United States Patent

Plunkett et al.

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[54] **APPARATUS FOR MAKING DOUBLEFACED CORRUGATED BOARD WITH FINE PRINTING THEREON**

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[52] **U.S. Cl.** **156/470**, 156/464, 156/552

[51] **Int. Cl.** **B31f 1/28**, B32b 31/04

[58] **Field of Search** 156/369, 470, 477, 205, 207, 156/210, 552, 522, 464, 461

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[57] **ABSTRACT**

The upper face of the corrugated board has a preprinted face of fine printing thereon. The machine supplies individual pieces of preprinted sheet material to a travelling web of a flat-face material and adhered corrugated material. The individual pieces are supplied in a timed sequence through a photoelectric system so that the individual pieces are accurately oriented on the travelling web for subsequent severing of the completed stream into a plurality of double-faced corrugated board blanks.

8 Claims, 5 Drawing Figures

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SHEET 1 OF 3

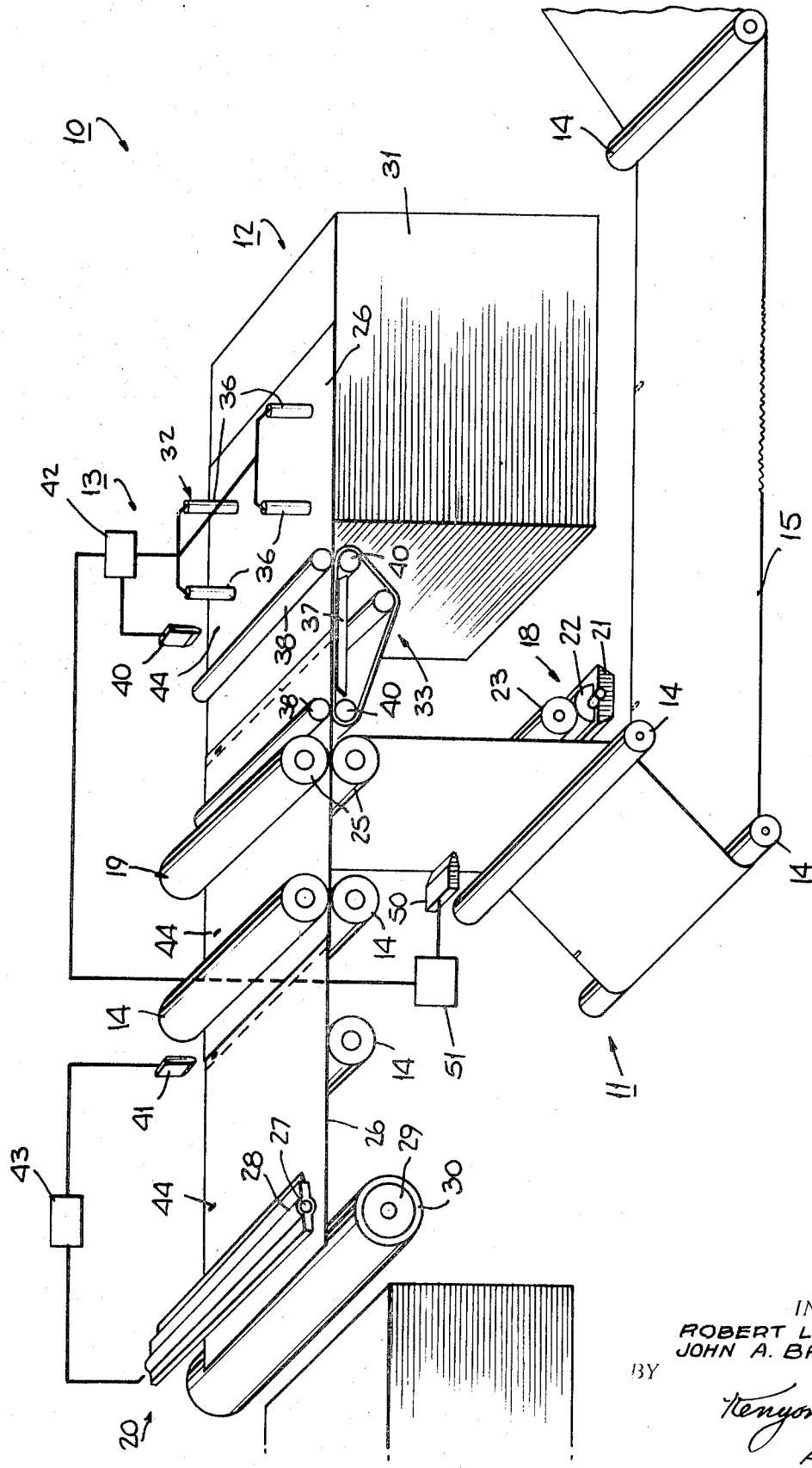


Fig. 1.

