United States Patent

Martin

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[54] METHOD AND APPARATUS FOR HANDLING SHEETS

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[52] **U.S. Cl.** **271/76**

[51] **Int. Cl.** **B65h 29/66**

[58] **Field of Search** ..... 271/76, 2 F, 69; 198/203

[56] **References Cited**

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[57] **ABSTRACT**

The herein method and apparatus is used in connection with a corrugator machine. Corrugator machines convert paper from a web roll into flat corrugated box blanks. Such corrugator machines have a number of sections for forming such box blanks, and the devices in these sections are driven in synchronism by a line shaft. In the herein apparatus the blanks discharged from the corrugator lengthwise are moved at right angles, then shingled and stacked. The velocity of each of the steps in handling the sheets is co-ordinated for a relative speed ratio between the right angle take off of the sheets, the shingling and stacking, and is co-ordinated with the speed of the corrugator machine, through the line shaft in such a manner that when the corrugator speed varies, then the right angle take off, the shingling and the stacking also varies, but the same relative speed ratios between the right angle take off conveyor, shingling or transfer conveyor, and stacking conveyor are preserved. The ratio adjustments are predicated on the basic equation of the speed of movement on the right angle take off which recieves the blanks from the corrugator as follows:

$$V_d = W/L\, V_c(1-S)$$

in which V_c is the speed of the corrugator in ft/min, V_d is the speed on the right angle take off, W is the width and L is the length of the blank, and S is the ratio of the shingle, namely, $S=O/W$ in which O is the overlap; and the basic equation for the speed of the transfer conveyor or shingling conveyor relatively to the right angle takeoff is

