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Kuckhermann

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[54] **APPARATUS FOR FORMING AND CONVEYING STACKS OF FLAT ARTICLES, ESPECIALLY SHEET ARTICLES**

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[51] **Int. Cl.** **B65h 31/30**

[58] **Field of Search** ..... 271/88, 86, 76; 93/93 C, 93 DP; 214/6 H; 198/135, 35

[56] **References Cited**

UNITED STATES PATENTS

3,525,444	8/1970	Brockmuller	271/88 X
3,339,914	9/1967	Grantham	271/88 X
2,262,236	11/1941	Huck	271/88
3,191,927	6/1965	Hartbauer et al.	271/86 X

FOREIGN PATENTS OR APPLICATIONS

69,117	5/1941	Czechoslovakia	198/20 T

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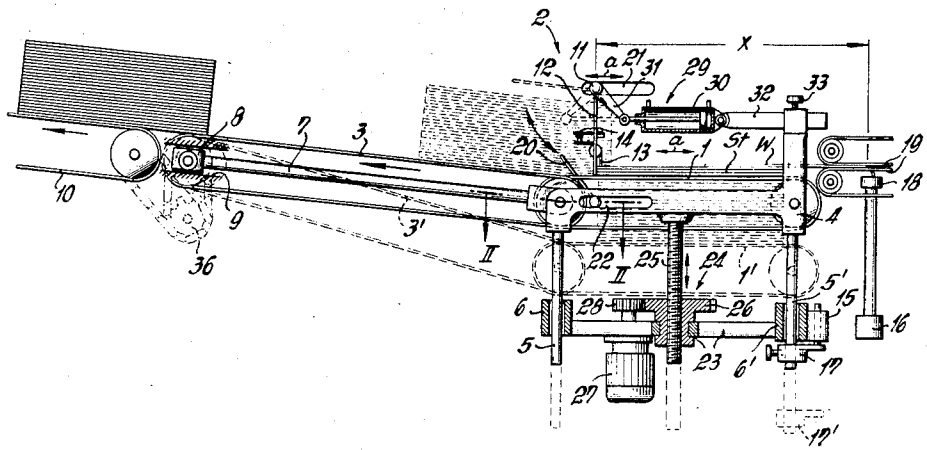
[57] **ABSTRACT**

In apparatus for forming and conveying stacks of sheet articles arriving on a supply conveyor, the apparatus comprising a stack conveyor on which the articles are successively deposited in superposed relationship aligned against a displaceable abutment whilst the stack conveyor is not feeding and by which each completed stack is fed to a discharge conveyor, the time interval between completion of one stack and commencement of formation of the next stack is minimised and the possible height of efficient stacking is increased by providing for lowering of the stack conveyor in dependence on the growth rate of a stack being formed so that the uppermost article in the stack being formed is substantially at a constant level slightly below the discharge end of the supply conveyor, the stack conveyor being raised again as a completed stack is being transported away and before a new stack is formed.

