United States Patent

[11] 3,591,018

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[54] **CARTON LOWERING MACHINE**
12 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **214/6,** 198/35, 198/163, 271/88
[51] **Int. Cl.** **B65h 7/04,** B65h 29/50
[50] **Field of Search** ..... 214/6 H, 6 K; 198/35, 154, 155, 158, 163; 271/77, 86, 87, 88

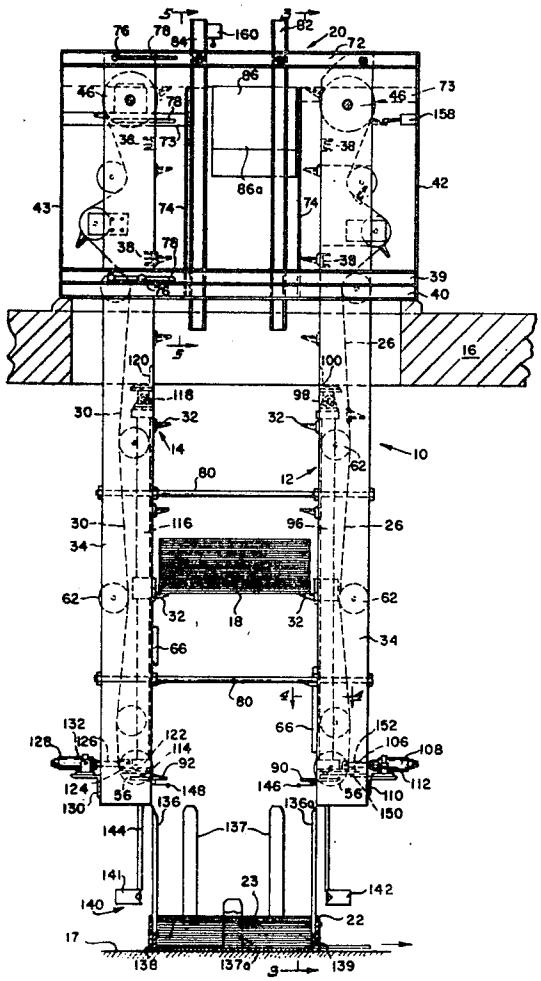
[56] **References Cited**

UNITED STATES PATENTS

2,889,073	6/1959	Nogle	271/DIG. 7
3,381,830	5/1968	Vasse	214/6 H
3,420,386	1/1969	Morrow et al.	214/6 K
1,951,445	3/1934	Sauerman	271/88
2,919,821	1/1960	Young	198/35
1,669,357	5/1928	Stout et al.	198/102

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ABSTRACT: A machine for handling and stacking sheetlike material including vertically opposed endless chain tracks, each having opposed cooperating tabs adapted to carry a number of sheets therebetween. A sheet transfer assembly is positioned adjacent the bottom end of the chain tracks to receive the sheets from the tab members and deposit them on a stack in a supply magazine from which sheets are periodically removed for a desired purpose. A control system responding to the height of the sheet stack within the magazine cycles the transfer assembly and the chain tracks to supply sheets automatically to the magazine as required to maintain a predetermined supply therein.