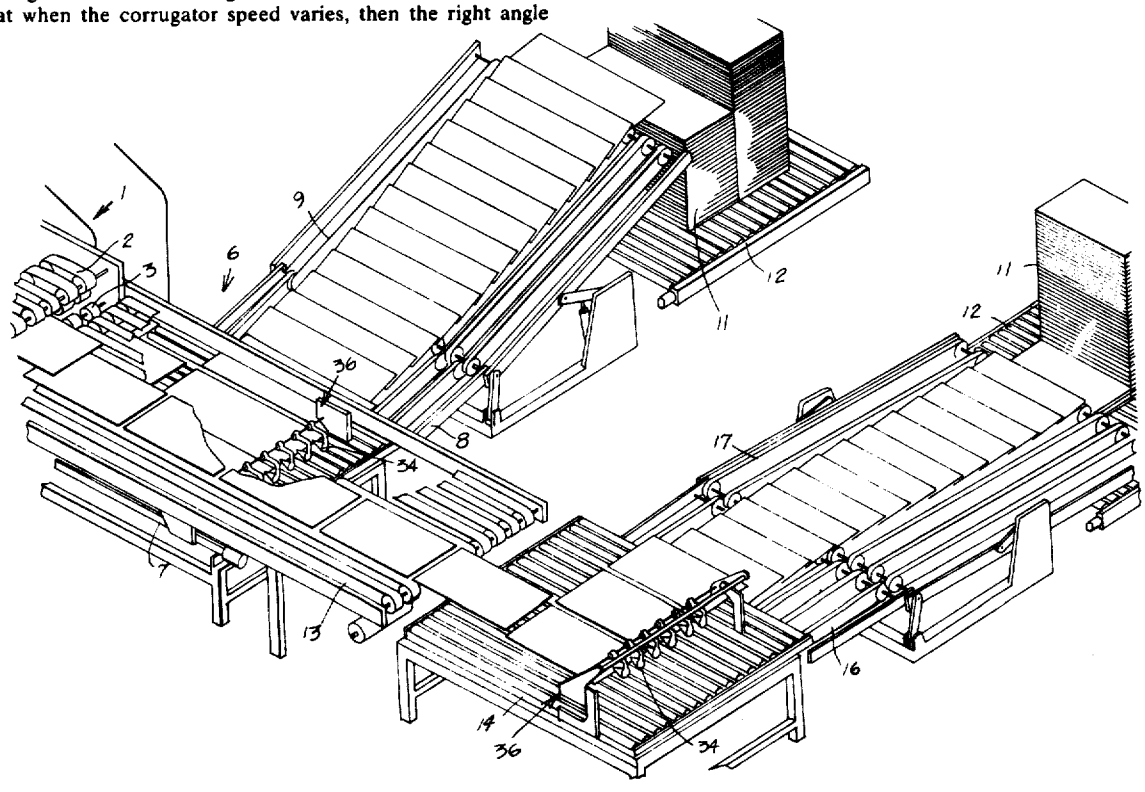
$$V_t = W/L\, V_c(1-S_t)$$

in which V_t is the speed of the transfer or shingling conveyor in ft/min and S_t is the ratio of the shingle on the transfer conveyor; and the basic equation for the speed of the stacker is

$$V_s = (W/L)\, V_c(1-S_s)$$

in which V_s is the speed of the stacker conveyor in ft/min and S_s is the ratio of the shingle on the stacker. A device is provided for adjusting the ratio of the respective conveyors to predetermine the speeds of the conveyors relatively to the speed of the corrugator in accordance with the width and length of the blanks. A connection is provided to the line shaft of the corrugator so as to automatically control the overall speed in accordance with the variation of speed of the corrugator but maintaining the predetermined relative ratios between the respective conveyors.