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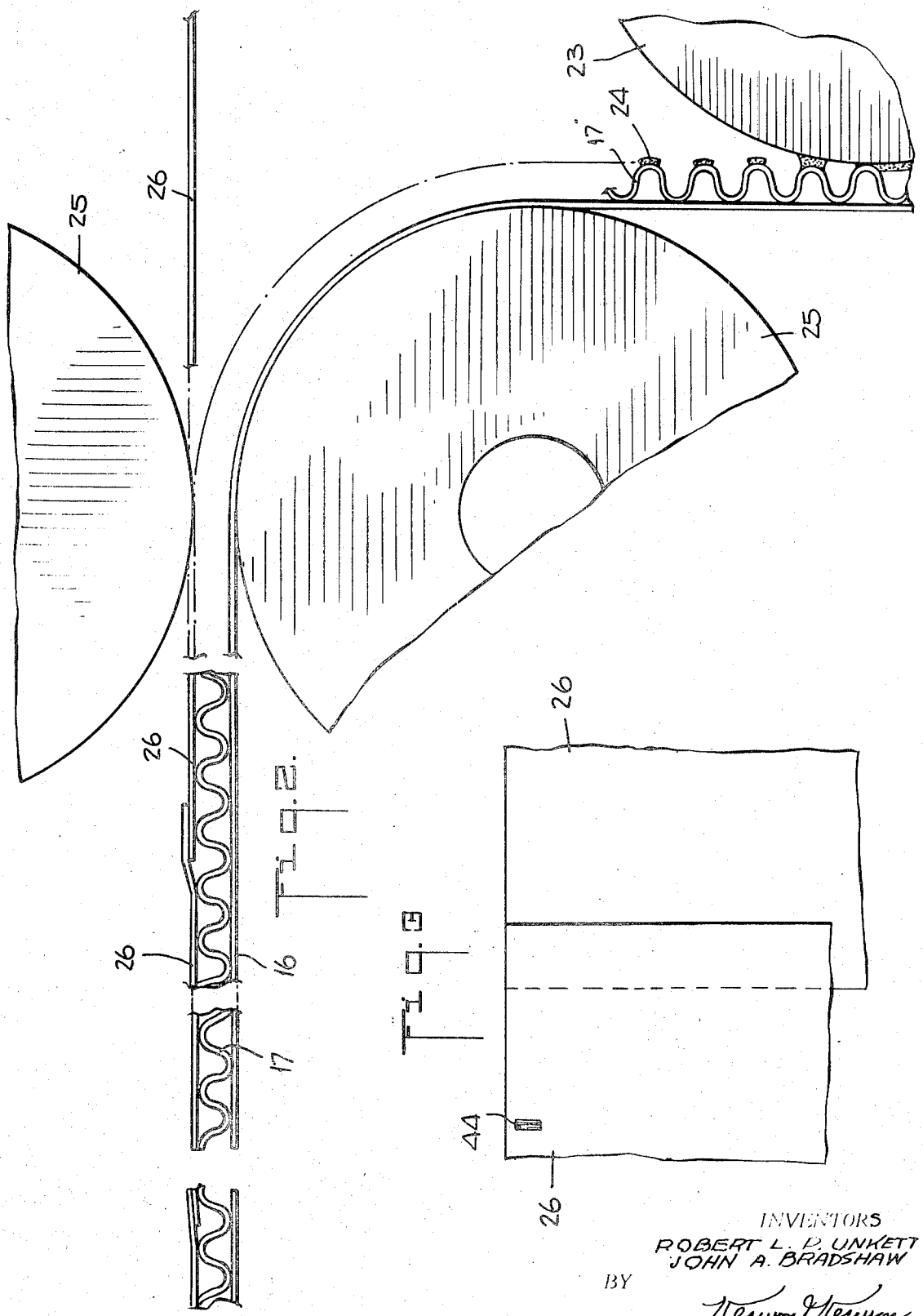


Fig. 2.

