May 14, 1968 F. L. CALIFANO ET AL 3,382,966

STACKING APPARATUS

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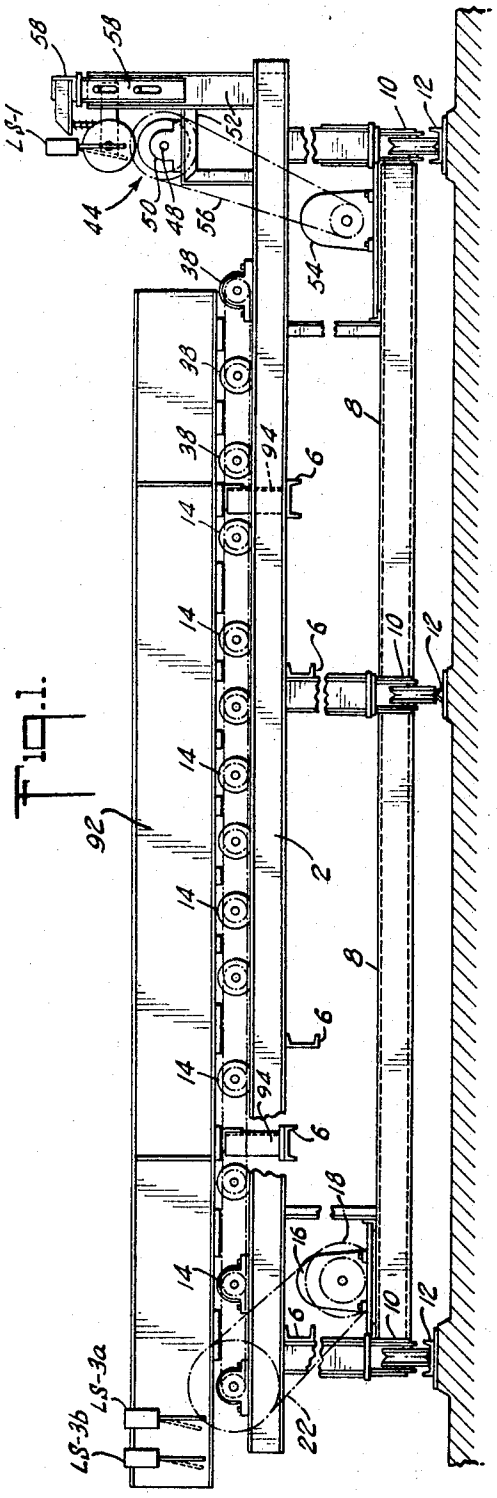


Fig. 1.

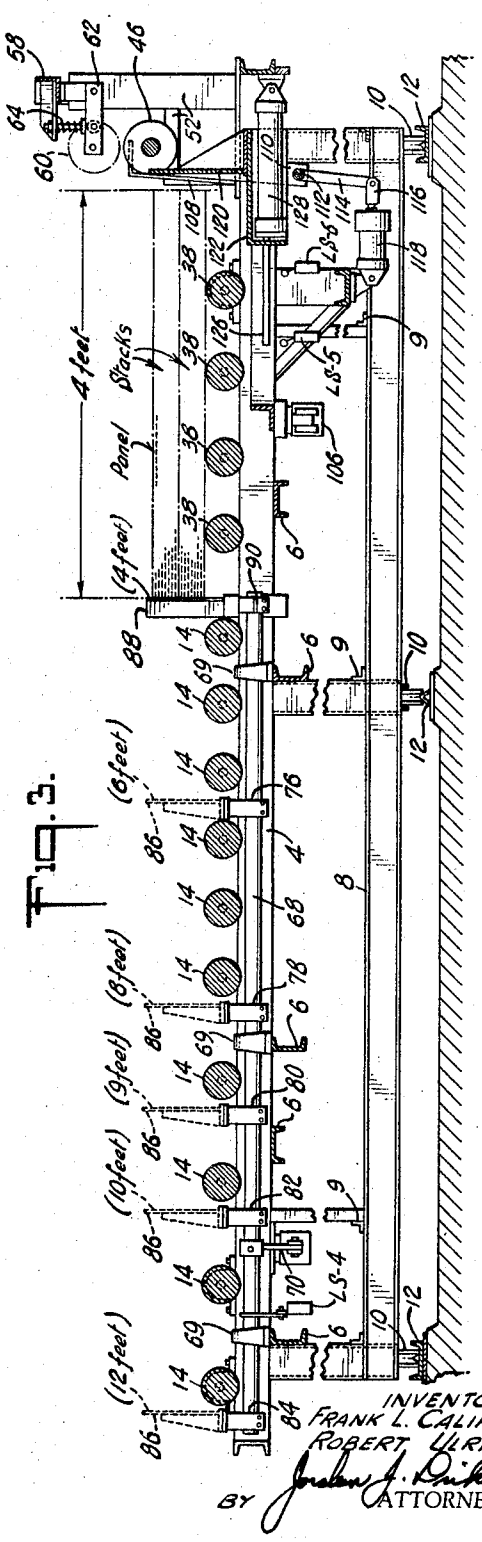


Fig. 2.