3 Claims, 5 Drawing Figures



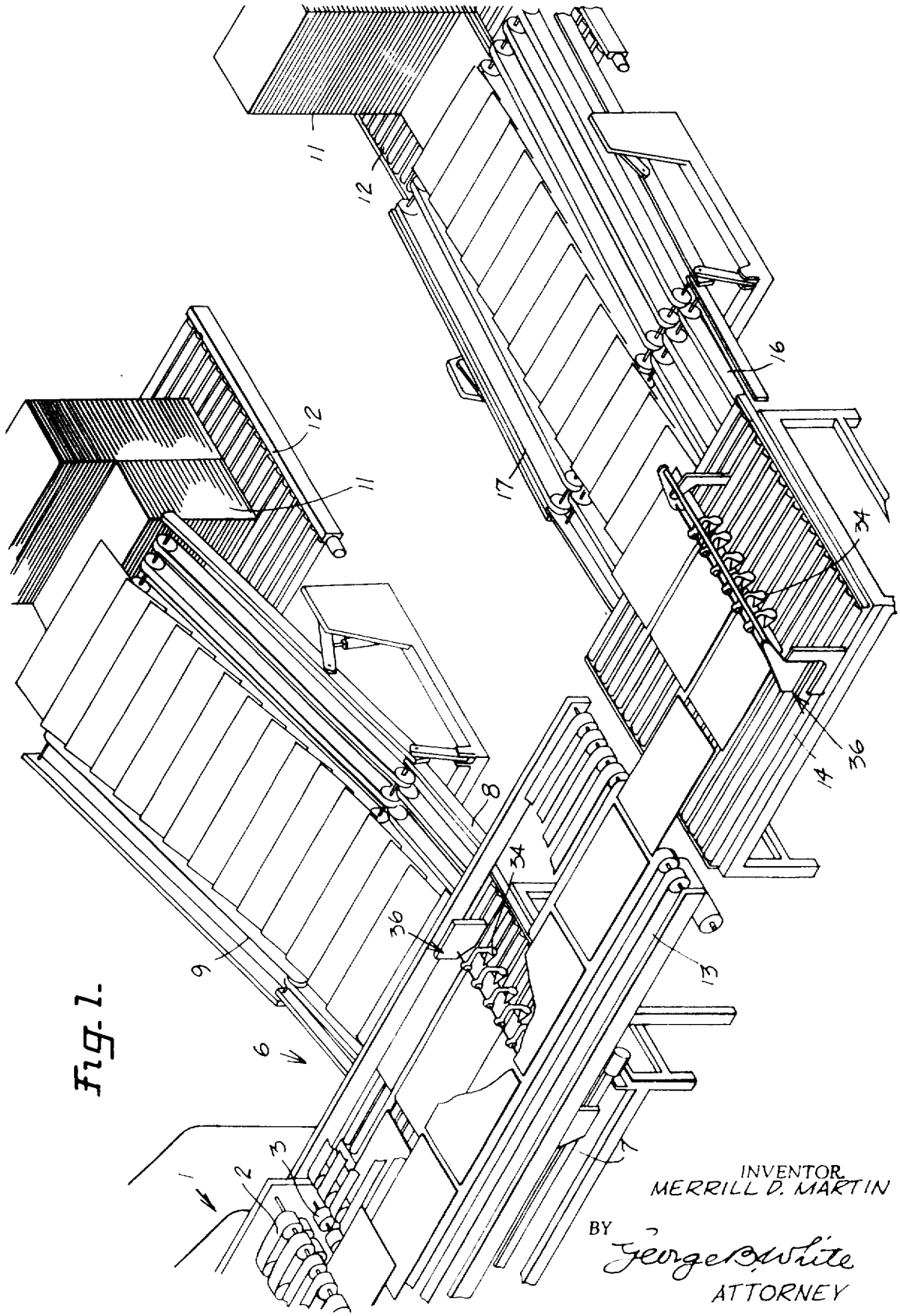


Fig. 1.

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Fig. 2.

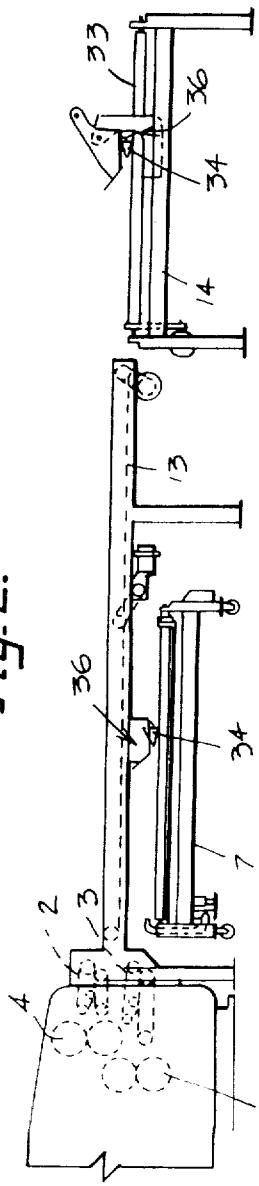
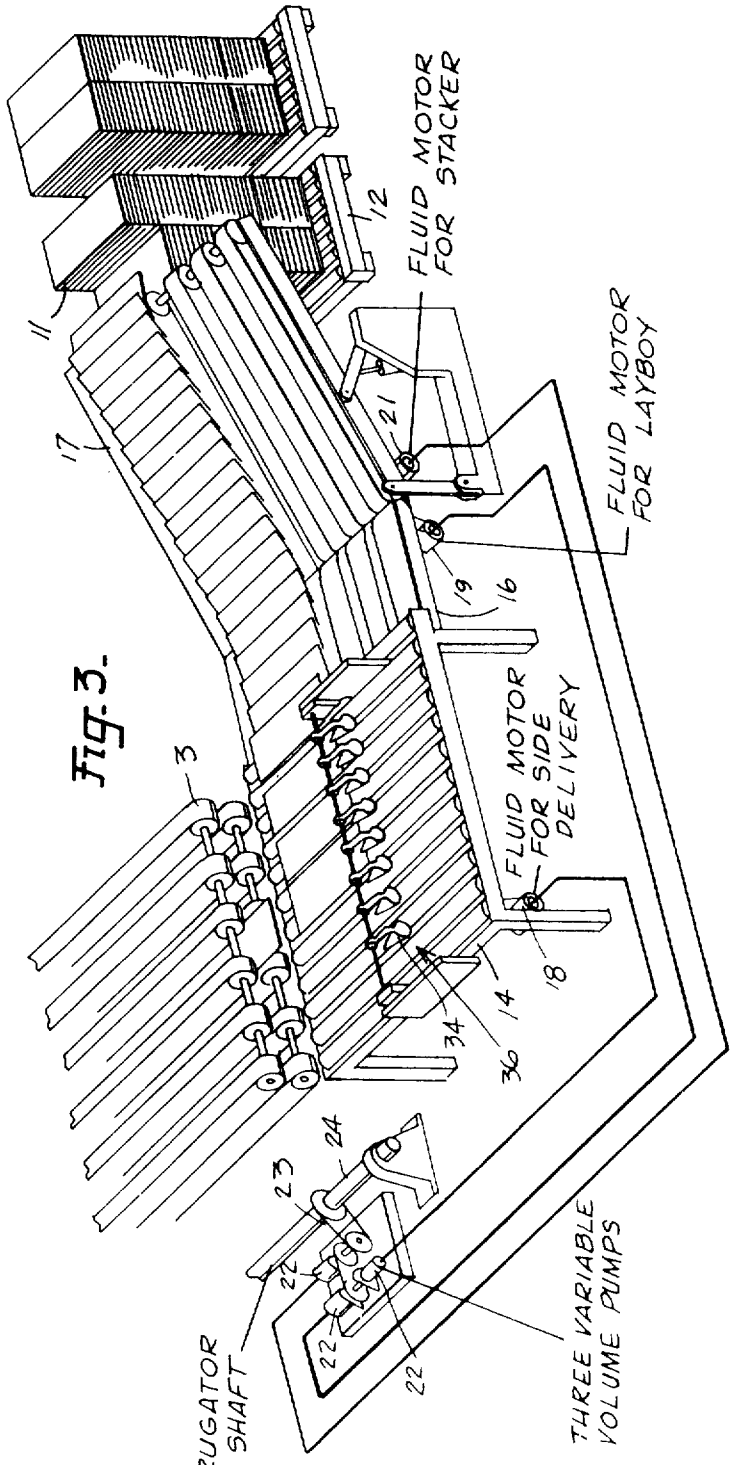


