Dec. 13, 1966 G. H. WILLIAMSON 3,291,010

COUNTING AND STACKING APPARATUS

Filed Dec. 23, 1963 3 Sheets-Sheet 1

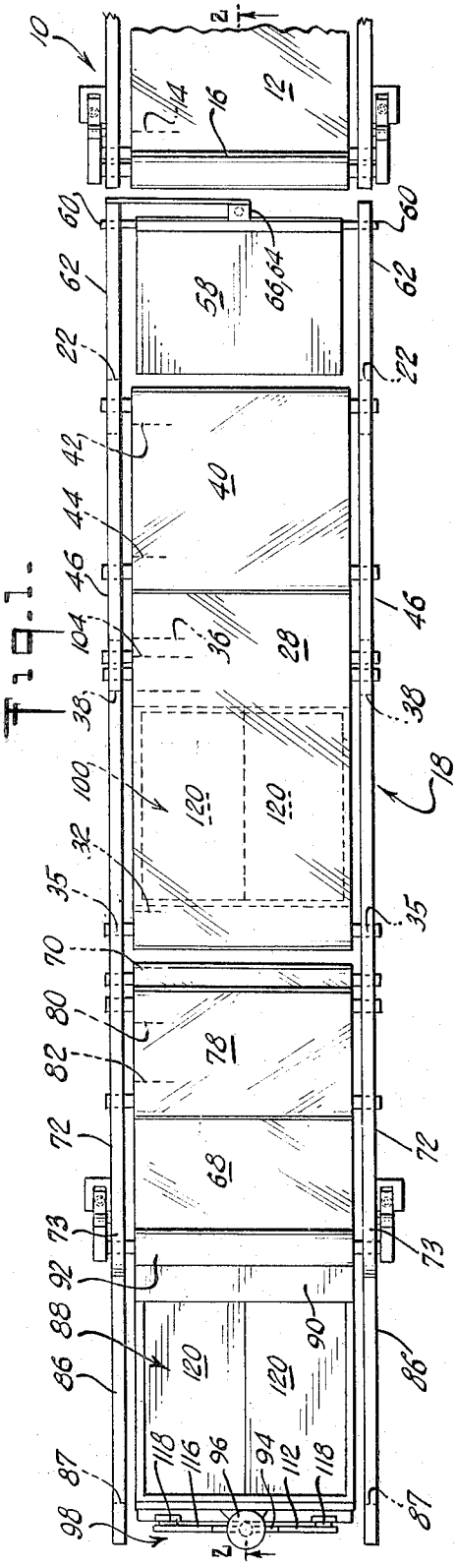


Fig. 1.

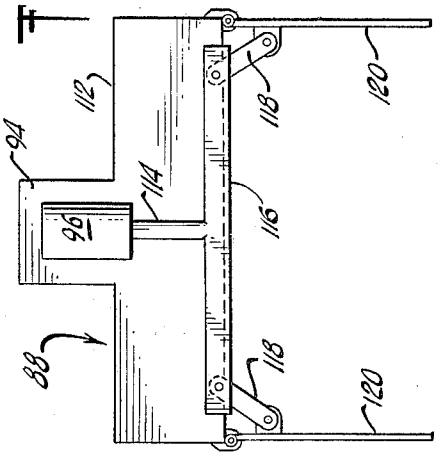


Fig. 4.

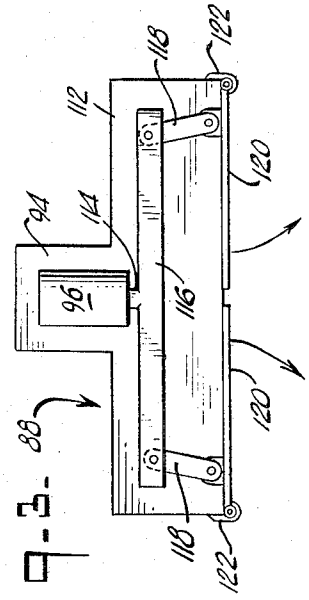


Fig. 5.