Fig. 3

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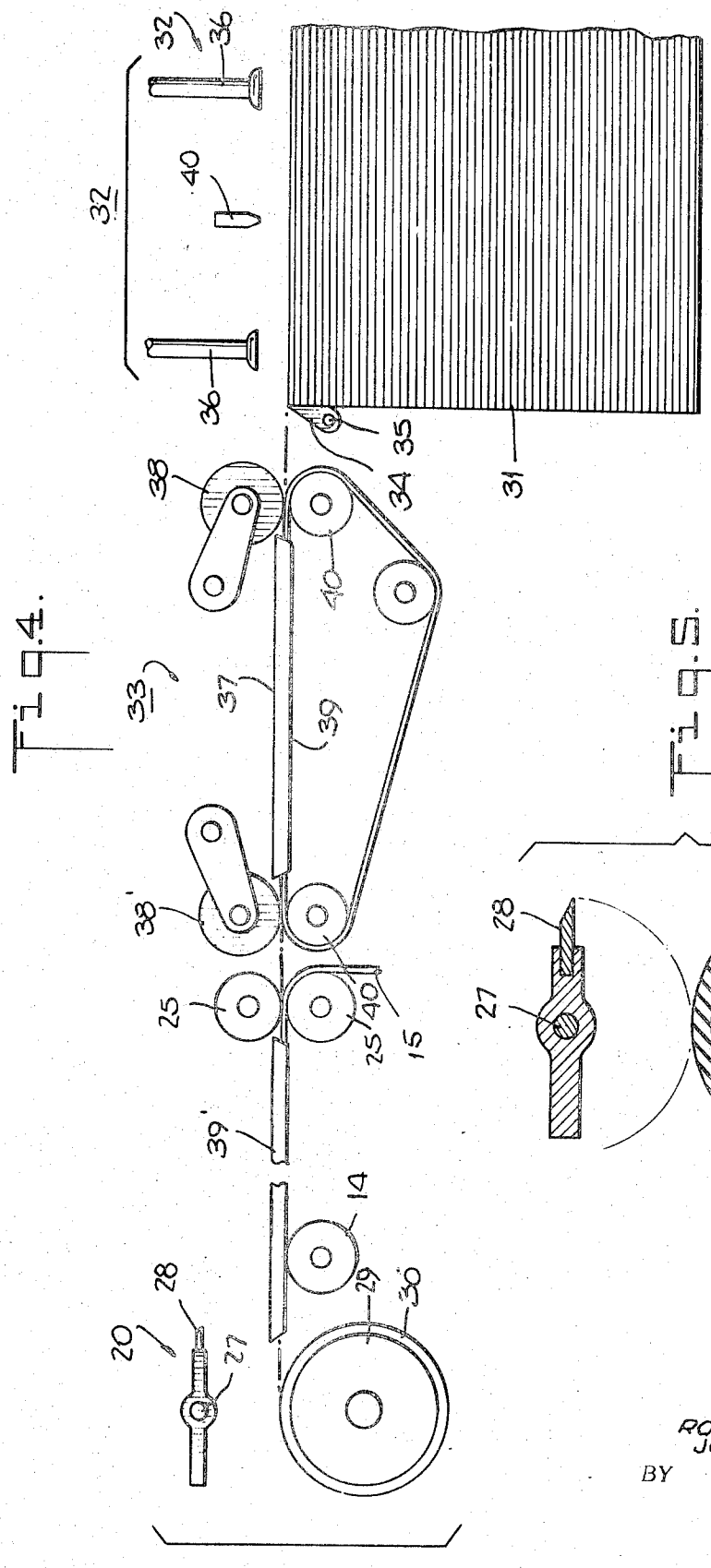


Fig. 4.

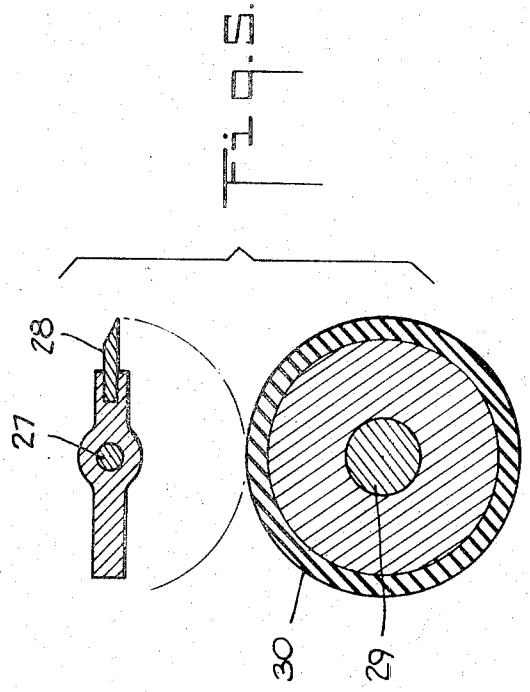


Fig. 5.