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SHEET 1 OF 5

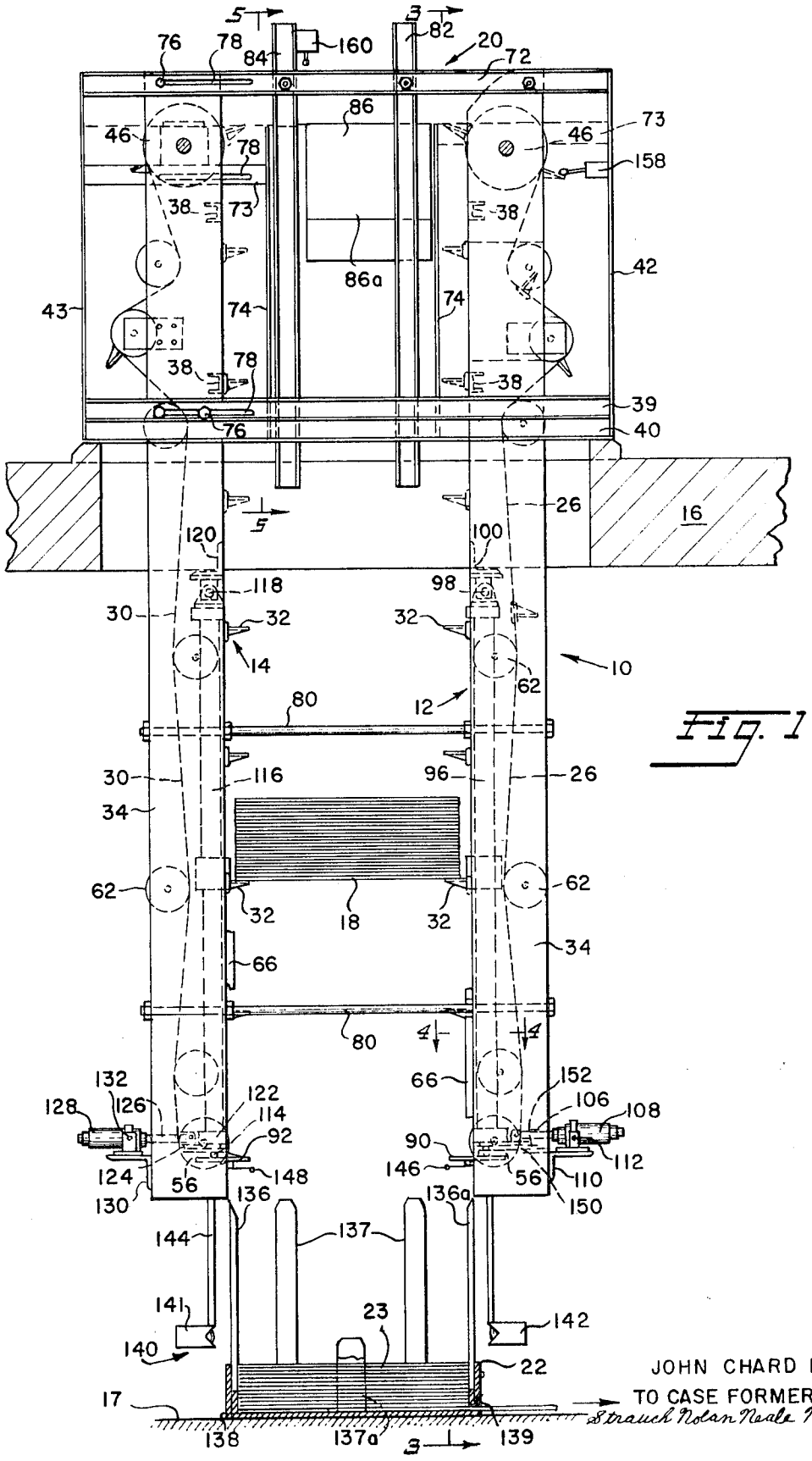


Fig. 1

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TO CASE FORMER