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STACKING APPARATUS

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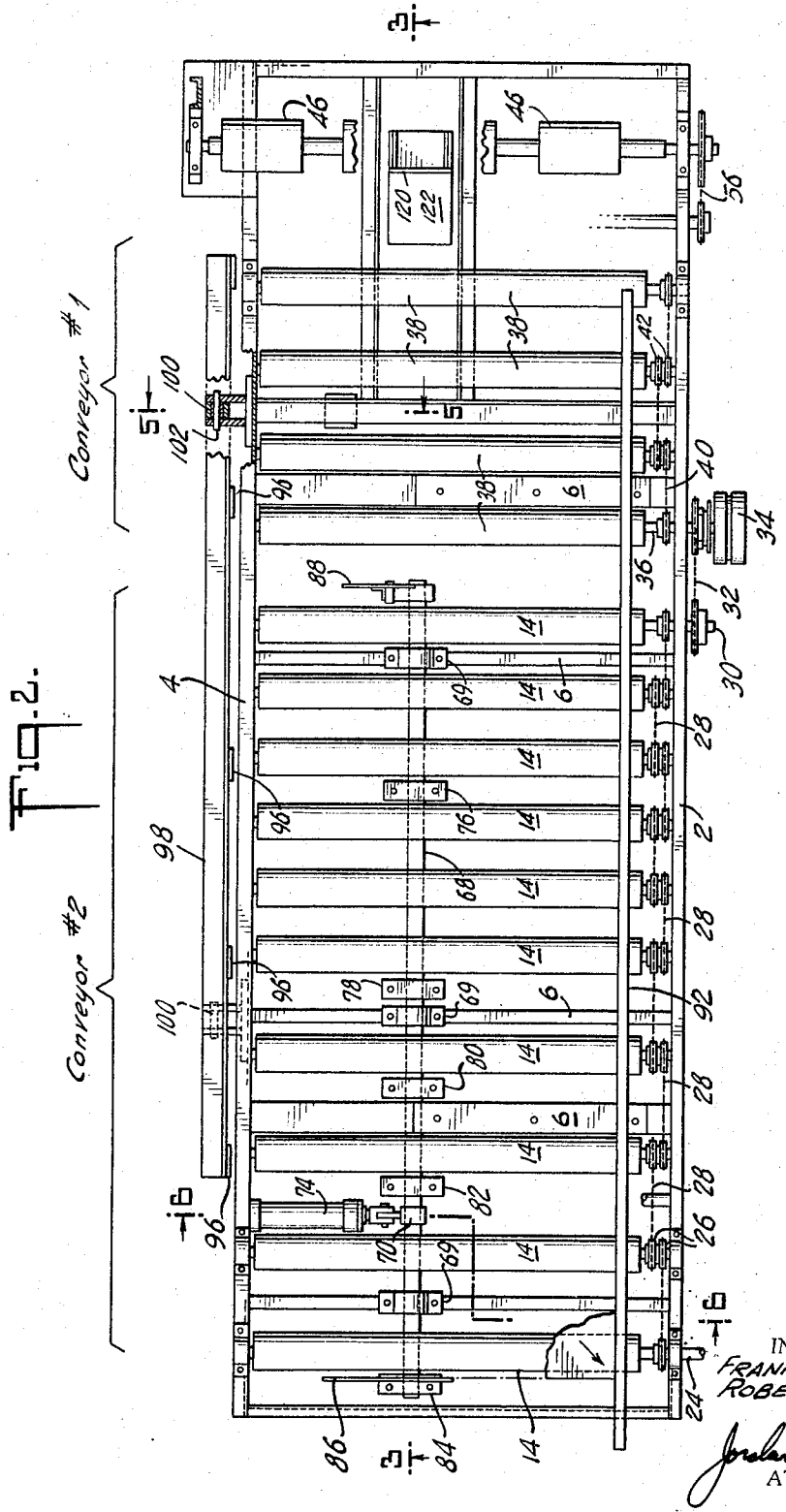


Fig. 2.

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STACKING APPARATUS

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Fig. 4.