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APPARATUS FOR MAKING DOUBLEFACED CORRUGATED BOARD WITH FINE PRINTING THEREON

This invention relates to an apparatus and method for making double-faced corrugated board with fine printing thereon. More particularly, this invention relates to an apparatus and method of accurately positioning individual preprinted pieces of material on a travelling web of single-faced corrugated board.

Heretofore, it has been known to form corrugated board by bonding together streams of corrugated material and flat sheet material and subsequently severing the stream into individual boards in a continuous manner. It has also been known to provide a printed surface on at least one surface of the formed boards for display purposes or identification purposes. In some instances, the printing was supplied by imprinting each severed board with a printed pattern by means of a rubber stamp. In other instances, the printing was initially placed on one of the flat sheets before forming of the boards. However, these procedures either did not provide a bright, sharp printed image, for example, in the instance of the rubberstamp, or did not provide an accurately positioned printed image with respect to a severed board, for example, in the instance of the preprinted sheets.

In order to overcome these disadvantages, it has been known to form corrugated boards by sequentially bonding a series of preprinted sheets onto a moving web of material formed of a single flat sheet and an overlying corrugated sheet. The series of preprinted sheets have been supplied to the moving stream by moving a number of sheets in overlapping relation at a speed synchronized with the speed of the moving stream. However, this procedure has utilized a mechanical stop in the path of the preprinted sheets which is moved into and out of the path in dependence upon the speed of the moving web. Further, the registration of the individual sheets on the moving web has frequently not been accurate.

Accordingly, it is an object of the invention to maintain a continuous supply of preprinted sheets to a travelling web of single-faced corrugated board.

It is another object of the invention to provide an apparatus for making corrugated board in a rapid economical manner.

It is another object of the invention to provide an economical and practical method of joining sheets of material to a web of corrugated-board material.

Briefly, the invention provides an apparatus and method for registering individual preprinted sheets onto a travelling web of corrugated board. The apparatus includes a conveyor system for feeding a continuous web of single-face corrugated-board material through a predetermined path, a sheet-feeding device positioned to exactly place successive preprinted sheets of material onto the single-face stream, for example, from a stack of sheets, and a photoelectric system which cooperates with an eyemark on each of the preprinted sheets to actuate the feed of the preprinted sheets onto the single-face web. The conveyor system is constructed with various rollers and guides to guide the single-face material which consists of a layer of flat sheet material and a bonded layer of corrugated sheet material from a supply source past an adhesive-applying means. The adhesive-applying means is placed so as to apply an amount of adhesive onto the crowns or outer rounded peaks of the corrugated layer which run parallel to the flat layer of the single-face material. The conveyor system also guides the web of single-face material after the preprinted sheets have been placed thereon through a pressure means wherein the preprinted sheets are firmly bonded to the corrugated layer and a cutting assembly wherein the web is severed into a series of individual double-face corrugated-board blanks.

The sheet-feeding device is positioned relative to the conveyor system between the adhesive-applying means and cutting assembly in order to feed the preprinted sheets of material from the stack onto the adhesive-treated surfaces of the corrugated layer of the single-face material. The individual preprinted sheets are fed onto the web of single-face material with a slight overlap of the forward strip over the rear strip.

The photoelectric system is arranged to be responsive to the eyemarks on the preprinted sheets so as to actuate the sheet-feeding device in a manner to continuously feed the sheets onto the stream of corrugated material. That is, when the photoelectric system "sees" an eyemark on a passing preprinted sheet, the system actuates the sheet-feeding device to start one feeding cycle wherein the topmost sheet from the stack is lifted and placed into the conveyor system. Thereafter, the sheet is placed over the adhesive-treated web of single-face material and pressed thereon by the pressure means. In the meantime, the sheet-feeding device returns to its initial position to await the next cycle. This allows a continuous flat surface to be applied over the corrugated layer.