Fig. 3.



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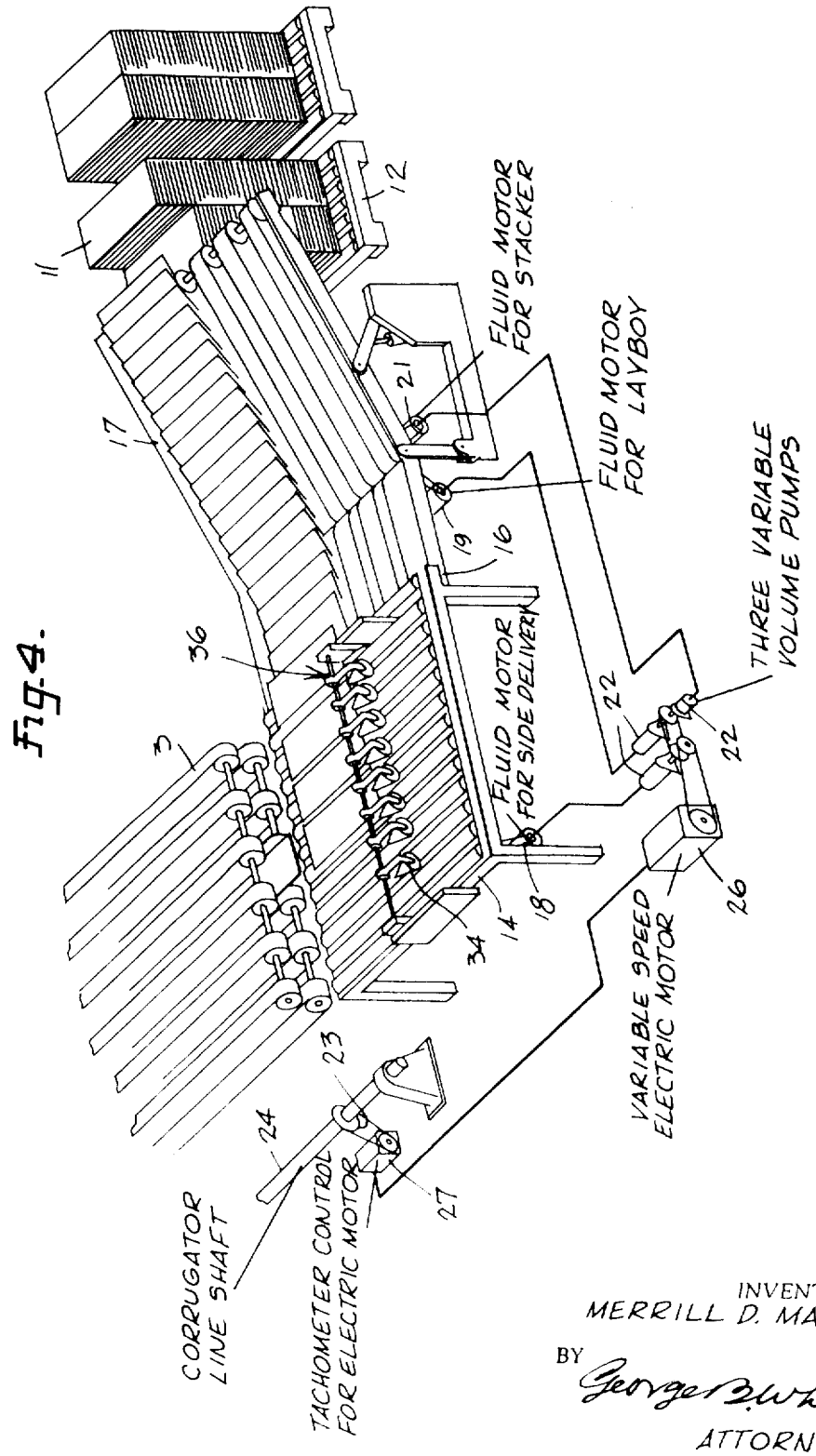