5 Claims, 6 Drawing Figures



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SHEET 1 OF 2

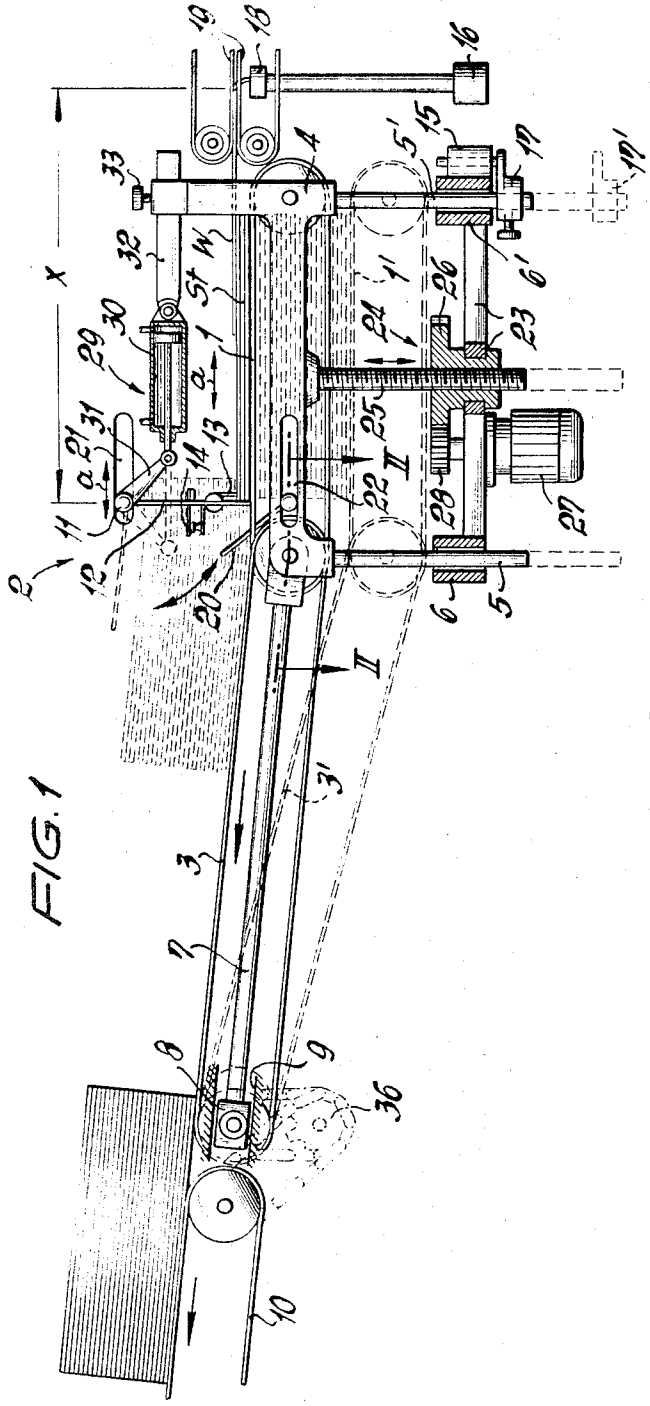

FIG. 1

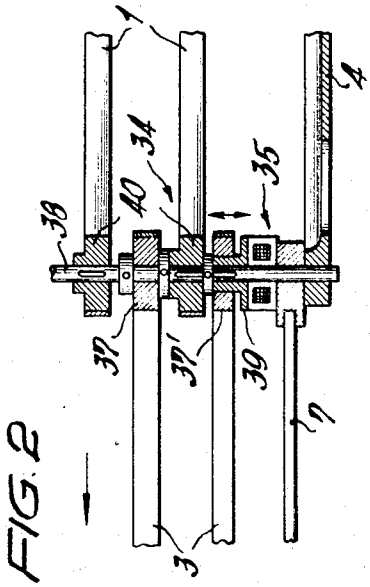

FIG. 2

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FIG.4

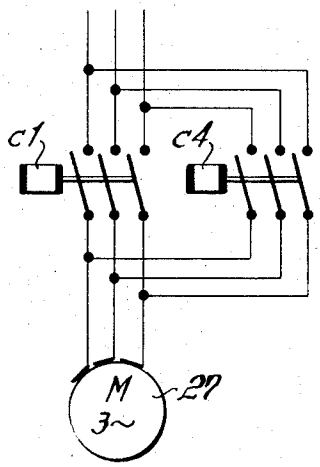


FIG.5

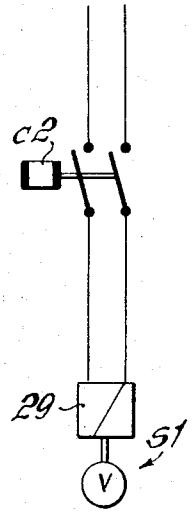


FIG.6

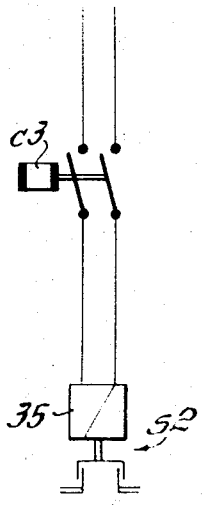
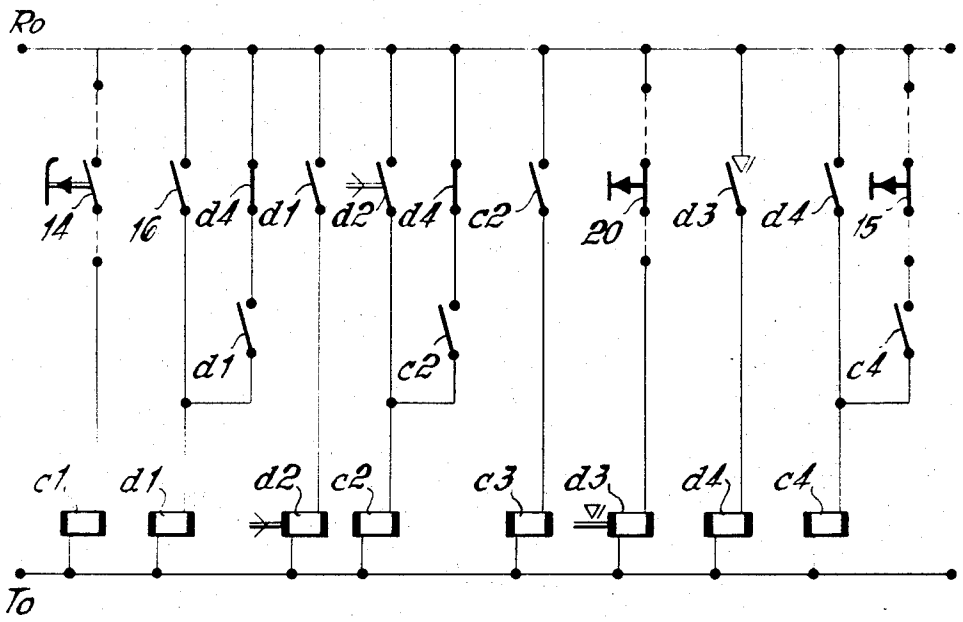


FIG.3



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APPARATUS FOR FORMING AND CONVEYING STACKS OF FLAT ARTICLES, ESPECIALLY SHEET ARTICLES

The invention relates to apparatus for forming and conveying stacks of flat articles, especially sheet articles such as flattened sacks or bags or flattened tubular sections of flexible material from which sacks or bags are to be made.

In bag manufacture, it is required that the empty sacks or bags be stacked in predetermined numbers prior to being packaged or to superpose flattened tube sections for the bags in stacks which are convenient to handle and convey to a processing station where, say, each tube section is closed at one end by a base-laying machine. A complete production unit for making bags always consists of a plurality of juxtaposed machines which are interconnected by conveyors and which, in order to save space in the factory, are positioned one behind the other in a straight line. Such a straight-line arrangement requires that the stacking apparatus for flattened tube sections or for the completed but empty bags should discharge the stacks in a direction opposite to that in which the articles are received for stacking. This means that an abutment or alignment stop against which the articles come to lie during stacking and which is instrumental in forming properly aligned stacks must be moved out of the path of a completed stack before the latter can be transported away. Further, the stop must be moved back again before a new stack can be formed.