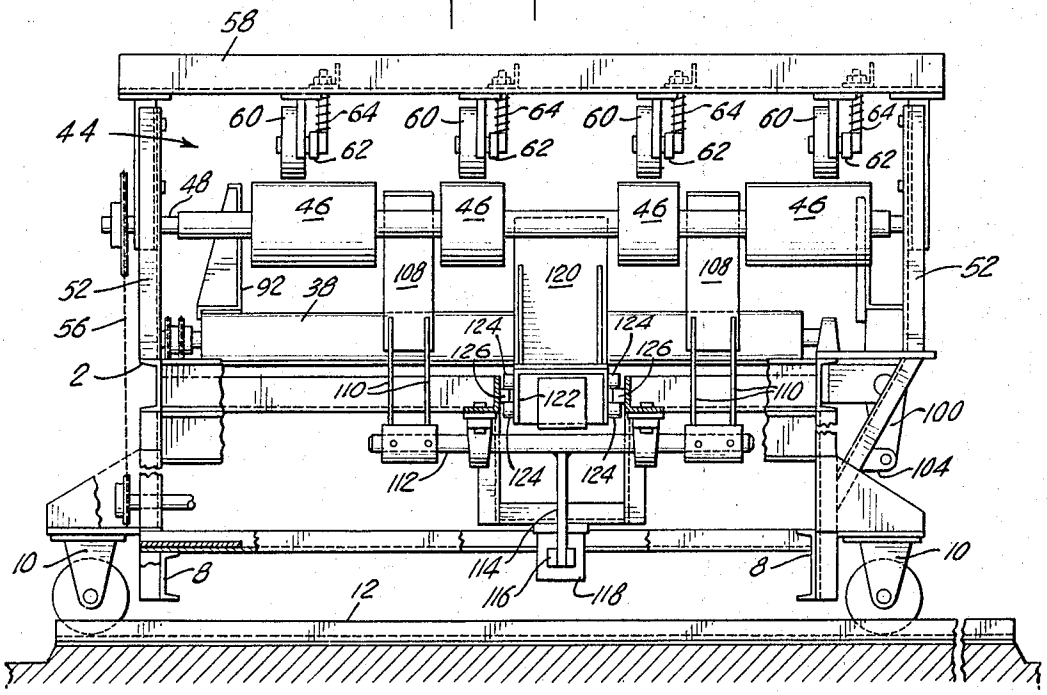
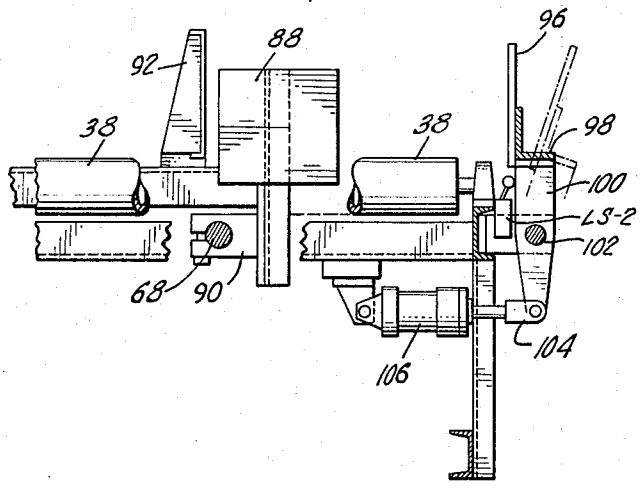


Fig. 5.



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Fig. 6.

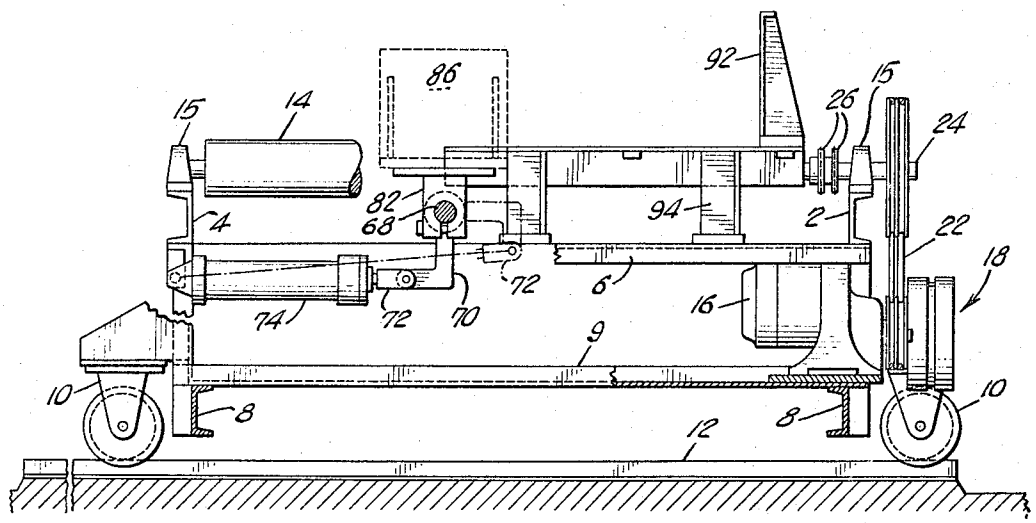
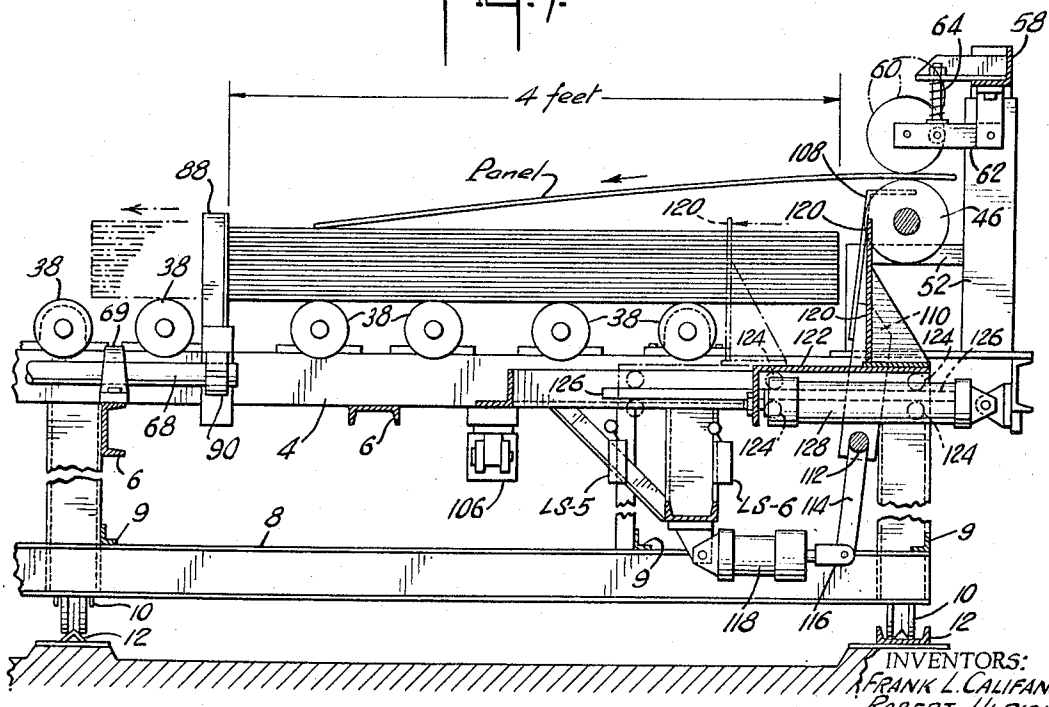