Fig-4.

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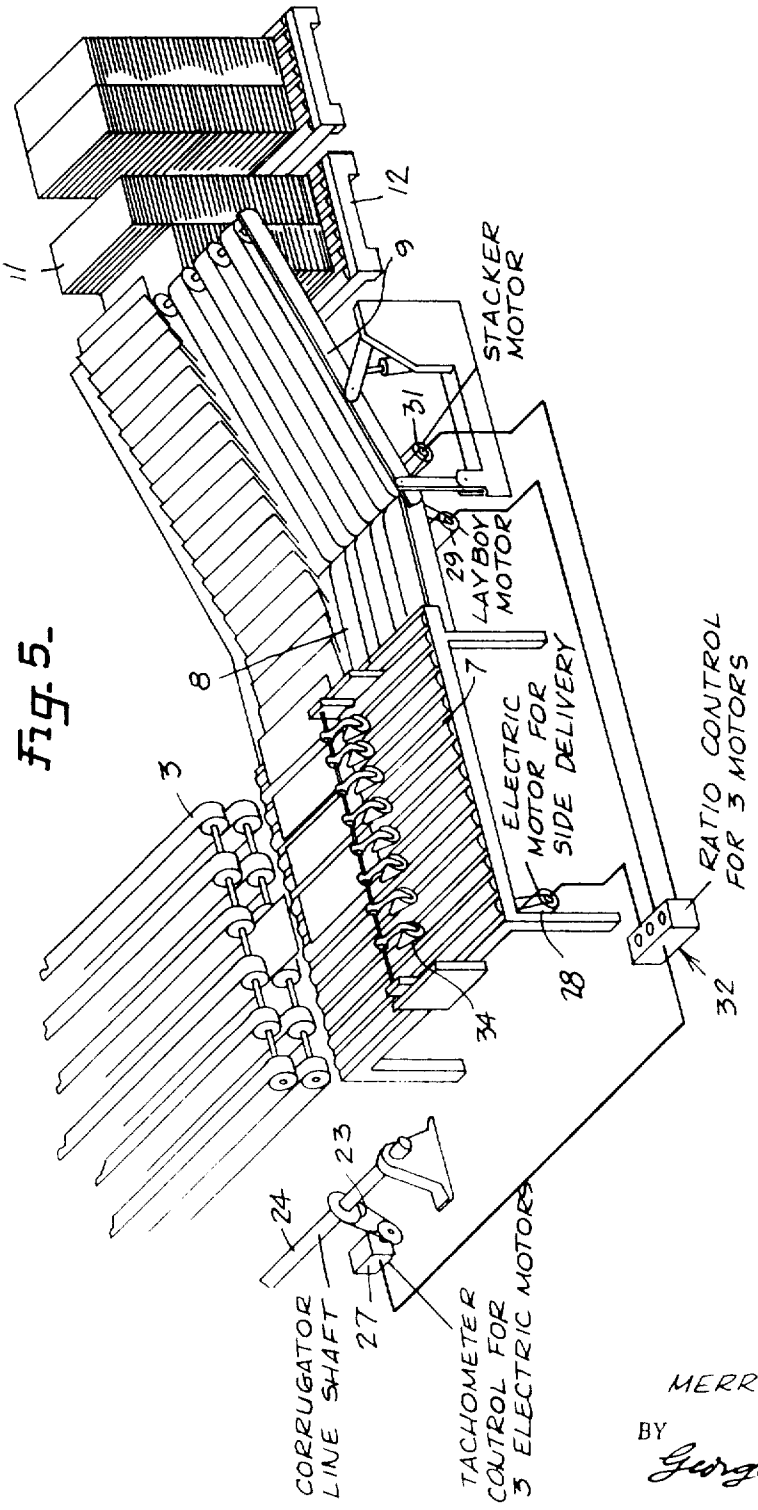