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COUNTING AND STACKING APPARATUS

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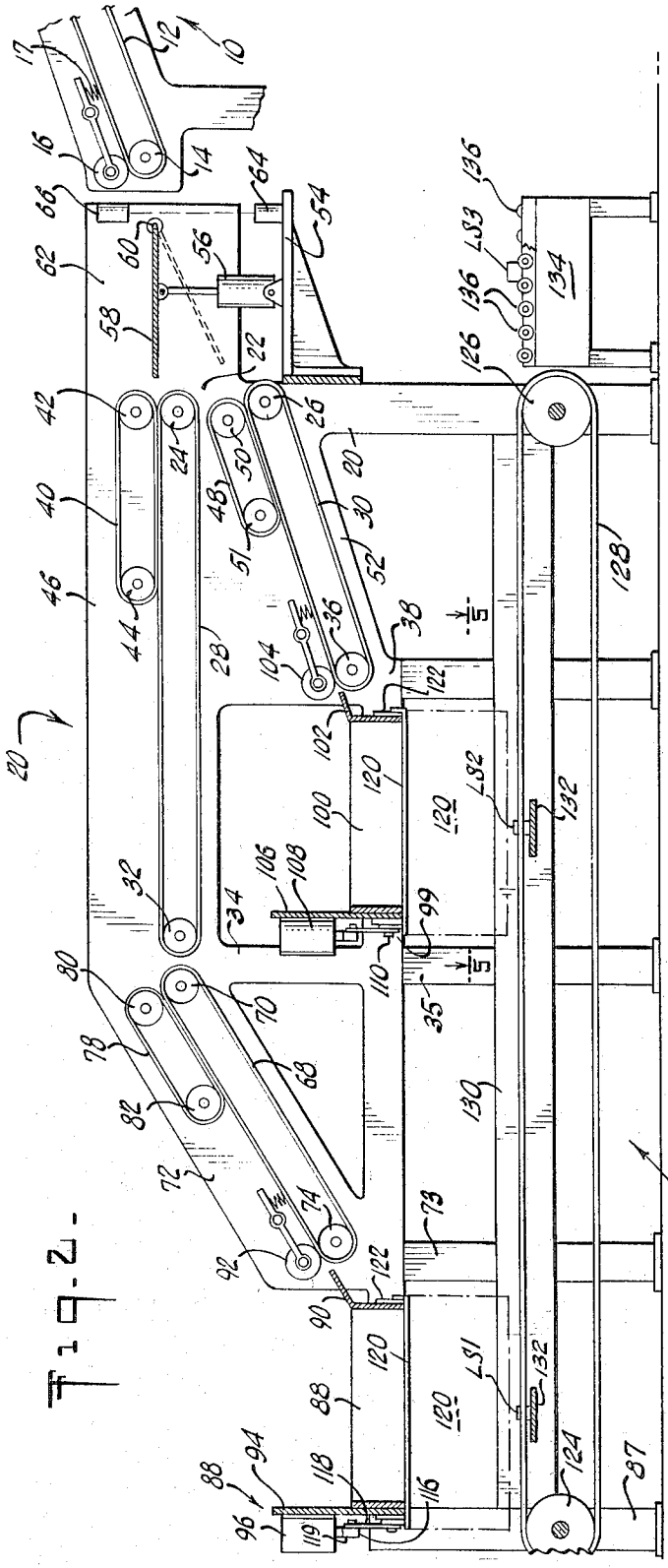


FIG. 2.

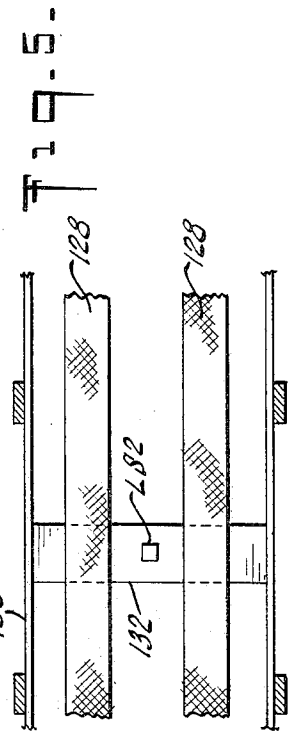


FIG. 5.