Fig. 7.



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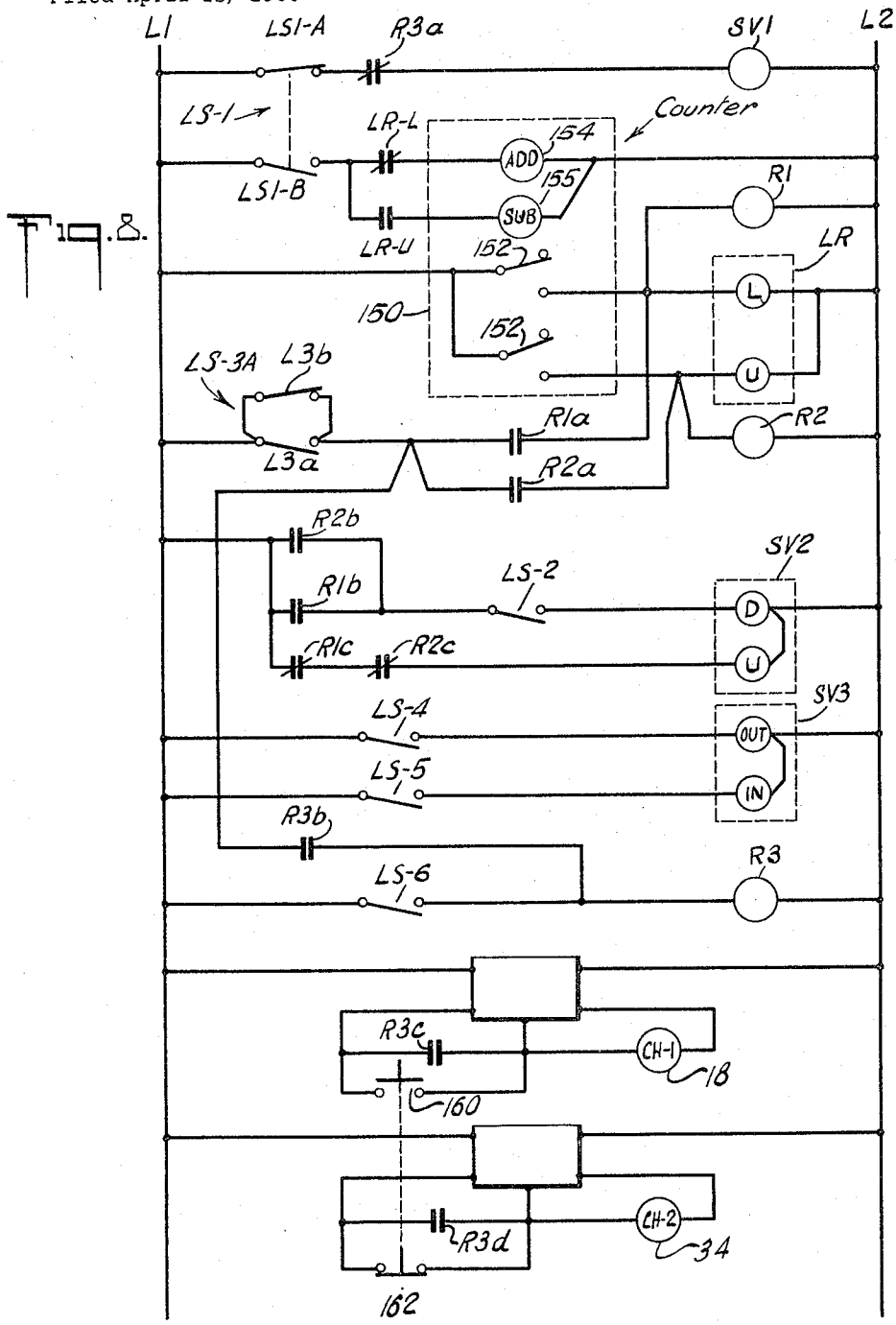
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Fig. 8.