Fig. 5.

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METHOD AND APPARATUS FOR HANDLING SHEETS

BACKGROUND OF THE INVENTION

At present the stacking of blanks discharged from a corrugator is handled manually and the cost of hiring and training employees, including reduced production and supervisory expense, is very high. The work at the discharge end of the corrugator is so difficult that there is a great turnover of labor, sometimes the man at the corrugator delivery must be changed weekly. An object of the invention is to provide an automatic system for receiving the blanks from the corrugator and then to stack the blanks properly. A further object of the invention is to provide a method and apparatus whereby so-called "multiple-outs" can be mechanically stacked at the highest corrugator speeds and with about the same efficiency as "one-outs." Namely, when the sheet in the corrugator is cut into several strips discharged simultaneously from the corrugator, then if they are of equal width they can be handled simultaneously, and if they are of different width, then they can be handled separately in this system. A feature of the invention is that a single operator can handle the entire system and the labor required is minimal, and by reason of the particular arrangement of a right angle take off, and the transfer device or conveyor and the stacker, the relative speed between these steps can be pre-determined and maintained although the overall operation is controlled by and conforms to the speed in the corrugator.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a perspective view of the arrangement of the double system of conveyors for handling the sheets from the corrugator to stacking.

FIG. 2 is a somewhat diagrammatic side view of the intake side of the conveyor system.

FIG. 3 is a diagrammatic view illustrating the connection between the corrugator line shaft and the individually adjustable fluid motor drives for the elements of the conveyor system.

FIG. 4 is a diagrammatic view illustrating another form of connection between the corrugator line shaft and the fluid motors.

FIG. 5 is a diagrammatic view showing the connection between the corrugator line shaft and electric motor drive for the respective conveyors.

DETAILED DESCRIPTION

The delivery end 1 of the corrugator machine has discharging conveyors 2 and 3 respectively adjacent to the knives 4 and 5, whereby the blanks cut by the knives are discharged from the corrugator. As shown on the lower conveyor and stacking system 6, the blanks are discharged from the lower discharge conveyors 3 directly on to a right angle take off 7 whereby the sheets are advanced at right angles widthwise on to a transfer conveyor 8 and to a stacker conveyor 9 by which latter the blanks are stacked into stacks 11 on a conveyor 12.

The upper discharge conveyors 2 discharge the blanks lengthwise on to a longitudinal delivery conveyor 13 which in turn delivers the blanks on to a more distant right angle take off 14, which in turn delivers the blanks on to another transfer conveyor 16 which in turn properly shingles and transfers the blanks on to another stacker conveyor 17 to form stacks on a pallet.

Each of these conveyors in this system is driven by separate driving means. For instance, in FIG. 3 a fluid motor 18 drives the right angle take off 14; another fluid motor 19 drives the transfer conveyor or shingling conveyor 16 and a third fluid motor 21 drives the stacker conveyor 17.