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Fig. 6.

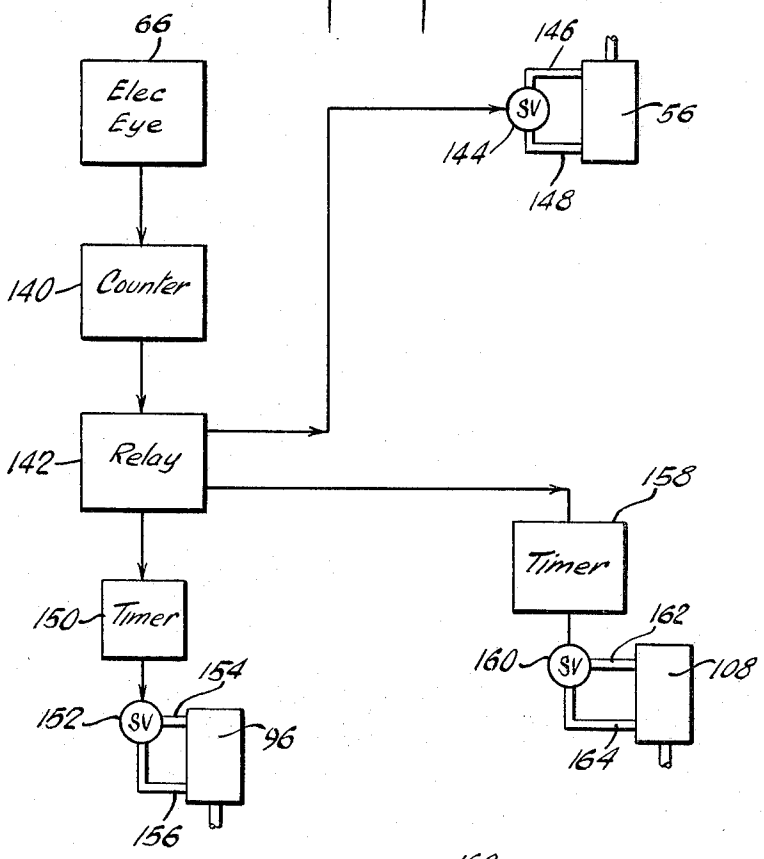
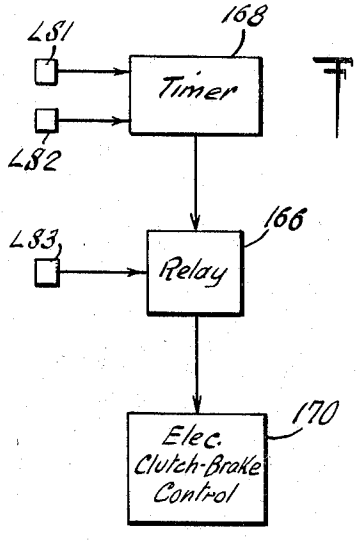


Fig. 7.



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COUNTING AND STACKING APPARATUS

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Filed Dec. 23, 1963, Ser. No. 332,664
7 Claims. (Cl. 93—93)

This invention relates to apparatus for counting and stacking sheets of material, and more particularly, it relates to apparatus for continuously and automatically forming stacks of predetermined numbers of sheets, such as shingles, or the like.

In the manufacture of asphalt shingles, provision must be made at the end of the manufacturing line to receive shingles from the line conveyor, group them into stacks of a predetermined number, and move the stacks to another area for subsequent handling, such as packaging and storing. It is important that the means provided for performing these functions be able to handle the shingles at the rate at which they are deposited from the manufacturing line conveyor, and to arrange the shingles in neat, rectilinear stacks of the exact required number to facilitate packaging. For many years, and to a large extent even at the present time, these functions were provided by manual labor, requiring men to be stationed at the end of the conveyor to collect the shingles into stacks of the proper size, and to place them on another conveyor to be transported to the packaging station. Besides the large number of man-hours used in this manner, the element of human error is always present, which often results in stacks being formed which do not contain the proper number of shingles.