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ATTORNEYS

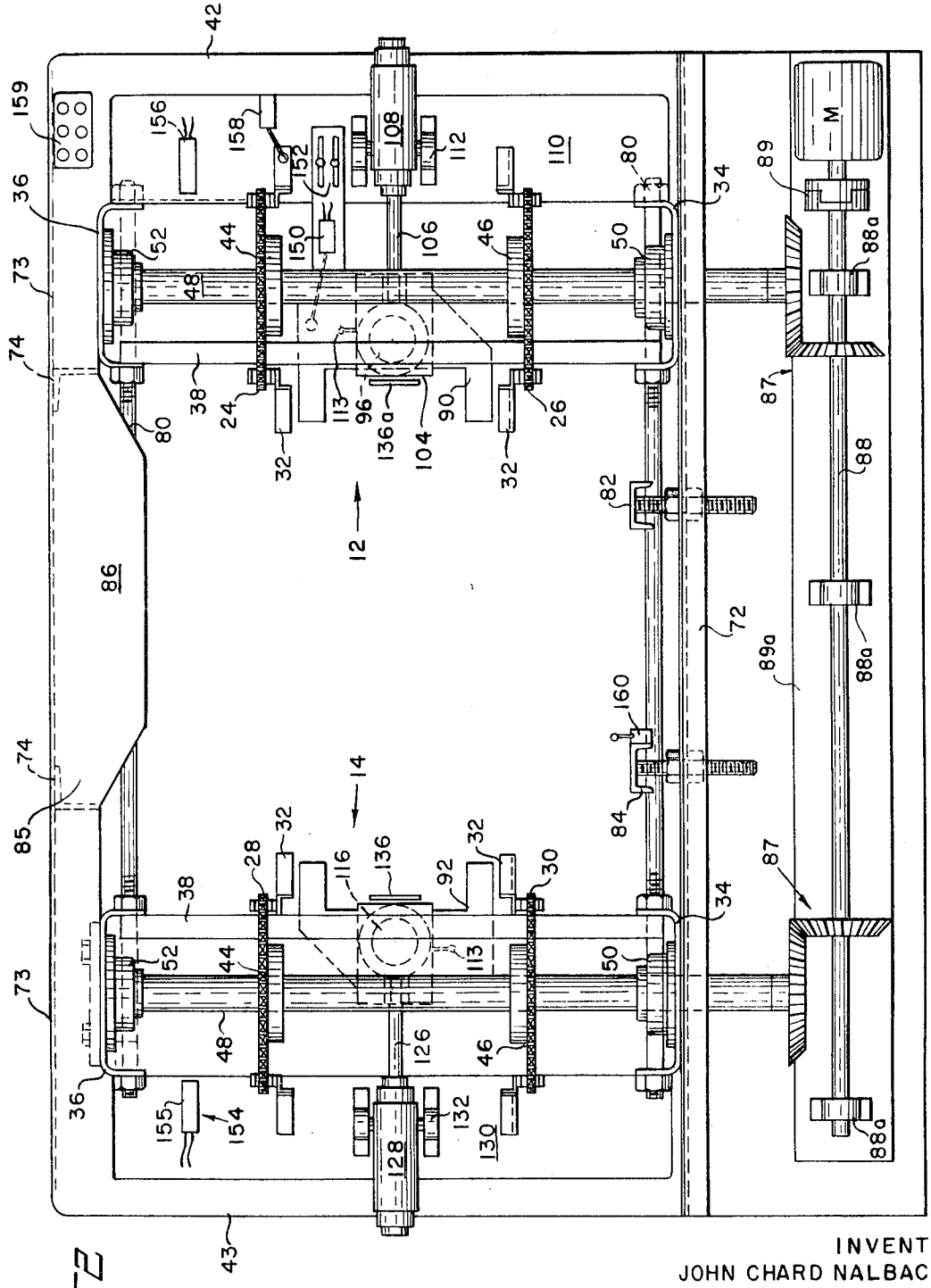


Fig. 2

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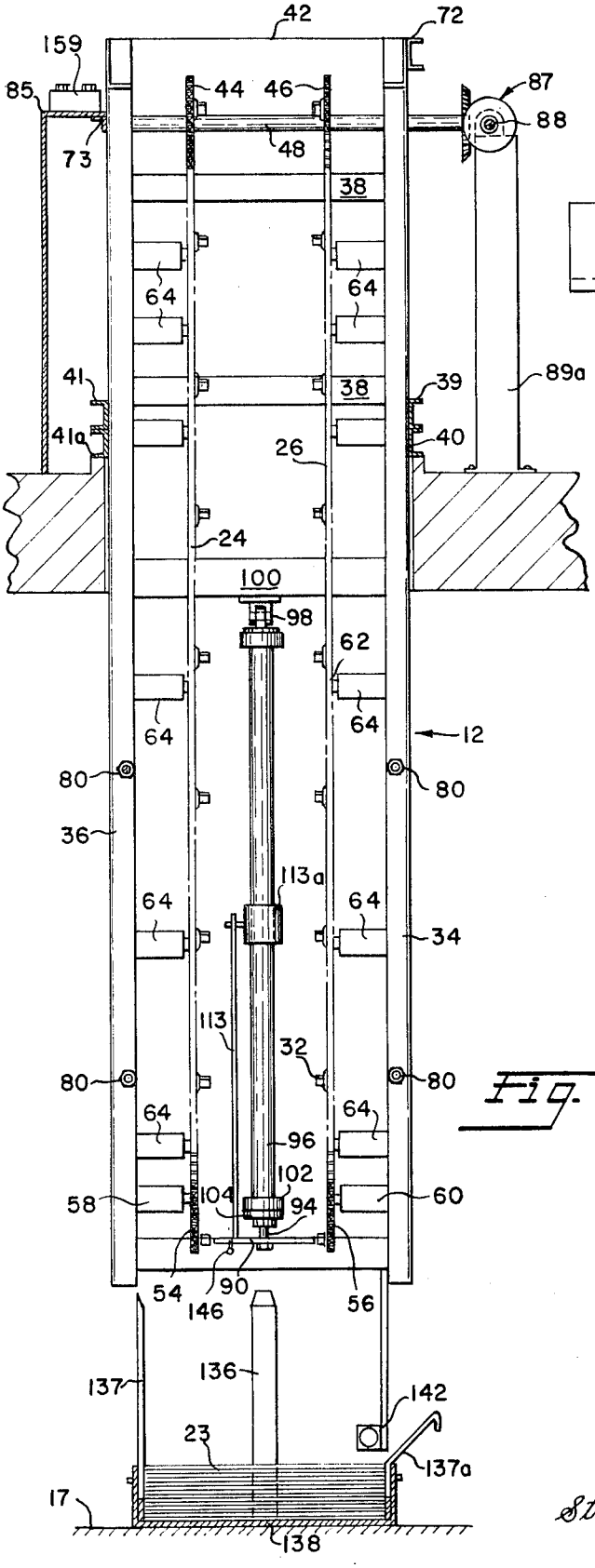