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United States Patent Office 3,382,966 Patented May 14, 1968

3,382,966

STACKING APPARATUS

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Filed Apr. 13, 1966, Ser. No. 542,403
5 Claims. (Cl. 198—35)

This invention relates to apparatus for the high speed counting, stacking and squaring of relatively large building panels of different widths and lengths.

In the construction industry, building panels typically are supplied in lengths from four to twelve feet and widths from one to four feet. These also vary in thickness, weight, composition and surface characteristics. For example, building panels may comprise lightweight acoustical fibre or asphalt impregnated felt. Another variable is the number of pieces included in a bundle. Typically these building materials are bound by metal, paper or plastic straps. Prior to taping or strapping in automatic or semi-automatic equipment, it is necessary to assemble a predetermined number of pieces in a neatly squared bundle.

It is the principal object of this invention to provide apparatus for receiving boards or panels delivered at high speed, to count, stack, and square them in a bundle, and to immediately remove the bundle to another location for application thereto of tape or the like.

In particular, it is an object of this invention to provide apparatus capable of handling these building materials in different widths, lengths and thicknesses.

Further objects, advantages and details of this invention will become apparent from the following description, read in conjunction with the accompanying drawings in which:

FIGURE 1 is a side view of the stacking and squaring apparatus according to this invention;

FIGURE 2 is a plan view of the apparatus shown in FIGURE 1;

FIGURE 3 is a lengthwise, vertical section taken as indicated by lines 3—3 in FIGURE 2;

FIGURE 4 is an elevation of the receiving end of the apparatus;

FIGURE 5 is a partial transverse section taken as indicated by lines 5—5 in FIGURE 2;

FIGURE 6 is a full transverse vertical section taken as indicated by lines 6—6 in FIGURE 2;

FIGURE 7 is a lengthwise, vertical section of the receiving end of the apparatus taken basically along the same lines as FIGURE 3; and

FIGURE 8 is a schematic diagram of the electrical control system of this apparatus.

Referring initially to FIGURE 2, one of the basic elements of this apparatus is a conveyor in two parts, designated "conveyor #1" and "conveyor #2." Depending upon the size of panels being stacked and squared, these two sections are operated either independently or simultaneously as a single unit, as will be described hereafter. The entire conveyor assembly is housed within a structural steel framework comprising lengthwise channel section beams 2 and 4 which are spanned by cross beams 6. A lower frame sub-structure includes lengthwise beams 8 and cross-beams 9. This apparatus preferably is mobile, both for purposes of varying alignment requirements in the production line and for reasons of factory maintenance. To this end, there are provided caster assemblies 10 having wheels which ride on transverse rails or tracks 12. Thus, this entire piece of machinery can be moved completely into or out of the line, being replaced by other equipment if desired, and is movable for variable alignment as indicated previously.

Conveyor #2 comprises a plurality of parallel horizontal rolls 14 journalled in pillow blocks 15 on the lengthwise upper frame members. The conveyor is driven intermittently or continuously from a continuously running electric motor 16 through an electrically engageable clutch 18. When the clutch 18 is energized, i.e., engaged, the main conveyor drive shaft 24 is driven through a belt drive 22, but the conveyor is at rest when this clutch is deenergized even when the motor 16 is running. From the shaft 24, all of the rolls 14 are driven from roll to roll through an interconnecting system of double sprockets 26 and chains 28. The last roll 14 in the series has an output shaft 30 which is connected through chain drive 32 to an electrically engagable clutch 34. When clutch 34 is energized, i.e., when it is engaged, it transmits motion from chain drive 32 to the main drive shaft 36 of conveyor #1. This conveyor section comprises rolls 38, similar to rolls 14, having double sprockets 42 and interconnecting chains 40 for transmitting motion from roll to roll.

As seen in FIGURES 1 to 3, panels are delivered from the right-hand side from a conventional conveyor (not shown) at high speed, and are drawn through a roll stand generally indicated at 44. Rolls 46 are keyed on a shaft 48 that is journalled in bearings 50 mounted on secondary structural framework 52. Shaft 48 is driven from a continuously running motor 54 through a chain drive 56. An upper cross-beam structure 58 is mounted for vertical adjustment on framework 52, and carries four idler rolls 60. Each roll 60 is carried on a swinging lever 62 which is biased downwardly by a compression coil spring arrangement 64. As panels are delivered to this roll stand assembly 44, they are grasped in the nip of the opposed rolls 46 and 60 and are drawn therebetween at the rate of several hundred feet per minute. As each leading edge of a panel enters the nip of the rolls it engages a limit switch LS-1. This limit switch actuates an electrical counter as will be described hereafter.