Conventional stacking apparatuses consist of a reciprocatable stacking table or an intermittently movable conveyor belt of which the respective table surface or conveying run is disposed a predetermined distance below the discharge end of a supply conveyor for the articles to be stacked. This predetermined distance must be at least equal to the highest stack that might have to be formed and of course the alignment stop must extend downwardly over the entire height of the completed stack to reach the stacking table or conveyor belt.

In known contructions of stacking apparatus, the height of the completed stacks is restricted because there is a limit to the distance below which the stacking table or conveyor belt can be disposed beneath the level of the supply conveyor. If this distance is too large, there is a distinct danger that the articles will turn or fold over as they are being flung onto the stacking table or conveyor belt, especially if the articles are made of flexible film material. In addition, the alignment stop of known stacking apparatus must be moved through long distances to move out of the path of a completed stack and then back again. In known stacking apparatus the time for moving the alignment stop must therefore be added to the time it takes to transport a completed stack from the stacking station and this results in a considerable total period during which the stacking apparatus must not be supplied with further articles for forming a new stack. However, this means that the time interval between supplying the last article for a completed stack and the first article for a new stack must be at least equal to the aforementioned total period if the completed stack is to be discharged during this time interval. To achieve such a time interval, the production rate for the articles to be stacked must therefore stay below a predetermined limit.

The invention aims to provide a stacking and conveying apparatus in which the total period between completion of one stack and formation of a new stack is limited to, or is almost limited to, the actual time it takes to transport a completed stack away, and which also permits the formation of stacks of any desired height.