Fig. 3

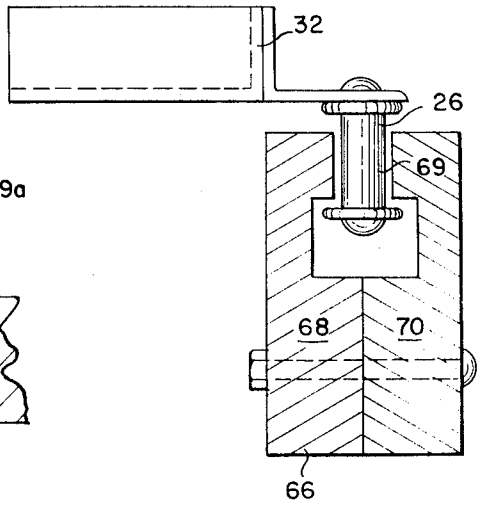
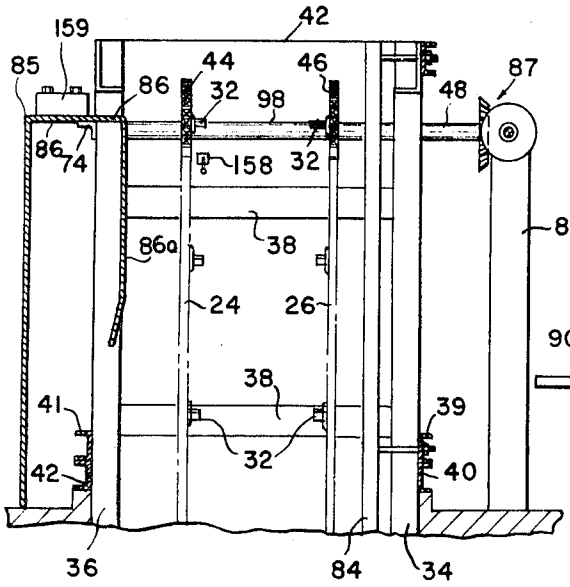