In order to have the photoelectric system see the passing eyemark at the precise instant to start the feed cycle exactly on time, a photoelectric scanner of the system is positioned alongside the sheet transport path at a setting so as to produce, for example, a succession of sheets with the leading sheet overlapping the trailing sheet by one-half inch. An advance of the scanner position one-quarter inch would cause the feeding cycles to be closer together with a resultant overlap of three-quarters inch. A retardation of the scanner position one-half inch, on the other hand, would cause a reduction in the overlap to substantially zero. This arrangement thus utilizes the eyemarks on each preprinted sheet to be used to feed the sheets exactly in succession and to control the degree of overlap.

Since it is intended to print the eyemarks on each preprinted sheet at the same distance from the trailing edge, it becomes unnecessary to change the scanner setting for each change in sheet size in order to obtain the same amount of overlap. In addition, repeating eyemarks can be placed on the web of single-face material to cooperate with the photoelectric system so as to activate the sheet-feeding device in the event that an accurate positioning of sheets onto the moving web is not required, for example, in the event that preprinted sheets are not used. In this latter case, should the web of single-face material stop or run out for any reason, the sheet-feeding device can be deactivated simultaneously or after a predetermined number of cycles. The photoelectric system also is constructed to activate the cutting assembly in successive cycles and includes a scanner mounted near the cutting assembly to see the eyemarks of the preprinted sheets when the formed double-face corrugated board comes adjacent the cutting assembly so as to activate the cutting assembly to accurately sever the board at predetermined points, for example, by bringing the printing position correctly to the cutting edge.

By using the photoelectric system and eyemarks on the preprinted sheets or a count of the crowns on the corrugated web, the continuously moving web of single-face corrugated board is accurately supplied with preprinted sheets and the formed double-board web is cut into accurately sized corrugated-board blanks with preprinted surfaces.

Further, both the single-face web material and the sheet material can be preprinted, the accurate positioning of the sheets on the web thus permitting a double-faced blank to be produced which can be used, for example, for display plates, for boxes having printed interior and exteriors, and the like.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 schematically illustrates an apparatus of the invention;

FIG. 2 illustrates an end view of the adhesive-applying means and pressure means of the conveyor assembly of the apparatus of FIG. 1;

FIG. 3 illustrates a plan view of two overlapped preprinted sheets with an eyemark on the overlapping sheets;

FIG. 4 illustrates a side view of the sheet-feeding device in relation to the travelling web of single-face corrugated material; and

FIG. 5 illustrates a cross-sectional view of the assembly of the apparatus of FIG. 1.

Referring to FIG. 1, an apparatus 10 for making double-faced corrugated board includes a conveyor system 11, a sheet-feeding device 12 and a photoelectric system 13.

The conveyor system 11 has a plurality of guide rollers 14 for guiding a web of single-face corrugated board 15 of known construction, for example, having a flat sheet layer 16 and a bonded sheet layer 17, from a suitable source (not shown) past an adhesive-applying means 18, and through a pressure means 19 and a cutting assembly 20. The guide rollers 14 which are of a known construction are driven at a suitable speed to convey the web 15 or are permitted to roll free as the web 15 passes over each.

Referring to FIGS. 1 and 2, the adhesive-applying means 18 is constructed of an adhesive reservoir trough 21 which contains a replenishable supply of adhesive, a roller 22 which is rotatably mounted so as to project into the trough 21 to pick up a charge of adhesive on the surface thereof, and a doctor roller 23 which is rotatably mounted adjacent the adhesive pickup roller 22 and the web 15 to receive a measured quantity or film of adhesive from the pickup roller 22 and to deliver an amount of adhesive 24 onto the flat surfaces of the corrugated layer 17 of the web 15 (FIG. 3).

The pressure means 19 is of known construction and includes a pair of flat surfaced rollers 25 which are adjustably spaced apart a distance slightly less than the thickness of the web 15 and a preprinted sheet 26 mounted on the web 15. The rollers 25 function not only to press the preprinted sheets 26 and web 15 together but also serve as draw rollers to drive the web 15 through the conveyor system 11. In this regard, at least one of the rollers 25 is positively driven through a suitable transmission from the main drive (not shown) of the apparatus. Further, in order to adjust to various thicknesses of material, at least one of the rollers 25 is adjustably mounted in a suitable manner (not shown) to vary the spacing between the rollers 25.