A number of various arrangements have been suggested to automatically collect predetermined numbers of shingles in stacks and to convey the stacks to other stations for subsequent handling. A commonly employed arrangement is illustrated in Patent No. 2,606,483, which discloses a receiving unit in combination with a switch mechanism which actuates means for lowering the receiving unit a predetermined amount equal to the thickness of each shingle received, thereby maintaining the top of the accumulated vertical stack of shingles at a constant level substantially coinciding with the delivery path of the shingles. When the stack reaches a predetermined height, it is lowered into contact with a conveyor which moves the stack away from the receiving unit, at which time an auxiliary receiving unit is shifted into position to support shingles until the main receiving unit is moved back into receiving position. Although this apparatus can function automatically, it is relatively complicated, requiring precise adjustment of the stack lowering means, and is not adapted to receive and stack shingles delivered at a rapid rate.

A more simplified semi-automatic construction is disclosed in Patent No. 2,821,123. This arrangement comprises two receiving pans in vertical alignment, and a gate for deflecting shingles from the main conveyor to one or the other of the pans, so that while one pan is being unloaded the other pan is receiving shingles. Movement of the gate is controlled by a shingle counting mechanism to assure the proper number of shingles in each stack. While this arrangement is relatively simple, and automatically forms stacks of the desired number of shingles, it is necessary to manually lift the stacks from the pans and provide for their transportation to the packaging station, thereby requiring manual labor for its operation.

Patent No. 2,886,929 discloses a fully automatic apparatus for counting, stacking, and transporting shingles. A counting and diverting mechanism of the type described in the preceding paragraph is employed to convey shingles to collecting pans, which are lowered when filled to deposit the collected stack onto a conveyor arranged transversely of the main conveyor. The stacks are then delivered to another conveyor, arranged parallel to the first conveyor, which transports them to a stacking station. This arrangement occupies a large amount of floor space, due to the separate transverse conveyors required in association with each collecting pan. Because the delivery units connecting the diverting gate and the pans transport the shingles by gravity, only limited rates of shingle production can be handled. The large number of components making up the apparatus makes the arrangement relatively expensive and complicated.

Another arrangement for automatically stacking shingles is disclosed in Patent No. 3,020,043, which employs a diverting gate and two gravity conveyors on which stops are provided for halting the progress of shingles traveling thereon. When the stop on one conveyor is raised to operative position, the stop on the other conveyor is lowered to permit the shingles previously collected to slide down the gravity conveyor to a fixed conveyor section. The end portions of the gravity conveyors are pivotally mounted and are moved alternately to connect with the fixed conveyor section. The rate at which this apparatus can handle shingles is limited because of the use of gravity conveyors, which causes the speed of movement of the shingles and shingle stacks to be uncontrolled for a period of time. The apparatus requires exacting design and construction to permit the pivoted conveyor sections to be moved, and problems may be encountered in obtaining a squared stack, due to collecting the shingles on an incline.

There is a need for an automatic stacking apparatus which can handle high rates of production, does not take much floor space, is simple in operation, and can operate with a minimum of care.

It is an object of the present invention to provide a simple, compact automatic shingle stacking apparatus for continuously arranging shingles in stacks of predetermined numbers of shingles, and conveying the stacks to subsequent handling stations.

Another object is to provide an automatic shingle stacker which can handle shingles at a rapid rate.

Another object is to provide an efficient, accurate, automatic shingle stacker which is relatively inexpensive and easy to maintain.

Briefly, the invention comprises two receptacles, means for transporting predetermined numbers of shingles from the end of a shingle manufacturing line to alternate receptacles to stack the shingles therein, conveying means positioned beneath the receptacles, and means for alternately depositing on the conveying means a stack of shingles from one receptacle while the other receptacle is receiving shingles. Since this arrangement permits shingles from both receptacles to be deposited on a single conveying means, the entire apparatus need be only as long as the distance from the end of the line conveyor to the most distant shingle receptacle. Besides being compact, the invention is further characterized by the relatively few elements required, making the apparatus economical to construct and relatively easy to maintain. In addition to the benefits just mentioned, the machine is capable of handling high rates of shingle production, and it can be adjusted to handle shingles at varying rates.