Fig. 4

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Fig. 5



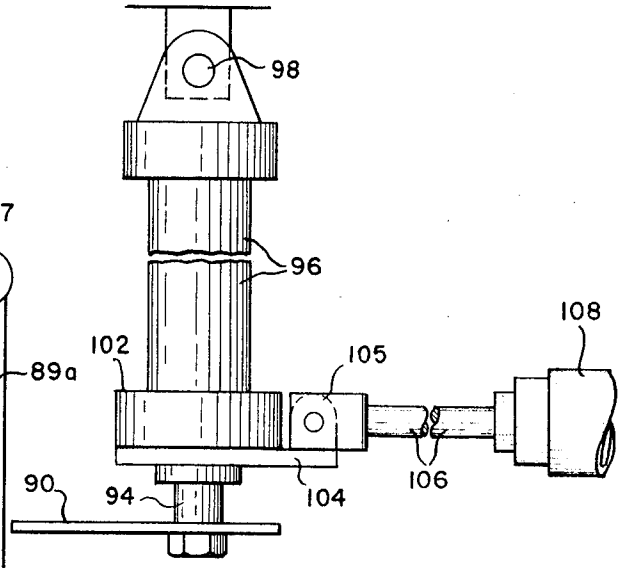


Fig. 6

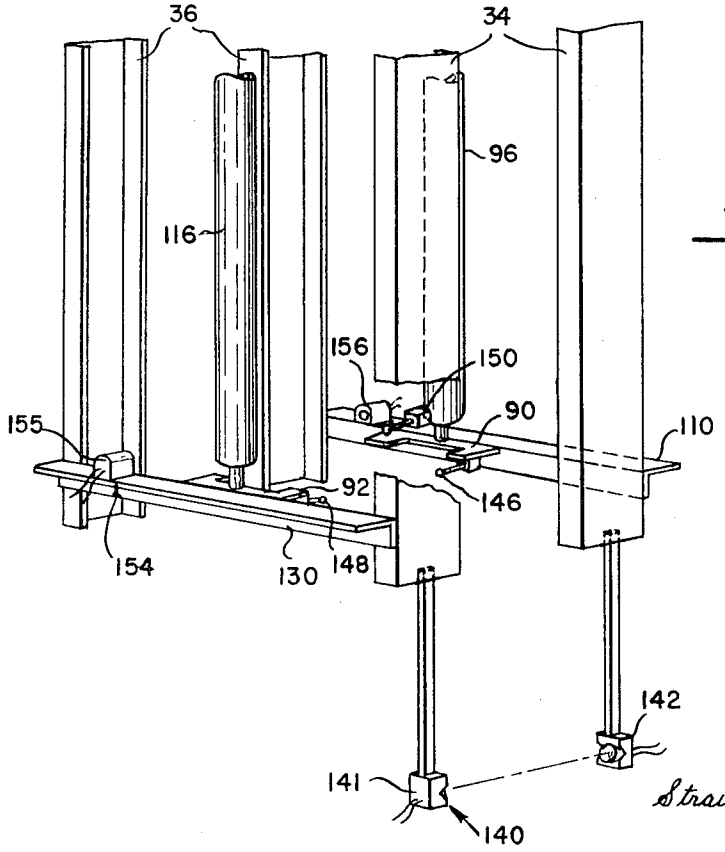
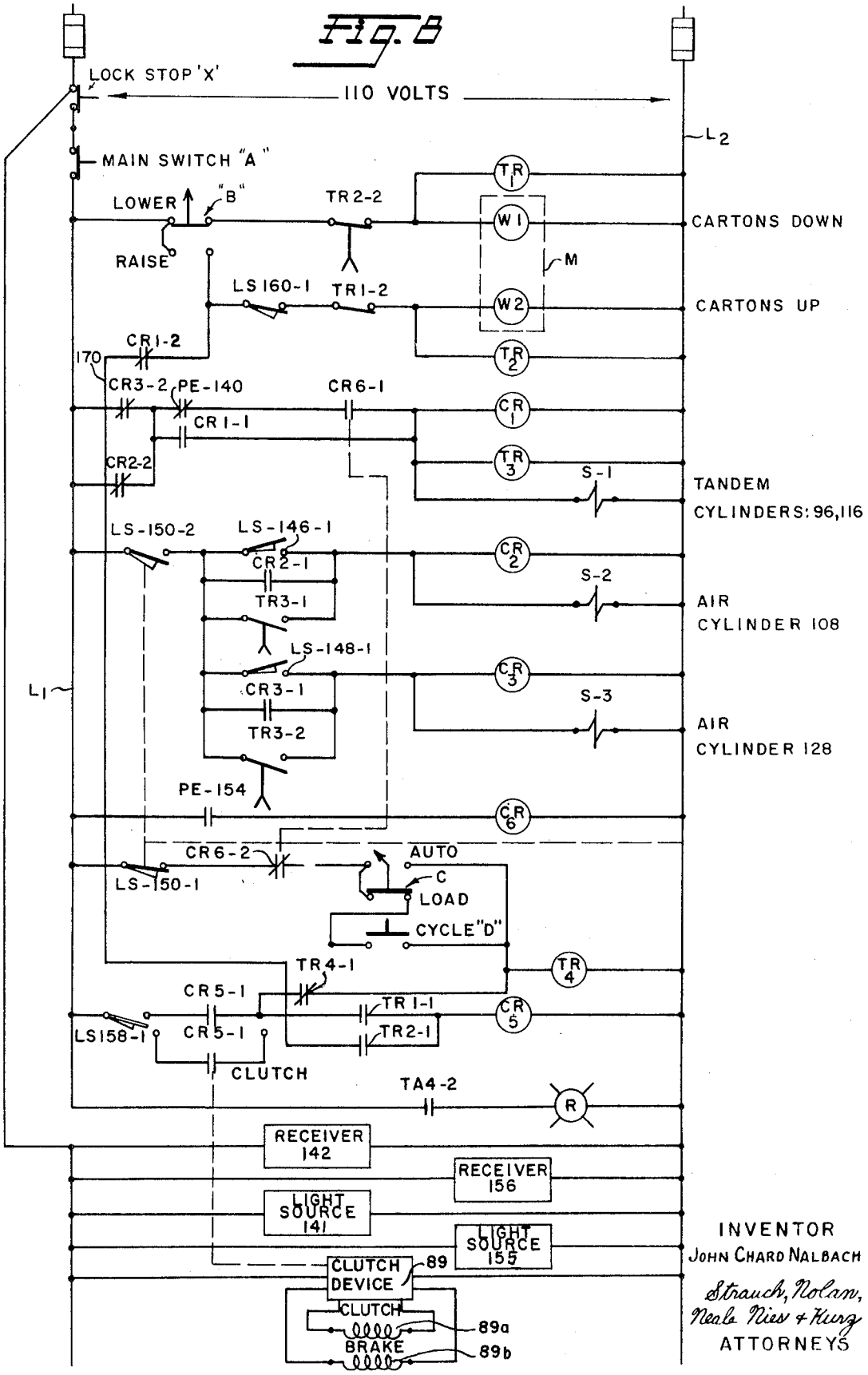


Fig. 7

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Fig. 8



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CARTON LOWERING MACHINE

BACKGROUND OF INVENTION

This invention is generally concerned with material handling apparatus and is more particularly directed to a machine for conveying sheetlike material vertically from one floor to another and for stacking the sheets in an appropriate magazine from which they may be withdrawn for desired usage. The machine is preferably automatically controlled in response to the presence of the sheets in the magazine in order that additional sheets may be conveyed thereto upon demand to maintain an adequate supply therein.

The invention may be used to convey any flattened or boxlike material and is specifically illustrated herein with reference to the conveying and stacking of flat corrugated cases or cartons from an upper storage floor to a magazine located on a floor below, the magazine serving as a carton supply source for a case forming machine which includes a device for automatically withdrawing a carton from the bottom of the stack within the magazine.