The essence of the improvement is that there are three variable volume pumps 22 each connected to the respective fluid motors 18, 19 and 21 whereby the individual relative speeds of the right angle take off conveyor, the transfer conveyor and the stacking conveyor can be adjusted to a predetermined ratio, but all three variable volume pumps 22 are driven through a transmission 23 by the line shaft 24 of the corrugator indicated in FIG. 3.

Another instance shown in FIG. 4, a variable speed electric motor 26 is interconnected between the three variable volume pumps 22 heretofore described and a tachometer control 27 for the electric motor 26, and the tachometer control is driven through the transmission 23 by the corrugator line shaft 24.

In the example shown in FIG. 5, electric motors 28, 29 and 31 respectively drive the right angle take off 7 transfer or shingling conveyor 8 and stacking conveyor 9. The electric motors 28, 29 and 31 are connected to a suitable ratio control 32, for instance of a rheostat type, and are ultimately controlled by the tachometer control 27 driven by the corrugator line shaft 24 as heretofore described.

In each of the above illustrations an initial ratio of conveyor speeds can be adjusted and predetermined, and preserved constantly throughout the operation, although the overall speed of handling the sheets is controlled by the corrugator line shaft 24 and the corresponding speed of operation of the corrugator.

The basic principle whereby the relative speeds are determined and adjusted is predicated on the basic equation of

$$V_d = W/L\ V_c\ (1\text{-}S)$$

in which V_d is the speed of advance on the right angle take off 7 or 14 respectively, W is the width and L is the length of the blank, V_c is the speed of the corrugator and S is the ratio of the shingle, namely $S = W/O$ in which O is the overlap. Shingle in this art means the partial overlap of the consecutive sheets on one another and the ratio of the shingle is the ratio between the distance of the overlap relatively to the entire width of the blank. This shingle is determined by the speed of the transfer or shingling conveyor relatively to the speed of the right angle take off. If the speed of the right angle take off is lower than the rate of delivery of the blanks from the corrugator, then the blanks may be shingled initially on the right angle take off. If the speed of the transfer conveyor 8 or 16 respectively is the same as the speed of delivery of the right angle take off, then there is no change or forming of a shingle on the transfer conveyors. Relative increase of the speed of the transfer conveyor will shorten the overlap and relative decrease of the speed of the transfer conveyor will increase the overlap.

The stacker conveyors 9 and 17 in this illustration operate in the manner described in U.S. Pat. No. 3,321,202 issued on May 23, 1967 to Merrill D. Martin. Accordingly the variation of the aforementioned basic equation can be used to determine the speed of the transfer conveyor and of the stacker conveyor, namely the basic equation for the speed of the transfer conveyor is

$$V_t = W/L\ V_c(1\text{-}S_t)$$

in which V_t is the speed of the transfer conveyor in ft/min and S_t is the ratio of the shingle on the transfer conveyor, namely $S = W/O$ in which O is the desired overlap to be established on the transfer conveyor; and the basic equation for the relative speed of the stacker is

$$V_s = W/L\ V_c\ (1\text{-}S_s)$$

in which V_s is the speed of the stacker in ft./min. and S_s is the desired shingle on the stacker conveyor.

By the above equations the relative speeds of the conveyors can be adjusted in accordance with the ratio of width and length of the blank as well as the ratio of shingle desired. As heretofore described, once this ratio is established, the ratio of speeds remains constant although the speed itself will change as controlled by the corrugator line shaft.

Each right angle take off conveyor is provided with power rollers 33, and also with a transverse series of back stops 34 resiliently mounted and balanced on a cross frame 36 which is adjustable longitudinally along the power rollers 33 to a distance corresponding to the length of the blanks discharged on to the power rollers 33. In this manner in case of so-called multiple-outs, namely where the knives cut several blanks of equal width and discharge simultaneously several such blanks, the speed of the right angle take off rollers 33 can be so adjusted that each sheet advances widthwise to the point where

the adjacent sheet discharged will land directly on top of the preceding one in sequence. This permits the sheets or blanks to be handled in groups or piles of two superimposed blanks when running "two-out" or three superimposed blanks when running "three-out," and so on.