Extending lengthwise beneath the conveyor section #2 is a shaft 68 which is journalled in pillow blocks 69 on the frame cross-beams 6. An arm 70 has one end affixed to shaft 68 and its other end is connected to the reciprocable rod 72 of a pneumatic piston and cylinder unit 74. Unit 74 is operable to turn shaft 68 from its normal position (FIGURE 6) through ninety degrees in a counterclockwise direction as viewed from the output end of the conveyor. At measured points along the length of shaft 68, it has clamped to it the brackets 76, 78, 80, 82 and 84. To any one of these brackets there can be bolted a stop 86 in the form of an upstanding plate. Stop 86 is used when panels of six, eight, nine, ten or twelve feet are being handled. In FIGURE 3, however, the machine is shown as being set up to handle panels four feet in length, and for this purpose a different stop 88 is used. This stop is secured to shaft 68 by a bracket 90. When panels four feet in length pass through the rolls 46 and 60 they engage and are halted by the stop 88. Similarly, if boards six feet in length are being stacked and squared, the stop 86 is mounted on the bracket 76. The brackets 78, 80, 82, 84 are similarly spaced from the rearward end of the stack at distances, respectively, of eight, nine, ten and twelve feet. Before a stack can be removed by the conveyor rolls 14 and 38, the shaft 68 must rotate counterclockwise (FIGURE 6) to remove either stop 86 or 88 from in front of the stack. In operation, this takes place as will be described hereafter with reference to FIGURE 8.

On the left-hand side of the machine, as the panels progress in their direction of travel, there is mounted a stationary abutment or squaring plate 92. This plate is

secured to brackets **94** which are transversely adjustable on the crossbeams **6** to accommodate panels of different widths. Referring particularly to FIGURE 5, at the right-hand side of both conveyor sections there is a movable squaring assembly comprising plates **96** which are affixed to a common member **98**. Member **98**, in turn, is supported by a pair of levers **100** which are pivoted at **102** on brackets mounted from the main conveyor framework, and one of which is connected to the reciprocable rod **104** of a piston and cylinder unit **106**. Pneumatic unit **106** is operated to move plates **96** inwardly intermittently to force all of the panels in the stack against the opposite stationary abutment. The control aspects of this operation will be described hereafter, except to note presently the provision of a limit switch designated LS–2, which is closed by inward movement of the squaring plates **96**.

Referring particularly to FIGURES 3 and 4, this apparatus includes end squaring means comprising a pair of plates **108**. Each of these plates is mounted on brackets **110** which are affixed to a transverse shaft **112**. Shaft **112** can be turned by an arm **114** which is connected to the reciprocable rod **116** of a pneumatic piston and cylinder unit **118**. In operation, the end squaring plates **108** repetitively move inwardly into engagement with the ends of panels in the stack, thereby to urge them uniformly against the stop **88** (or **86**) at the opposite end of the stack.

It should be understood that while a stack of panels four feet in length is being formed the conveyor section #1, comprising rolls **38**, is stationary and stop **88** is in the upward position shown in FIGURES 3 and 5. Keeping in mind the fact that a production line rate of several hundred feet per minute must be maintained, it obviously is desirable to remove a finished squared stack as quickly as possible. Also, on the other hand, it obviously is desirable to maintain the squared condition of the stack itself. If at this stage the stack were rapidly accelerated by a sudden activation of conveyor rolls **14** and **38**, it would likely cause a disruption of the stack due to inertia. That is, if the rolls **38** suddenly were started in motion, the panels toward the upper portion of the stack would slide backwardly, requiring a subsequent resquaring of the rearward edges. One of the aspects of this invention is that such consequences are avoided. Referring to FIGURES 3 and 4, there is shown a pusher plate **120**. Pusher **120** is mounted on a slide **122** having, at each side, two pairs of oppositely spaced rollers **124**. Between these rollers **124** (FIGURE 4) there are rails **126** on which the slide **122** is reciprocable. The length of the stroke of pusher **120** preferably is approximately one foot or more. To effect this reciprocation, a pneumatic piston and cylinder unit **128** is mounted between slide **122** and the machine framework.

As will be described hereafter in connection with the overall control system, after the limit switch LS–1 has signalled the delivery of a predetermined number of panels constituting the number desired in a stack, and before the conveyor sections #1 and #2 are activated to remove this stack, the pusher **120** moves forwardly to begin to advance it in the direction in which it will eventually be carried by these conveyor sections. During this motion the slide **122** operates first a limit switch LS–6 and finally a limit switch LS–5. One consequence of the actuation of switch LS–6 is that the conveyor is activated to remove the stacks. It should be noted that even after such activation of the conveyor the pusher **120** still has a portion of its path of travel remaining. Thus, concurrently with sudden activation of the conveyor rolls, the pusher **120** is accelerating the stack to maintain its rearward edge in vertical alignment. A second consequence of the actuation of limit switch LS–6 is the withdrawal of the side squaring plates **96**. The function of limit switch LS–5 is to effect reversal of the pusher **120** to its original inactive position.

The limit switches LS–1 LS–2, LS–3*a*, LS–3*b*, LS–4 LS–5 and LS–6 all play important parts in the overall operation of this apparatus. For a complete understanding of this apparatus, therefore, reference must be made to FIGURE 8.