In the past, it has been common practice to store the flattened cartons on an upper floor and then transport them by elevators to a lower floor where the case forming machine and associated packaging equipment are located. The flattened cartons were then manually loaded by an operator into a magazine from which the cartons were fed to the case forming machine, and, during operation, the operator was required to manually maintain an adequate supply of cartons within the magazine. This general operation proved to be very inefficient and costly in several respects. During operation, the operator had to be readily available to periodically add cartons to the stack in the case forming machine. Hence, when several case forming machines were operating at the same time, a number of operators were required to ensure continued operation. Consequently, labor costs have been excessively high and have contributed heavily to the overall cost of the case forming and packaging operation.

Additionally, the fact that the cartons were removed from the elevators and placed on the lower floor before they were loaded into the magazine by the operator increased the floor space requirements of the case forming machine, which, of course, increased overhead and prevented maximum utilization of space.

Also, this type of operation which required the use of separate elevators and manual handling for transport of the cartons between the upper and lower floors increased plant equipment costs and prevented the use of the elevators for other suitable purposes, or possibly complete elimination thereof.

With these particular problems in mind and because available prior art material handling devices were inadequate to overcome these problems, this invention was developed to provide a machine capable of accomplishing the objects set forth below.

SUMMARY OF INVENTION

The primary object of the invention resides in the provision of sheet-handling apparatus capable of automatically lowering sheets from an upper floor to a supply magazine on a lower floor and maintaining an adequate supply of sheets within the magazine to ensure continued operation of any production equipment associated with the magazine.

Another object resides in the provision of a flattened carton lowering machine which, after being initially loaded with a plurality of cartons, is automatically cycled in response to the presence of cartons within a magazine to maintain an adequate carton supply therein.

Still another object resides in the provision of a carton-lowering machine upon which a large number of flattened cartons may be initially loaded and stored until needed, and then cycled to supply the cartons to the supply magazine of a case forming machine upon demand in response to the number of cartons within the magazine.

A still further object resides in the provision of a carton-lowering machine including a pair of opposed endless chain tracks which are initially manually loaded with a plurality of flattened cartons and which are then automatically cycled in response to the presence of cartons in a loading magazine to place a number of cartons upon reciprocating plate elements functioning to lower and gently deposit the cartons into a magazine while maintaining relative alignment therebetween.

Another object resides in the provision of a carton lowering machine which is initially loaded with a plurality of flattened cartons and an associated automatic control system which, in response to the presence of cartons in a case forming supply magazine, cycles the carton-lowering machine to maintain an adequate supply of cartons within the magazine.

The invention accomplishes the objects set forth and overcomes the above-mentioned prior art disadvantages by providing a carton-lowering machine comprising a pair of opposed chain tracks, each having a pair of laterally spaced endless chains with vertically spaced tab members therealong cooperating with substantially aligned tab members of the chains of the other track, with each set of cooperating tabs supporting a plurality of cartons. The chain tracks are suspended from an upper floor where an operator manually places a group of cartons on each set of cooperating tabs and periodically cycles the chain tracks until they are fully loaded with cartons supported between each set of cooperating tabs.

To ensure that the cartons are gently deposited within the magazine in order that substantial relative alignment therebetween be maintained, tandem cylinder actuated, vertically reciprocating U-shaped plates receive the cartons from the tabs of the endless chains and then lower and deposit them within the magazine.

An automatic control system for cycling the reciprocating plates and endless chain tracks in timed relation is provided and includes a photosensitive cell which senses the level of the stack of cartons within the magazine and, when a predetermined lower level is reached, actuates the tandem cylinders to lower the plates and cartons resting thereon toward the magazine. A sensing limit switch is located on the bottom of each of the plates which, upon lowering thereof, contacts the top of the carton stack and actuates a pneumatic operator which pivots the plates outwardly causing the cartons to be released therefrom and deposited on the stack. When both plates have been pivoted outwardly, the tandem cylinders are deactuated to raise the plates to their uppermost position at which time another limit switch is actuated to deactivate the pneumatic operators and thereby permit the plates to be pivoted inwardly. Simultaneously therewith the drive system for the chains is coupled so that the next group of cartons supported on the next cooperating tab members is moved downwardly and placed on the U-shaped plates. When the next group is so placed, another photosensitive cell stops the chain drive and the overall machine is retained in this rest position until such time that the level of cartons within the magazine again drops to repeat the cycle again.

To add versatility to the carton-lowering machine, at least one of the chain track assemblies is mounted to permit adjustment toward and away from the other so that various sized cartons may be transferred. Additionally, the chain drive system is reversible to move cartons downwardly and upwardly, the latter at a greater speed, thus enabling an operator, if time permits, to again fully load the chain tracks even if they have not been completely unloaded. This particular feature has been found to result in maximum efficiency and utilization of an operator's time, particularly when a single operator may be responsible for maintaining continued operation of a number of carton lowering machines.