The cutting assembly 20 includes a rotatable shaft 27 on which a cutting blade or shear 28 is mounted and a rotatable drum 29 around which a surface layer of shock-absorbing material 30 such as rubber, polyurethane foam or the like is mounted. The blade 28 is sized to cut through the stream of double-faced board material and project into the shock-absorbing material 30 on the drum 29. In this manner, a minimum of wear is imposed on the blade 28. The shaft 27 is driven in an intermittent fashion with rest and moving periods such that during the nonrotation rest period, the blade 28 is disposed in a stationary horizontal position.

The conveyor system 11 is driven in a continuous manner from the main drive (not shown) so that a stream of bonded preprinted sheets and single-face corrugated board is continuously fed towards the cutting assembly 20 and severed into individual double-faced corrugated blanks. That is, the rollers 25 of the pressure means 19 and any other pairs of feed rollers driving the bonded web are driven in synchronism to continuously feed the bonded web. Also, the lower drum 29 of the cutting assembly 20 is driven in synchronism with the rollers 25 of the pressure means 19. As is more fully set out below, the shaft 27 of the cutting assembly 20 is driven from the main drive via a known clutch control 43. Thus, during the moving period, the shaft 27 is driven in synchronism with the drum 29 and, during the rest period, the shaft 27 is disengaged from rotation via the clutch control.

Referring to FIG. 4, the sheet-feeding device 12 which is of known construction includes a sheet supply stacker 31, a sheet mover 32 and a sheet conveyor 33. The stacker 31 is constructed to contain a stack of preprinted sheets 26 and to move the stack in an upward direction as each topmost sheet 26 is removed by the sheet mover 32. A plurality of guide fingers 34 are fixedly mounted on a common rod 35 which is pivotally mounted at the forward face of the stacker 31. The guide fingers 34 are positioned in parallel relation to each other to project across the plane of the topmost sheet 26 in the stacker 31 so as to align the sheet 26 flush therewith for accurate placement on the web 15. The sheet mover 32 includes a plurality of pneumatic nozzles 36 which communicate with a suitable suction source to pick up the topmost sheet 26 in the stacker 31. The nozzles 36 are mounted above the stacker 31 in a manner so as to move through a predetermined path. That is, the nozzles 36 are synchronized with each other to first move towards the topmost sheet 26 in the stacker 31 and pick up the sheet 26 under suction; second, to move the sheet 26 out of the stacker 31 into the conveyor 33; and third, to return into position for a subsequent cycle. During the third phase of the cycle, the sheet 26 is removed from the nozzles 36 by the action of the conveyor 33 and an upward movement of the nozzles 36. The conveyor 33 includes an apron 37 composed of a plurality of endless movable tapes and a pair of nip rollers 38, 38' which are positioned over the respective ends of the apron 37. The nip rollers 38, 38' are both driven in synchronism and are positioned relative to the apron 37 to draw a sheet 26 therethrough and to feed the drawn sheet 26 onto the web 15 between the pressure means 19. In order to facilitate transferral of the sheets 26, the conveyor 33 includes flat rigid shelves 39, 39' under the apron 37 and between the front nip roller 28 and pressure means 19.

The apron 37 of the conveyor 33 is driven in a continuous manner through rollers 40 which are driven via a suitable transmission (not shown) from the main drive of the apparatus 10. In addition, the apron 37 is driven in synchronism with the rollers 25 of the pressure means 19 in order to move the preprinted sheet 26 onto the web 15 at the speed of the stream 15. Also, the rod 35 is pivoted in synchronism with the nozzles 36 so as to pivot the guide fingers 34 in counterclockwise manner, as viewed, out of the path of the topmost sheet 26 as the nozzles 36 are moved in their second phase towards the conveyor 33.

Referring to FIG. 1, the photoelectric system 13 includes a pair of photoelectric scanners 40, 41 and suitable controls 42, 43 for activating the sheet mover 32 and blade shaft 27. One scanner 40 mounted over the stacker 31 in a position to sense the passage of the topmost preprinted sheet 26 from the stacker 31 while the other scanner 41 is mounted over the double-face board web upstream of the cutting assembly 20 in a position to sense the passage of predetermined cutting points on the stream.