The nature of the invention will be more fully understood and other objects may become apparent when the following detailed description is considered in connection with the accompanying drawing, wherein:

FIG. 1 is a plan view of the apparatus of the present invention;

FIG. 2 is a longitudinal sectional view taken on line 2—2 of FIG 1, with the rolls and conveyor belts being shown in elevation for the sake of clarity;

FIG. 3 is an end view of a shingle accumulator or receptable with the lower supports thereof in closed position;

FIG. 4 is an end elevation similar to FIG. 3, but showing the bottom supports in open position;

FIG. 5 is an enlarged partial plan view of the lowermost conveyor of the apparatus and showing the switch arrangement associated therewith;

FIG. 6 is a schematic representation of typical electrical control circuit employed in operating the shingle diverter and the shingle accumulators in timed relationship; and,

FIG. 7 is a schematic representation of a typical electrical circuit employed in operating and controlling the movement of the lowermost conveyor.

Referring to FIGS. 1 and 2 of the drawing, the end of the conveyor in the shingle manufacturing line is indicated at **10** and comprises an endless belt **12** trained around a pulley **14**. A velocity wheel **16**, which may comprise one or more transversely spaced rolls, may be resiliently mounted, as at **17**, in engagement with the endless belt **12** and in alignment with the pulley **14**, to insure that shingles deposited from the conveyor **10** have enough speed to reach the next supporting surface in the path toward the stacking apparatus. The wheel **16** is not driven, but is biased toward the belt **12** in a manner well known in the art.

The apparatus of the present invention is indicated generally at **18**, and comprises a plurality of legs **22** carrying a support frame **20**. Suitably journaled in the frame just above the legs **22** are pulleys **24** and **26**, the latter pulley being positioned beneath the pulley **24** a substantial distance. Trained about the pulleys **24** and **26** are endless belts **28** and **30**, respectively. The endless belt **28** is also trained about pulley **32**, which is rotatably mounted in the frame just above the vertical struts **34** extending above the middle support legs **35**. The endless belt **30** is also trained about a pulley **36**, which is rotatably journaled in the frame just above the legs **38**.

Positioned above the conveyor **28** is a hugger conveyor belt **40** trained about pulleys **42** and **44**, both of which are journaled in the horizontal frame portions **46**. Beneath the conveyor **28** and extending substantially parallel to the conveyor **30** is a hugger conveyor belt **48** trained about pulleys **50** and **51**, which are mounted in the frame portions **52** connecting the support legs **22** and **38**.

Connected to the support legs **22** adjacent the pulley **26** is a horizontal support **54** extending toward the conveyor **10**, on which support a cylinder **56** is pivotally mounted in a generally upright position. The piston rod of the cylinder **56** is pivotally connected to a diverter or gate **58**, which in turn is pivotally mounted at **60** in plates **62** extending horizontally from the frame portions **46**. By means of this arrangement, shingles deposited from the end of the conveyor **10** are supported by the diverter or gate member **58**. When the cylinder **56** is in its extended position, as shown in FIG. 2, the shingles will be directed to the conveyor **28**, and when the cylinder is in its retracted position, the gate will be disposed in the dotted line position and the shingles will be directed from the conveyor **10** to the conveyor **30**. The hugger conveyors **40** and **48** assist in directing the shingles in their transfer from the conveyor **10** to the conveyors **28** and **30**, respectively, and the plates **62** further guide the shingles between the end of the line conveyor **10** and the conveyors **28** and **30**.

Also supported on the horizontal support plate **54** is an electric eye transmitter **64** aligned with a suitable receiver **66** mounted on support means adjacent the upper end of the plate **62**. The purpose of the electric eye mechanism will be made clear hereinafter.

Disposed adjacent the pulley **32** is a conveyor belt **68** adapted to receive shingles deposited from the conveyor **28**. The conveyor belt **68** is trained about a pulley member **70** rotatably mounted adjacent pulley **32** in frame members **72**, which extend diagonally from the vertical struts **34** to the support legs **73**, and about a pulley member **74**, rotatably mounted in the same frame members just above the upper ends of legs **73**. Immediately above and parallel to the conveyor **68** is a small hugger conveyor belt **78** trained about a pulley **80**, mounted in the frame members **72** adjacent the pulley **70**, and trained about pulley **82**, mounted in the same frame members.