Additional objects and advantages will become apparent from the reading of the following detailed description of a preferred embodiment of the invention and with reference to the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary front elevation illustrating the overall structure of the carton lowering machine and its association with the case forming magazine;

FIG. 2 is a top plan view of FIG. 1;

FIG. 3 is a side fragmentary elevation taken along line 3–3 of FIG. 1;

FIG. 4 is a section taken along line 4–4 of FIG. 1 illustrating the chain track spacer and its operative relationship to the endless chain and tab members;

FIG. 5 is a fragmentary elevation taken along line 5–5 of FIG. 1 illustrating the loading shelf and carton guide bars at the loading station;

FIG. 6 is an enlarged fragmentary elevation illustrating the connecting structure between the tandem cylinders, reciprocating lowering plates, and pivoting air cylinders;

FIG. 7 is a fragmentary perspective view illustrating the location of the various operating switch elements positioned at the bottom of the track assemblies adjacent the carton supply magazine; and,

FIG. 8 is a schematic illustration of an electrical circuit which may be used to control the operation of the carton lowering machine of the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to FIGS. 1–3, the carton lowering machine 10 comprises opposed chain track assemblies 12 and 14 suspended from an upper floor 16 and capable of lowering flattened cartons 18 from the upper floor loading station 20 to a supply magazine 22 of a case forming machine (not shown) on a lower floor 17. The track assembly 12 includes a pair of laterally spaced endless chains 24 and 26 and assembly 14 includes similar endless chains 28 and 30 which are transversely aligned with chains 24 and 26, respectively. Each of the chains has a plurality of tab members 32 equidistantly spaced therealong and, as shown in FIG. 1, each set of opposing tab members of the respective aligned chains are in substantial horizontal alignment to support a plurality of cartons 18 therebetween. The track assemblies 12 and 14 are substantially identical in structure and only track 12 will be specifically described, with like numerals being applied to like structure on both track assemblies.

The chain track 12 includes vertical channel shaped support members 34 and 36 cross-connected by a number of vertically spaced channel beams 38 and suspended on floor 16 by connecting transverse frame members 39, 40 and 41, 41*a*, respectively, extending between sidewalls 42 and 43 of a suitable cover at loading station 20. The chains 24 and 26 are driven respectively by sprockets 44 and 46 fixed to shaft 48 which is rotatably mounted in bearings 50 and 52 suitably connected to channel members 34 and 36, respectively. The chains 24 and 26 at the lower end of the track assembly 12 pass over the lower sprockets 54 and 56 suitably mounted on brackets 58 and 60, respectively, which are connected to the channel members 36 and 34, the chains in their outer flight similarly passing over a number of idler sprockets 62 connected to the channel members by suitable brackets 64.

Each of the chains is provided with a spacer and guide channel 66 suitably connected to channel members 34 and 36 and shown fragmentarily in FIG. 1 and partially in section in FIG. 4. The channel 66 extends between the drive and lower sprockets to guide the chains along a fixed path during movement thereof. The roller link of each of the chains rides within the guide channel 69 formed by connected opposed members 68 and 70, while the tab members 32 extend inwardly of the chains and guide channel to support the cartons 18.

A frame member 72 extends across and connects the top of the channel members 34 of track assemblies 12 and 14. The top of each of the rear channel members 36 is connected to its respective horizontal angle bar 73 extending between the respective sidewalls 42 and 43 and vertical beams 74.

As shown in FIG. 1, the channels 34 and 36 of track assembly 14 are adjustably mounted on frame members 39, 41, 72 and 73 by suitable bolt assemblies 76 which ride in slots 78 in the frame members. This provides movement of track 14 toward and away from track 12 so that cartons of varying widths may be carried by the cooperating tab members 32 of the opposing track assemblies. A plurality of tie rods 80 extend between the track assemblies and connect the respective support members 34 and 36 to maintain the track assemblies in a fixed spaced parallel relationship after they have been properly positioned as desired.

As shown in FIGS. 1, 2, and 5, a pair of inwardly adjustable guide bars 82 and 84 are mounted on frame members 39 and 72 at the loading station 20 to permit their adjustment according to the size of carton 18 being conveyed. A loading shelf 85, the center portion 86 of which extends inwardly and terminates in a vertical flange 86*a* enables an operator to readily load a group of cartons 18 on the respective cooperating tab members 32. During a loading operation, the top of the shelf is substantially horizontally aligned with the respective cooperating tabs, and guides 82, 84 and shelf flange 86*a* properly orient and align the cartons on the tabs as the cartons move downwardly.