The scanner 40, which is adjustably mounted forward of the forward edge of the stacker 31 relative to the exit speed of the preprinted sheets 26, cooperates with an eyemark 44 on the preprinted sheets 26 so that, on passage of the eyemark 44 on the topmost sheet 26 past the scanner 40 during passage into the conveyor 33, the scanner 40 reacts to the presence of the eyemark 44 to activate the control 42 for recycling of the sheet mover 32. That is, as the topmost sheet 26 is being pulled from the stacker 31, the next sheet 26 is being picked up by the nozzles 36 and moved out of the stacker. The position of the eyemark 44 on the sheets 26, the position of the scanner 40 and the path of the nozzles 36 are such that the trailing sheet 26 leaving the stacker 31 begins to move before the foremost sheet 26 has left the stacker 31 completely. This causes a slight lapping to take place between successive sheets. The underlap of the trailing sheet can also be facilitated through the guide fingers 34 since the guide fingers 34 can be used to lift the trailing end of the sheet in the conveyor 33 while simultaneously serving to align the next sheet in the stacker 31 upon pivoting into a vertical position (cf. FIG. 4).

The scanner 41 which is adjustably mounted with respect to the cutting assembly 20 cooperates with the eyemark 44 (FIG. 3) on the preprinted sheets 26 so that, on passage of the eyemark 44 past the scanner 41, the scanner 41 reacts to the presence of the eyemark 44 to activate the clutch control 43 for cycling the blade shaft 27 of the cutting assembly 20 via the main drive. The position of the scanner 41 relative to the stream of double-face board, the horizontal position of the blade 28 and the timing relationship between the scanner 41 and shaft 27 are such that the clutch control 43 is actuated to permit engagement of the shaft drive (not shown) with the

main drive (not shown) of the apparatus **10** to cause the blade **28** to rotate at the web speed to sever the web on a plane passing through the area of overlap of successive sheets **26**.

In operation, the conveyor system **11** conveys the web **15** of single-face corrugated-board material past the adhesive applying means **19** (FIG. **1**) where the adhesive is applied to the corrugated layer **17** (FIG. **2**). Thereafter, the web is drawn into the pressure means **19**. At the same time, a preprinted sheet **26** which has been picked up by the pneumatic sheet mover **32** and fed into the conveyor **33** (FIG. **4**) is fed onto the web **15** at a point immediately before the nip of the pressure means **19**. This preprinted sheet **26** which is accurately positioned over the web **15** in a flush manner is then bonded to the web **15** by virtue of the adhesive **24** and the slight pressure accorded by the rollers **25** of the pressure means **19**. A web of double-face corrugated board is thus formed.

Before the sheet **26** has been completely bonded to the web **15**, a second preprinted sheet **26** is fed onto the web **15** in underlapping relation to the first sheet **26** via the strip-feeding device **12**. The forward end of this second sheet **26** is then bonded to the web **15** while the rear end of the first sheet overlaps the second sheet in unbonded relationship. This maintains an accurate continuous supply of preprinted sheets onto the single-face corrugated board web **15**.

After passing from the pressure means **19** the bonded stream of double-face corrugated board is fed toward the cutting assembly **20**. Upon passing the scanner **41**, the eyemark **44** on the formed web is sensed by the scanner **41** and a signal is sent to the clutch control **43** to activate the shaft **27**. The shaft **27** then rotates clockwise as viewed in FIG. **1** to cause the blade **28** to sever the stream within the overlapped sheet areas. As the rear end of the foremost sheet **26** overlaps the next trailing sheet and is free of adhesive, a waste strip of sheet material is cut from the stream of double-face board at the same time as a double-face corrugated-board blank is cut. Further, the edge of the cut blank is provided with a double thickness of preprinted sheet of slight width, for example, one-quarter inch.

By way of example, for preprinted sheets **26** of a length of 40 inches, the eyemark **44** for activating the scanner **40** is placed about 8 inches from the rear end. Also, the sheet mover **32** is actuated to begin movement of the next sheet **26** towards the conveyor **33** at a time when about 38 inches of the first sheet has passed into the conveyor **33**. This allows approximately a ½-inch overlap between the sheets **26**.