Supported on the horizontal frame members **86** which connect the upper end of support legs **73** and **87**, is a shingle accumulator or receptable **88** disposed adjacent the end of the conveyor **68**. The receptacle **88**, which may take any desired form so long as it is capable of receiving and holding a plurality of shingles as they accumulate into a stack, is illustrated as having a rectangular box-like configuration. Disposed between the end of the receptacle **88** and the end of the conveyor **68** is a support or platform **90** which may be welded or otherwise secured to the receptacle **88**, and which serves to guide and assist the shingles in moving from the conveyor **68** into the receptacle **88**. A velocity wheel **92** may be resiliently mounted on the support **76** immediately above the pulley **74** and in contact with the endless belt **68**, in a manner similar to the arrangement of the velocity wheel **16** and conveyor **12**, in order to impart sufficient velocity to the shingles as they are transferred from the conveyor **68** into the receptacle **88**. An upright support plate **94** is provided on the back end of the receptacle **88** to support a cylinder **96**, which may be welded to the plate. The piston rod of the cylinder **96** is connected to suitable linkage **98** for opening and closing lower supports or doors on the receptacle **88** to drop a stack of shingles which has accumulated in the receptacle **88**.

Mounted on the horizontal frame members **99** which connect the upper end of support legs **35** and **38** is another accumulator or receptacle **100** similar to the receptacle **88**. A support platform **102** connects the front end of the accumulator **100** and the end of pulley **36**, and a velocity wheel **104** may be resiliently mounted above the pulley **36** for the same reason as discussed in connection with the velocity wheel **92**. The back end of the receptacle **100** is provided with an upright support plate **106** which carries cylinder **108**, connected by its piston rod to suitable linkage **110** for operating the lower support mechanism of the receptacle.

Referring to FIG. 3, which illustrates the lower support operating mechanism of the receptacle **88**, it is seen that the upright support plate **94** is shown as an extension of the black end **112** of the receptacle **88**. The piston rod **114** of the cylinder **96** is connected to a horizontally disposed bar **116** at substantially the midpoint thereof, and the bar is connected at its ends by links **118** to lower support plates or doors **120**. The ends of the doors adjacent the sides of the receptacle **88** are hinged to support lugs **122** welded or otherwise attached to the side of the receptacle. When the piston rod **114** is extended, as shown in FIG. 4, the linkage moves the support plates **120** to their open position to permit a stack of shingles accumulated in the receptacle to drop.

Referring back to FIG. 2, a pulley **124** is rotatably mounted on the support legs **87**, and a similar pulley **126** is rotatably mounted on the support leg **22**. Trained around the pulleys **124** and **126** is a conveyor belt **128**, the upper run of which extends between horizontally disposed side guides **130** connected to the support legs. As shown in FIG. 5, the conveyor **128** may be comprised of two spaced endless belts to enable a limit switch LS–2 to be mounted just beneath the upper run of the conveyor and aligned with the receptacle **100**. In the illustrative embodiment shown, the switch is carried by a plate **132**, the ends of which are connected to the side guide members **130**. The purpose of the limit switch LS–2, which

is preferably spring biased toward its open position, will be brought out more clearly hereinafter. A limit switch LS–1 is provided beneath the receptacle 88 in a manner similar to the installation of switch LS–2.

Adjacent the front end of the conveyor 128 is a support table 134 having a plurality of rollers 136 arranged at substantially the same height as the upper run of the conveyor 128, to enable a stack of shingles to be deposited from the conveyor onto the table 134. A limit switch LS–3, preferably spring biased toward its closed position, is disposed between adjacent rollers on the table 134, for a purpose to be made clear hereinafter. The limit switches have not been shown in detail, as they are well known and are readily available commercially. Automatic transfer equipment could be provided, if desired, to transfer stacks of shingles from the table 134 to other stations, as for packaging.