The central controlling component for this system comprises a standard commercially available counter **150** in which switch-operating cams are driven in one direction during energization of an "add" coil **154**, and in the opposite direction during energization of a "sub" (subtract) coil **155**. The cam-operated switches **152** close alternately to energize either the coil L or U of a latching relay LR. These coils L and U operate, respectively, sets of contacts LR–L and LR–U. A reversal occurs when coil U is de-energized and coil L is energized to place the "add" solenoid in operation. It should be understood that the counter is set so that these reversals occur only after each predetermined number of panels has passed between rolls **46** and **60**, corresponding to the number desired in a finished bundle or stack. Each panel passing between these rolls operates the switch LS–1, which has double sets of contacts as indicated at LS1–A and LS1–B (FIGURE 8). When the leading edge of a panel hits limit switch LS–1 the contacts LS1–A open and the contacts LS1–B close, until the trailing edge of the panel passes beyond this limit switch to restore contacts LS1–A and LS1–B to their normally closed and open positions, respectively.

A counter of the type employed in this apparatus and having the operation as herein outlined is completely conventional and well known in its own art, and need not be described further herein. For purposes of understanding the operation of this machine, it is adequate merely to note that after each predetermined number of panels (constituting the desired number in a finished stack or bundle) has been sensed by limit switch LS–1, a cycle of events is triggered by the energization of either a relay R1 or R2. These relays alternate in operation, the one being energized at the end of counting in one direction, and the other being energized at the end of counting in the other direction.

When the completion of a stack or bundle is signalled by energization of either relay R1 or R2, the next occurrence is the operation of the respective sets of relay contacts R1*a*, R1*b*, and R1*c*, or R2*a*, R2*b* and R2*c*, depending upon whether relay R1, R2 is energized.

A solenoid valve SV2 controls the operation of pneumatic unit **74** (FIGURE 6) to rotate shaft **68**, thereby to raise and lower the stop **86** or **88**. When the SV2 solenoid D is energized the stop is caused to move downward, and it is restored to its upper position by energization of the U solenoid. Therefore, when either relay contacts R1*b* or R2*b* are closed, in series with a closed switch LS–2 and the "down" solenoid D, the stop moves downward. The LS–2 switch (FIGURE 5) is closed when the side-squaring plates **96** are in their inward position.

The solenoid valve SV2 having been energized to lower the stop **86** or **88**, the next event is the closing of switch LS–4 (FIGURE 3) when the stop reaches its fully retracted position.

The pneumatic unit **128** for operating the pusher **120** is controlled by solenoid valve SV3 having "OUT" and "IN" solenoids. Immediately following the closing of limit switch LS–4 by lowering of a stop plate, the "OUT" solenoid is energized and pusher **120** begins to move against the stack and to push it along the conveyor. As pusher **120** moves away from its rest position the limit switch LS–6 (FIGURE 3) is momentarily closed.

At this time, the squaring plates **96** and **108** are still in their inward position against the edges of the stack. The pneumatic units **106** and **118** for operating these squaring plates (FIGURES 3 and 5) are controlled by a solenoid valve SV1, which is in series with the limit switch contact LS1–A, and a set of normally closed contacts R3*a*. As long as contacts R3*a* are closed, then, each time the leading edge of a panel opens contacts LS1–A,

the solenoid valve SV1 is deenergized and the squaring pushers **96** and **108** momentarily open outwardly to allow space for dropping of the panel.

The relay R3 which controls solenoid valve SV1 through its contacts R3*a* is in series with the limit switch LS–6. Therefore, as the pusher **120** moves away from its home position and momentarily closes the limit switch LS–6, the relay R3 is energized and contacts R3*a* are opened to effect withdrawal of the squaring plates. Also, relay R3 closes its holding contacts R3*b* and also a set of contacts R3*c* and R3*d* which will be mentioned hereafter.

The squaring plates **96** and **108** having been withdrawn, the pusher **120** continues to move forwardly. Relay contacts R3*c* and R3*d*, now closed, are in series with the electrically operated clutches **18** and **34**, respectively. These clutches, therefore, now become engaged and the conveyor rollers **14** and **38** immediately are driven to begin removal of the stack. The relays R1, R2 and R3, meanwhile, are held in energized condition through their holding contacts R1*a*, R2*a*, R3*b*, through the normally closed limit switch contacts L3*b* (FIGURE 1).

As pusher **120** reaches the end of its stroke, it closes the switch LS–5 (FIGURE 3) which is in series with the "IN" coil of solenoid valve SV3, resulting in withdrawal of pusher **120** to its rest position.

As the stack, carried by conveyor rollers **14**, approaches the limit switches L3*a* and L3*b*, its leading edge first closes L3*a*. Next, the leading edge opens L3*b*. L3*a* remains closed, thereby holding in the relay contacts R3*b*, and either of the sets of contacts R1*a* and R2*a*. When the trailing edge of the stack rides beneath L3*a* it opens, thereby breaking these holding circuits. Thereupon, both of the relay contacts R1*c* and R2*c* must become closed in series with the SV2 "UP" solenoid, and the pneumatic unit **74** will be closed to rotate shaft **68** and restore the stop **86** or **88** to its upstanding position. Also, when relay R3 drops out, the R3*a* contacts close to permit normal operation of the solenoid valve SV1 for controlling operation of the side and end squaring plates.