According to the invention, there is provided apparatus for forming and conveying stacks of flat articles arriving on a supply conveyor, comprising a stack conveyor onto which the articles are succesively thrown from the discharge end of the supply conveyor to stack up against an aligning stop whilst the stack conveyor is not feeding, the stop being movable out of the path of a completed stack before feeding of the stack conveyor is started to transport the stack to a discharge conveyor, wherein the stack conveyor is lowerable during stacking in dependence on the growth rate of a stack being formed such that the uppermost article of the stack being formed will be at a substantially constant level slightly below the discharge end of the supply conveyor, an intermediate conveyor is provided between said stack conveyor and discharge conveyor, the upstream end of the intermediate conveyor being lowerable in unison with the stack conveyor and the downstream end of the intermediate conveyor remaining at sustantially the same level as the discharge conveyor, and wherein the stack conveyor and intermediate conveyor are raisable after completion of a stack whilst the latter is transported away.

By means of the invention, therefore, during stacking only the lower edge portion of the aligning stop is disposed in the path of the arriving articles to catch and align same at the top of the stack being formed. This is because the aligning stop does not follow the descent of the stack conveyor. Consequently, only a very short time is required to move the aligning stop out of the path of a completed stack to enable the latter to be transported away. Since the top of the stack being formed is at a constant optimum level below the discharge end of the supply conveyor, there is little danger of the articles turning over as they are dropped onto the stack and therefore this danger need no longer be taken into account when determining the maximum height of the completed stacks. By causing the upstream end of the intermediate conveyor to descend together with the stack conveyor, it is possible to commence feeding of each completed stack at the same time as the stack conveyor is being raised again, the aligning stop proving no hindrance to this because it engages only the very top of the completed stack and will release same at the moment it starts to swing away. It is therefore not necessary to delay feeding of the completed stack until the aligning stop has been swung away completely.

Lowering of the stack conveyor may be controlled by a senser which is adapted to scan the position of the uppermost article in the stack being formed, the senser preferably being mounted at the lower edge of the aligning stop on the upstream side thereof and being adapted to actuate a switch which is included in the electric circuit for a lowering drive for the stack conveyor and intermediate conveyor.

The raising and lowering drive for the stack conveyor and intermediate conveyor and a pivoting drive for moving the aligning stop upwardly out of the path of the completed stack may be operable by a counter for the articles after it has counted a predetermined num-

ber of articles supplied by the supply conveyor so as to ensure that each stack will contain the same number of articles. In view of tolerances in the thickness of the articles, it would not be possible to ensure equal numbers of articles in each stack if feeding of each completed stack were to be effected in dependence on the height of the stack. Further, it is desirable to provide a feeler which is responsive to the passage of a completed stack for actuating the pivoting drive to return the aligning stop into the path of a new stack to be formed. In this way the aligning stop will be returned into the path of newly arriving articles at the earliest possible moment so that the new stack can be started as soon as the preceding stack has left the stacking station.

An example of the invention will now be described with reference to the accompanying diagrammatic drawings wherein:

FIG. 1 is a side elevation of a stacking apparatus;

FIG. 2 is a part-section on the line II—II in FIG. 1;

FIG. 3 is a circuit diagram of an electric control for operating the FIG. 1 apparatus, and

FIGS. 4 to 6 show further details of the FIG. 3 circuit.

The stacking apparatus comprises a stack conveyor 1 consisting of a plurality of parallel belts, an aligning stop or abutment 2 and an intermediate conveyor 3 which also consists of a plurality of parallel belts. The conveyor 1 is mounted in a frame 4 which is provided with guide bars 5, 5' slidable in sleeves 6, 6' which are interconnected by a cross-member 23 which constitutes a support for a screw and nut device 24. The screw 25 of the screw and nut device is fixed to the frame 4 and the nut 26 is in the form of a gear which is carried by the support 23 and rotatable by a pinion 28 driven by a reversible motor 27 which is also carried by the support 23. The screw and nut device 24 constitutes a raising and lowering drive for raising and lowering the stack conveyor 1.

The downstream end of the stack conveyor 1 is hinged to a frame 7 of the intermediate conveyor 3. The downstream end of the frame 7 is hinged to a block 8 which is slidable in a guide 9. The guide 9 is so located that the discharge end of the conveyor 3 is disposed substantially at the same level as the upstream end of a discharge conveyor 10. As shown in FIG. 2, the individual belts of the conveyors 1 and 3 pass over coaxial rollers 40 and 37, 37'.