Referring to FIGS. 1, 2, 6, and 7, the operation of the apparatus will be described. With the diverter 58 in the full line position of FIG. 2, shingles deposited from the conveyor 10 will be transferred to the conveyor 28, from which they subsequently will be transferred to the conveyor 68 and then deposited in the accumulator or receptacle 88. The bottom supports or doors of the receptacle 88 are closed so that the shingles may accumulate therein to form a stack of shingles. As each shingle is transferred from the conveyor 10 to the diverter 58, an impulse is sent from the electric eye receiver 66 to a counting circuit 140, which previously had been set to energize a relay 142 upon the desired number of shingles having been transferred from the conveyor 10. The relay 142 actuates a servo valve 144 which admits air or other fluid through the line 145 into the upper end of the cylinder 56 to retract the piston rod of the cylinder, thereby moving the diverter 58 to its dotted line position, causing shingles to be delivered to the lowermost conveyor 30 and into the receptacle 100. The relay 142 also actuates a timer 150 which actuates the servo valve 152 after a predetermined length of time calculated to permit the last shingle deposited on the conveyor 68 to reach the accumulator or receptacle 88. The servo valve 152 admits fluid into the cylinder 96 through the line 154, to cause the piston rod of the cylinder 96 to be extended, thus opening the lower supports or doors of the receptacle 88 and permitting the stack of shingles which had accumulated in the receptacle to drop to the upper run of the conveyor 128. The relay 142 also actuates, through recycled timer 158, the servo valve 160 to admit air through the line 164 connected to the cylinder 108 to retract the piston rod thereof, thus closing the lower supports or doors of the receptacle 100, which had been open from the previous cycle.

The stack of shingles which drops from the receptacle 88 to the conveyor 128 closes the limit switch LS–1, which energizes a relay circuit 166 through a timing circuit 168 to energize the electrical clutch-brake control 170. The clutch-brake control 170 releases the brake and engages the clutch of the drive for conveyor 128. to cause the conveyor 128 to transport the stack of shingles thereon toward the table 134. The drive motor of conveyor 128 is not shown, since it may comprise any conventional drive arrangement. The purpose of the timing circuit 168 is to permit the dropped stack of shingles to be completely settled before the conveyor 128 begins to move. As the stack of shingles is transferred from the conveyor 128 to the table 134, it opens a switch LS–3 which, through the relay 166, reverses the electrical clutch-brake control 170 to stop the movement of the conveyor 128. By this time, the electric eye receiver 66 will have sent an impulse to the counter 140 corresponding to the last shingle to be diverted to the conveyor 30, and the counter 140 energizes the relay 142, which actuates the servo valve 144 to reverse the flow of air to the cylinder 56, causing it to raise the diverter 58 back into the full-line position. After a suitable delay caused by the timer 158, but shorter than the delay imposed by the timer 150, due to the difference in the lengths of travel from the conveyor 10 to the receptacle 100 and from the conveyor 10 to the receptacle 88, the servo valve 160 is reversed, and the cylinder 108 opens the lower support plates or doors of the receptacle 100 to drop a stack of shingles. The servo valve 152 will have been actuated through recycled timer 150, reversing the flow of air to cylinder 96 to close the doors of the receptacle 88. The stack of shingles dropped from the receptacle 100 closes the limit switch LS–2 which, through timer 168 and relay 166, actuates the clutch-brake control 170, which will again start movement of the conveyor 128. The cycle is repeated as long as shingles are deposited from the conveyor 10, and it results in the shingles being rapidly accumulated and stacked into piles of shingles, each containing the exact desired number of shingles.

As indicated previously, switches LS–1 and LS–2 are preferably spring biased open. They may be connected in parallel so that they function as start buttons for actuating timer 168. Once the timer 168 and relay 166 are energized, the function of switches LS–1 and LS–2 is ended for that particular cycle, until the relay 166 is de-energized by the opening of switch LS–3, which is locked in with the circuit of relay 166 and which functions as a stop button. Thus, a stack of shingles dropped from receptacle 88 closes LS–1, and subsequently closes LS–2 as it travels on the conveyor 128. But since the timer 158 and relay 166 were actuated upon closing of LS–1, they cannot be deactuated except upon opening of LS–3, and subsequent closing of LS–2 by the stack of shingles does not affect the operation of the apparatus.