Referring again to FIG. **1**, the photoelectric system **13** can be optionally provided with a third photoelectric scanner **50** and a suitable control **51** for activating or deactivating the sheet-feeding device **12** of the apparatus **11**. Such a scanner **50** is constructed to operate with an eyemark on the web **15** of single-face corrugated-board structure. The scanner **50** is positioned relative to the web **15** so as to activate the sheet-feeding device **12** upon sensing the passage of the eyemark thereby. This scanner **50** can be utilized where an accurate positioning of the preprinted sheets is not needed. That is, in the event that the apparatus **10** is used merely to position sheets of board material on the travelling web **15**, the scanner above the sheet-feeding device **12** can be taken out of operation while reliance is made on the scanner **50** adjacent the adhesive-applying means **18** for actuation of the sheet-feeding device **12**. The operation of the apparatus **10** in this latter case is such that as successive eyemarks on the web **15** pass the scanner **50**, the scanner passes a signal to the control **51** to successively activate the sheet mover **32** of the sheet-feeding device **12**.

It is noted that instead of placing a single eyemark on each preprinted sheet a pair of eyemarks can be used with each eyemark being used to activate a respective one of the scanners **40**, **41** so that the sheets are fed in an accurate continuous manner onto the web **15** and subsequently severed in the cutting assembly **20**.

It is further noted that the apparatus provided by the invention accurately positions successive preprinted sheets on the travelling web of single-face corrugated-board material by initiating the feeding of a sheet onto the web only when a preceding sheet has passed the predetermined point defined by the scanner.

It is further noted that the apparatus of the invention can be used to position a wide range of preprinted sheet sizes on a travelling web. For example, the sizes of the preprinted sheets can range from 25×38 inch sheets to 54×75 inch sheets. In this regard, the respective scanners of the photoelectric system can be adjusted with respect to the various sheets so as to feed or cut at a precise point.

What is claimed is:

1. An apparatus for accurately positioning a plurality of preprinted sheets on a moving web of corrugated board comprising

a conveyor system for guiding a web of corrugated-board material having an adhesive material on one side thereof in a predetermined path;

a sheet-feeding device which engages and moves a plurality of preprinted sheets in sequential manner for feeding onto said adhesive side of the web in slightly overlapping relation;

means for actuating said sheet-feeding device;

means for sensing the passage of a preprinted sheet from said sheet-feeding device to the web; and

control means responsive to aid sensing means upon passage of a preprinted sheet past said sensing means for triggering said actuating means to cause a subsequent preprinted sheet to be engaged and moved by said sheet-feeding device toward said web.

2. An apparatus as set forth in claim **1** wherein said sensing means includes a photoelectric scanner for sending a signal to said control means in response to sensing of the passage of a preprinted sheet thereby to actuate said control means. as set forth in claim **3** wherein the preprinted sheets

3. In a corrugated board forming apparatus having means for conveying a web of corrugated board and applying adhesive to one side thereof, and means for feeding individual preprinted sheets onto the web of corrugated board by engaging and moving said sheets in a direction toward the web so as to adhere the preprinted sheet to the web of corrugated board, the improvement comprising scanner means mounted adjacent the sheet-feeding means for sensing the passage of a preprinted sheet and emitting a signal in response thereto, means for actuating the sheet-feeding means, and means for transmitting the signal emitted by said scanner means to said sheet feeder actuating means so as to cause said sheet feeder to engage and advance another preprinted sheet toward the web of corrugated board.

4. An apparatus as set forth in claim **3** wherein the preprinted sheets are fed continuously and without interruption along a predetermined path toward the web of corrugated board and said scanner means is mounted with respect to the sheet-feeding means to cause the preprinted sheets to be fed sequentially and in an overlapping relation with respect to one another.

5. An apparatus as set forth in claim **4** wherein said scanner means is disposed above the path of travel of the preprinted sheets, the latter being provided with marks capable of being detected by said scanner means so that upon passage of each respective sheet said scanner means is caused to emit a signal in response to the mark and actuate the sheet-feeding means.

6. An apparatus as defined in claim **3** which further includes means for cutting the web of corrugated board having the preprinted sheet adhered thereto into a blank of a predetermined size and means for actuating said cutting means so as to cause said cutting means to sever the web of corrugated board in response to the passage of a preprinted sheet.

7. An apparatus as set forth in claim **6** wherein said cutter-actuating means is a second scanner means disposed so as to sense the passage of a preprinted sheet adhered to the web of corrugated board.

8. An apparatus as set forth in claim 6 wherein said cutter means is rotatably mounted and adapted to engage the web to be severed once every cycle, and which further includes a clutch-and-brake assembly connected to said cutter means so as to provide an intermittent-drive connection.

* * * * *