In the usual operation the transfer conveyor or shingling conveyor drive speed is set somewhat lower to establish the initial shingle between the blanks or between the groups of blanks. The belt conveyors of the stacking conveyor 9 are adjusted normally slightly faster than those on the transfer conveyor so as to pull the lower blanks or sheets of each pile somewhat faster than the upper blanks and thereby to form a more uniform shingle between the individual sheets.

The controls are located in such manner that they are accessible to the operator at substantially one location so that the operator can adjust the relative speeds of the conveyors in the system according to the length and width of the blanks or sheets handled quickly, thereafter the speed adjustment to the corrugator is accomplished automatically.

In all the forms of the herein combination of drives and conveyors, the sheets or boards are delivered to the stacker at intervals predetermined by the width of the sheet or board so that a proper shingle or overlap is established, whereby the sheets are maintained in proper order during the movement of the stacker. The surface velocity of the stacker in these adjustments is less than the surface velocity of the continuous side delivery. The ratio of velocity is maintained, although the various conveyors conform to variations of speed of the corrugator, for instance, while the corrugator is slowed down while making splices of web rolls, or when wet paper is run through the corrugator, or when extra large sheets are run.

In the corrugator the continuous sheet unrolled from the web roll is slit into width of the boxes to be made and then passed to the knives to be cut to length, and then ejected or discharged from the corrugator. Hence the velocity of the corrugator is proportional to the number of sheets cut to the desired length per minute, indicated by the formula of $f_c = V_c/L$, wherein fc is the frequency of cut. After the sheets are ejected the next important factor is the shingling or the ratio of the overlap (O) to the width (W) of the sheet. Hence the dependence in the basic equations on the ratio of width (W) and length (L) of the sheets cut at the velocity of the corrugator (V_c). Expressed otherwise, the delivery from the corrugator runs at a speed of $W/L\ V_c$ ft./min., and this is varied at the consecutive conveying according to the ratio of the proper shingle or overlap ($1\text{-}S$). The right angle delivery, the transfer conveyor and the stacker conveyor can be thus set each to a ratio of the corrugator speed according to the dimensions of the sheet and these ratios are maintained at all speeds of the corrugator by the method and device herein described.

I claim:

1. In a method of stacking sheets delivered from the discharge conveyor of a sheet making machine, the steps of

conveyance of the sheets from the discharge conveyor to a stacker,

varying the direction and speed of conveyance at a predetermined ratio to cause the sheets to overlap consecutively at a predetermined ratio to the width of the sheets,

and controlling the velocity of the movement of the sheets in accordance with the velocity of said sheet making machine and the length and width of the cut sheet, and maintaining the said predetermined velocity ratio,

said conveyance of said sheets from the sheet making machine to the stacker including,

moving the sheet on a delivery conveyor lengthwise,

discharging the sheets from said delivery conveyor to a take-off conveyor thereby to change the direction of movement of said sheets to widthwise direction,

discharging the sheets widthwise to a transfer conveyor at a different relative velocity,

transferring said sheets from said transfer conveyor to a stacker conveyor widthwise at a different velocity,

the relative velocities of said conveyors predetermining the spacing and overlap of the consecutive sheets on the stacker conveyor,

driving each of said conveyors at its own predetermined variable speed controlled in accordance with the length and width of the cut sheets and in accordance with the velocity of the sheet making machine,

the relative velocity of movement of the sheets from said machine to said stacker being determined by the following basic equation: $V_d = W/L\ V_c$ in which equation V_d is the speed of delivery, W is the width, L is the length of the sheet and V_c is the speed of the corrugator in ft./min., modified by the ratio of the overlap forming the shingle.

2. The method specified in claim 1, wherein the travel of the sheet during said conveyance passes through different areas of different velocities, and said ratio velocities being between said areas.

3. The method specified in claim 1,

said sheet making machine being a corrugator,

and all of said conveying steps of said sheet being controlled by the velocity of the sheets discharged from said corrugator without changing said predetermined ratio of velocity in the different areas of conveyance of said sheets to said stacker.

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