It should be understood that a number of changes can be made to the apparatus and circuitry illustrated and described without departing from the spirit of the invention. For example, the specific circuits illustrated schematically in FIGS. 6 and 7 may be altered or modified without affecting the end result of the operation of the apparatus. The particular receptacles shown and the means for removing or opening the lower supports thereof may also be modified, and the specific arrangement of conveyors illustrated for transporting shingles to the receptacles may be altered, so long as the shingles are provided with satisfactory routes to the receptacles.

Although the foregoing description of the invention refers to a shingle handling apparatus, it should be understood that the invention is not limited to the shingle manufacturing art, but may be employed to count and stack other articles, such as various types of flat sheets, and the like.

It is to be understood that other variations and modifications of the present invention may be made without departing from the spirit of the invention. It also is to be understood that the scope of the invention is not to be interpreted as limited to the specific embodiments disclosed herein, but only in accordance with the appended claims when read in the light of the foregoing disclosure.

What I claim is:

1. Apparatus for handling sheets of material continuously being deposited from the end of a conveyor, comprising

(1) a first accumulator,

(2) means to transport sheets from the conveyor to the first accumlator,

(3) a second accumulator,

(4) means to transport sheets from the conveyor to the second accumulator,

(5) each accumulator having sheet support surfaces movable between open and closed positions,

(6) means directing the flow of sheets from the conveyor alternately to the first and second sheet transporting means at predetermined intervals,

(7) conveying means positioned beneath the accumulators and operable to alternately start and stop,

(8) means causing the sheet support surfaces of the first and second accumulators to alternately open and close in timed relation to the operation of the sheet directing means whereby the support surface of one accumulator is in open position, permitting a stack of sheets to be dropped to the conveying means, while the support surface of the other accumulator is in closed position, to support sheets as they are being deposited into said other accumulator, and

(9) means for alternately starting and stopping movement of the conveying means in timed relation to the opening and closing of the sheet support surfaces of the accumulators whereby the conveying means is stationary at the time a stack of sheets is being deposited thereon from one of the accumulators.

2. Apparatus as recited in claim 1, including additionally switch means associated with the conveying means for starting and stopping movement of the conveying means, the switch means being actuated by the sheets.

3. Apparatus as recited in claim 1, including additionally an article counting mechanism for actuating the article directing means.

4. Apparatus as recited in claim 3, wherein the means for moving the support surfaces are actuated by the article counting mechanism.

5. Apparatus as recited in claim 1, wherein the conveying means is parallel to the conveyor.

6. A method of stacking and transporting sheets of material moving in a continuous stream on a conveyor, comprising the steps of

(1) conveying the sheets to a first support to form a stack thereon,

(2) diverting the flow of sheets to a second support after a predetermined number of sheets has been conveyed to the first support,

(3) dropping the stack of sheets from the first support to a conveying means as sheets are being stacked on the second support,

(4) diverting the flow of sheets from the second support to the first support after a predetermined number of sheets has been conveyed to the second support, and

(5) dropping the stack of sheets from the second support to the conveying means as sheets are being stacked on the first support.

7. A method of stacking and transporting sheets of material moving in a continuous stream on a conveyor, comprising the steps of

(1) conveying the sheets to a first receptacle to form a stack therein,

(2) diverting the flow of sheets to a second receptacle after a predetermined number of sheets has been conveyed to the first receptacle,

(3) dropping the stack of sheets from the first receptacle to a stationary conveying means as sheets are being stacked in the second receptacle,

(4) actuating the conveying means to move the stack of sheets therefrom,

(5) stopping the conveying means,

(6) diverting the flow of sheets from the second receptacle to the first receptacle after a predetermined number of sheets has been conveyed to the second receptacle,

(7) dropping the stack of sheets from the second receptacle to the stationary conveying means as sheets are being stacked in the first receptacle, and

(8) actuating the conveying means to move the stack of sheets therefrom.

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