Attention should now be focused on the lower portion of FIGURE 7 for an understanding of a feature involving a difference in operation for "short" and "long" boards. When panels four feet in length are being handled the stop **88** is installed on shaft **68**. In the previous description, the conveyors **14** and **38** were operated simultaneously. When "short" panels four feet long are being stacked, pushbutton switch **160** is closed and switch **162** is simultaneously opened. Thereby the relay contacts R3*c* are bypassed and the clutch **18** runs continuously. However, the clutch 34 then comes completely under the control of relay contacts R3*d*. With clutch **18** engaged continuously, the conveyor rollers **14** run continuously while a stack is being accumulated on the conveyor section #1. When stop **88** is lowered and pusher **120** begins to move, it is thereby possible to remove the stack more quickly than if both the conveyor sections #1 and #2 were operated intermittently. When long panels are being stacked, i.e., from six to twelve in length, the stop **86** is installed on shaft **68** at its appropriate location instead of stop **88**. The switch **160** is then opened and clutch **18**, which controls the input to both of the conveyor sections #1 and #2 from motor **16**, is placed solely under control of relay contacts R3*c*.

From the above description it will become evident that this invention provides a machine for rapidly counting, squaring and stacking panels of various lengths, and for removing the squared stack quickly. A feature of this removal is that the pusher **120** operates in cooperation with the stack removing conveyor in such a way that the end of the stack remains in the squared condition.

It will be understood that various departures from the specifically disclosed embodiment of this invention can be effected without departing from the scope thereof as defined by the following claims.

What is claimed is:

1. Apparatus for stacking and squaring panels and the like of various sizes, comprising a length of driven conveyor, conveyor driving and controlling means operable to turn said conveyor on and off, means for delivering panels onto said conveyor in succession from one end thereof, a stop member spaced from said end, means extending lengthwise adjacent said conveyor for mounting said stop member selectively at different points along the length of said conveyor, means operably connected to said stop member-mounting means to move said stop member into and out of the path of panels being delivered to said conveyor, a stationary side squaring abutment extending along the side of said conveyor, adjustable means for mounting said side squaring abutment at a plurality of stationary positions relative to said conveyor, side squaring means at the side of said conveyor opposite said side squaring abutment, end squaring means spaced rearwardly from said stop member toward said one end of the conveyor, means operating said side and end squaring means repetitively whereby panels are pushed against said stop member and side squaring abutment to form a squared stack, a pusher member movable against the rearward end of said stack to initiate movement thereof along said conveyor, means for operating said pusher member, control means responsive to delivery of a predetermined number of said panels unto said stack to operate said stop-member mounting means to remove said stop member out of the forward path of movement of said stack and to activate said pusher-operating means, said conveyor driving and controlling means being operative to turn said conveyor on responsive to the removal of said stop member and the beginning of operation of said pusher member.

2. Apparatus according to claim **1**, wherein said stop member mounting means comprises a rotatable shaft mounted parallel to and in vertically spaced relation to said conveyor, said stop member being mountable at a plurality of points along said shaft, and said means operably connected to the stop-member operating means comprising means for rotating said shaft to effect removal of said stop member from the path of travel of a stack of panels on said conveyor.

3. Apparatus according to claim **1**, wherein said conveyor comprises two sections, including a first section located toward said delivery end and a second section adjacently following the first section in the direction of travel of the conveyor, said stop member being selectively adjusted to be mounted adjacent said first section or at a desired location along said second section, said conveyor driving and controlling means including means selective to drive both said sections simultaneously responsive to removal of said stop member when the stop member is mounted along said second section, or to drive said second section continuously while driving only said first section responsive to said removal of the stop member when the same is located adjacent the first conveyor section.

4. Stacking and squaring apparatus comprising a straight length of conveyor, means delivering panels and the like onto said conveyor in a stack, a shaft extending parallel to said conveyor in vertically spaced relation to said stack, a stop member, means for securing said stop member to said shaft adjustably at any of a plurality of locations along the length thereof to position the stop member in front of the leading edge of said stack, means for rotating said shaft to remove said stop member from in front of said stack, squaring means at the sides of said stack, control means responsive to delivery of a predetermined number of said panels forming a completed stack to initiate operation of said shaft-rotating means, and means also responsive to said control means to drive said conveyor to remove said completed stack.

5. Stacking and squaring apparatus comprising a straight length of horizontally driven conveyor including means for starting and stopping the conveyor, means for delivering board-like panels onto the conveyor in succession to assemble a stack while it is stationary, means for squaring the edges of said stack as panels are deposited thereon, a pusher member at the rearward end of said stack, means operable to drive said pusher member against said rearward end of the stack to advance it in the direction of travel of the conveyor, and a control system for said conveyor and pusher member advancing means including means responsive to delivery of a predetermined number of panels to said stack to initiate operation of said pusher-advancing means and to initiate operation of said conveyor following the beginning of travel of said stack and pusher member.

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