The aligning stop 2 is adjustable in the direction of the arrows *a* so that it can be set to suit the dimensions of the articles to be stacked. The stop 2 comprises a flap 12 which is pivotable about a horizontal shaft 11 and at the lower edge of which there is provided a senser 13 which faces in the upstream direction. The senser 13 can actuate a switch 14 which will hereinafter be further described in relation to the circuit of FIG. 3 and which is effective to start a lowering drive for the stack conveyor 1. The flap 12 is pivoted by a pneumatic drive 29 between the full line position in FIG. 1 at which it can catch the arriving articles W and the chain-dotted position in FIG. 1 at which it is swung out of the path of a completed stack of articles.

The drive 29 comprises a double-acting pneumatic cylinder 30 pivotally suspended between a lever 31 and a displaceable bearing 32. The lever 31 is fixed to the shaft 11 which is also fixed to the flap 12. The bearing 32 is adjustable in unison with the flap 12 when the latter is set to a different size of articles to be stacked and can then be clamped in position by means of a screw 33 on the frame 4.

The various drives for the stacking apparatus, namely a drive 34 (FIG. 2) for feeding the stack conveyor 1, the raising and lowering drive constituted by the nut and screw device 24 and the drive 29 for pivoting the flap 12 of the aligning stop 2 to a position where it releases a completed stack are actuated by an impulse generator 16 which may be an electronic repetition counter of the kind marketed by the Swiss firm Elesta under the Trade Mark CP 31. The setting on the impulse generator 16 determines the number of articles W to be contained in each stack S*t* and therefore also determines the lowermost final position of the stack conveyor shown in chain-dotted lines at 1' in FIG. 1. When the number of articles as set on the impulse generator 16 has been counted by a feeler 18 which is connected thereto and counts the number of articles arriving on a double-belt supply conveyor 19, the flap 12 is pivoted out of the path of the completed stack and thereafter the feed drive for the stack conveyor 1 and its lifting drive are started. An abutment 17 on one of the guide bars 5' limits the uppermost position of the conveyor 1 by opening a switch 15 to switch off the lifting drive and to activate the lowering drive when the appropriate circuit is later closed by the first few articles for the new stack pressing on the senser 13. In lowered conditions of the conveyor 1, the abutment 17 is out of contact with the switch 15 as indicated in chain-dotted lines at 17' in FIG. 1. For the return movement of the flap 12 into the path of the new stack to be formed, a feeler 20 is provided which operates the pivoting drive as soon as it has been released by a completed stack and swung up under spring force.

Upon commencement of a stacking operation, the conveyor 1 is in its uppermost position shown in full lines in FIG. 1, where its conveying run is located so closely below the discharge end of the supply conveyor 19 that the articles W will not turn over as they are thrown against the flap 12 located in their path. The flap stops the articles so that their leading edges are aligned in the stack being formed. Soon after a few articles have begun to pile up on the conveyor 1, the senser 13 is struck by the following articles and this causes the switch 14 to close. The switch 14 is also shown in FIG. 3. Closing of the switch 14 energises an output relay *c*1 and activates the motor 27 to turn in a direction effective to lower the conveyor 1. As soon as the stacked articles have released the senser 13 again, lowering movement of the conveyor 1 is interrupted until the next few articles again press on the senser 13. This intermittent and automatic lowering of the conveyor 1 ensures that the height through which the arriving articles W must drop onto the stack being formed is kept substantially constant and within limits that avoid the danger of turning over of the articles during transfer.

When the number of articles as preset on the impulse generator 16 has been counted by the feeler 18, the impulse generator closes a switch 16 (FIG. 3) by sending an impulse thereto, whereby a control relay *d*1 becomes energised and becomes self-holding through an opening contact *d*4. The relay *d*1 thereupon operates a delayed control relay *d*2. After expiry of an adjustable time delay, an output relay *c*2 becomes energised and self-holding through the opening contact *d*4. The relay *c*2 operates a control valve *s*1 (FIG. 5) of the pneumatic cylinder 30 for pivoting the flap 12 to the releas-

ing position. The piston rod of the cylinder is thereby projected and causes the flap **12** to move to a horizontal position. The time delay in operating the control relay *d*2 ensures that the uppermost article W of a stack to be formed will come to lie properly against the flap **12.**

