine, said feed means including each of said feed rolls.

4. In a method of operating apparatus for processing paperboard comprising the steps of positively feeding and metering web components to a double facer machine by extending at least one of the web components into intimate circumferential frictional contact with a feed roll adjacent the inlet end of said machine, joining the web components into double-faced board at the double facer machine, cutting double-faced board produced by the double facer machine into unit lengths, synchronizing the speed of cut-off with the surface of the feed roll, and maintaining the web component between the feed roll and the double facer machine taut by operating the double facer at a speed of about .5 percent to 20 percent greater than the surface speed of the feed roll.

5. A method in accordance with claim 4 including the step of tensioning said one web component before it contacts the feed roll to provide uniform back tension on said one web component.

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