Simultaneously, by means of the output relay *c*2 the output relay *c*3 is energised and operates a magnetic *s*2 of an electromagnetic clutch **35** so that the conveyor **1** is caused to circulate in unison with the intermediate conveyor **3.** The latter is continuously driven through a chain transmission **36** from the discharge conveyor **10** and is passed about the rollers **37, 37'** which are loosely mounted on a drive shaft **38** for the conveyor **1,** the drive shaft **38** being stationary during the stacking operation. Upon energisation of the clutch **35,** a positive drive connection is made between the rotating roll **37'** and the shaft **38** through a hub **39** of the clutch, the hub being fixed to the shaft **38.** When the shaft **38** begins to turn, the rolls **40** fixed thereto cause the conveyor **1** to commence feeding and the finished stack S*t* is transported away towards the intermediate conveyor **3.**

By reason of the pivotal mounting of the conveyor **3** at both its ends, transporting of the completed stack may already commence when this conveyor is in the chain-dotted position shown at **3'** in FIG. **1,** this resulting in a saving of time. Alternatively, the feeding motion of the conveyor **1** may be delayed until it and the associated end of the conveyor **3** have reached a somewhat higher position which can be accurately predetermined.

The completed stack fed by the conveyor **1** depresses the feeler **20** and thereby actuates an erasing relay *d*3 which, after the feeler has been released by the trailing edge of the stack, generates an impulse which momentarily closes a control relay *d*4. This energises an output relay *c*4 and causes self-holding through the switch **15.** The relay *c*4 is a reversing relay to cause the motor **27** to turn in a direction effective to lift the conveyor **1.**

Elevation of the two conveyors **1** and **3** is terminated by the abutment **17** which, in the uppermost position of the conveyor **1,** opens the switch **15.** The flap **12** is returned into the path of the new stack to be formed as soon as the rear edge of the previously completed stack has released the feeler **20.** At this time the relay *c*2 opens through the momentary opening of the opening contact *d*4 and thereby opens the control valve *s*1 so that the piston-rod side of the pneumatic cylinder **30** becomes vented and the flap **12** is pulled into the full line position of FIG. **1** by the retracting piston rod.

By adjusting the flap **12** along a slot **21** to have a particular spacing *x* from the counter **18,** feeding of a completed stack can be set for all lengths of articles to begin as soon as the last article for a stack has struck the flap **12.** Adjustment of the flap **12** along the slot **21** simultaneously moves the feeler **20** along a slot **22.**

The feeding speeds of the conveyors **1, 3** and **10** is preferably equal, the intermediate conveyor **3** being driven by the discharge conveyor **10** so that the conveyors **3** and **10** can feed a completed stack even if the conveyor **1** is already stationary.

I claim:

1. Apparatus for forming and conveying stacks of flat articles arriving on a supply conveyor comprising a stack conveyor adapted to successively receive said articles from the discharge end of said supply conveyor, an aligning stop cooperating with said stack conveyor and adapted to stack said articles up when said stack conveyor is not feeding, means for moving said aligning stop out of the path of a completed stack before said feeding of the stack conveyor is started to convey the stack to a discharge conveyor, means for lowering said stack conveyor during stacking in dependence on the growth rate of a stack being formed such that the uppermost article of the stack being formed is at a substantially constant level slightly below the discharge end of said supply conveyor, a moveable intermediate conveyor positioned between said stack conveyor and said discharge conveyor, means for lowering the upstream end of said intermediate conveyor in unison with said stack conveyor, means for keeping the downstream end of said intermediate conveyor at substantially the same level as said discharge conveyor, and means for raising said stack conveyor and said intermediate conveyor in unison after completion of a stack and while said stack is transported away.

2. Apparatus according to claim **1,** and further comprising a senser adapted to scan the position of the uppermost article in the stack being formed and for controlling the lowering of said stack conveyor.

3. Apparatus according to claim **2,** wherein the senser is mounted at the lower edge of the aligning stop on the upstream side thereof.

4. Apparatus according to claim **1,** wherein said means for raising and lowering said stack conveyor and said intermediate conveyor and said means for moving said aligning stop out of the path of the completed stack comprise a counter for the articles which activates said means after it has counted a predetermined number of articles supplied by the supply conveyor.

5. Apparatus according to claim **4** and further comprising a feeler responsive to the passage of a completed stack for actuating the return of said aligning stop into the path of a new stack to be formed.

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