The chain sprocket shafts 48 of track assemblies 12 and 14 are rotated in opposite directions through bevel gear assemblies 87 driven by gear shaft 88. A reversible motor "M" drives shaft 88 through a suitable electrically operated clutch mechanism 89. Shaft 88 is supported within bearings 88*a*, which, along with motor "M" and clutch device 89, is mounted above floor 16 by a suitable support assembly 89*a*.

The clutch device 89 is of a conventional clutch-brake type which, in a clutch engagement position, couples the motor shaft to gear shaft 88 and, in a brake position, applies a braking and stopping force to shaft 88 while at the same time permitting the motor shaft to continue to rotate.

U-shaped carton lowerer plates 90 and 92 are positioned at the bottom of track assemblies 12 and 14, respectively, to receive a group of cartons from the tabs 32 as the chains are cycled to move downwardly. As shown in FIGS. 2 and 3, the plates 90 and 92 are located between the chains so as not to interfere with movement thereof and to receive the cartons from the tabs 32 as they begin to move around the lower sprockets 54 and 56. The plate 90 is suitably secured to the end of a piston rod 94 of a tandem air-hydraulic cylinder 96 pivotally connected at 98 to a support bracket assembly 100 mounted on channel supports 34 and 36. As best shown in FIG. 6, the bottom collar 102 of cylinder 96 has connected thereto a clevis plate 104 which pivotally receives at 105 the end of a piston rod 106 of a small air cylinder 108 pivotally mounted within trunnion 112 on bracket shelf 110 which extends between channels 34 and 36.

A vertically extensible guide rod 113 is connected between plate 90 and an intermediate cylinder collar 113*a* to promote straight vertical movement of the plate and prevent rotation of the plate and piston rod.

Lower plate 92 is similarly connected to piston rod 114 of tandem air-hydraulic cylinder 116 pivotally mounted at 118 on bracket assembly 120. Connected to the lower cylinder collar 122 is a clevis plate 124 which pivotally receives piston rod 126 of a small air cylinder 128 pivotally mounted on bracket 130 within trunnion supports 132. A guide rod 113 is also provided between plate 92 and cylinder 116.

The magazine 22 is supported on the lower floor 17 beneath the track assemblies 12 and 14 and vertically aligned therewith to receive the cartons from the lowering plates 90 and 92. The magazine includes end bars 136 and 136*a* which may be adjustable toward and away from each other to conform to various sized cartons 18 deposited therein. As shown in FIGS. 2 and 3, the bars 136 and 136*a* are centrally aligned with the U-shaped plates 90 and 92 to permit the plates to be lowered a desired predetermined distance within the magazine without interference from the end bars and thus deposit the cartons therein. The magazine also includes rear bars 137 and

an angled front bar **137***a*. All the bars are connected to a base receptacle **138** having a bottom slot **139** through which the bottom carton of stack **23** is automatically removed and delivered to a case forming magazine by any suitable mechanism.

Operation of the carton lowering machine is under the control of various switch assemblies which cooperate to cycle the chain track assemblies **12** and **14** and reciprocable plates **90** and **92** to supply cartons to stack **23** of magazine **22** upon demand. As shown in FIGS. **1**, **3**, and **7**, photoelectric cell assembly **140** including a light emitter **141** and receiver **142** is positioned adjacent the magazine **22** by bracket members **144** connected at their upper ends to channel supports **34**, the photocell sensing the height of the stack **23** within the magazine **22** to initiate cycling movement of the reciprocating plates **90**, **92** and the chain track assemblies **12** and **14**.

Mounted on the bottom of lowering plates **90**, **92** are bar operated limit switches **146** and **148**, respectively, which upon actuation of tandem cylinders **96** and **116** and subsequent lowering of plates **90** and **92**, contact the top carton of stack **23** to perform a switching action which energizes small air cylinders **108** and **128** to pivot the plates **90** and **92** and tandem cylinders **96** and **116** outwardly about their respective pivot connections **98** and **118**, and thereby release the cartons from the plates and deposit them on the stack **23**.

Another bar operated limit switch **150** (FIGS. **2** and **7**), supported by bracket **152** from shelf **110**, is actuated by plate **90** as it moves toward and away from its uppermost rest position.

A second photocell assembly **154** (FIGS. **2** and **7**) having a photolight **155** mounted on shelf **130** and an aligned receiver **156** mounted on shelf **110** indicates whether or not a group of cartons is present on plates **90** and **92** when they are in their uppermost rest position. Photocell **154** cooperates with another bar operated limit switch **158** (FIGS. **1** and **2**) mounted on sidewall **42** to be actuated by the tab members **32** on the outer flight of chain **24** as the chain flight moves upwardly to insure that the chain track assemblies **12** and **14** are properly positioned during each cycling step.

The operation of the carton lowering machine **10** and the function of the various switches and sensing devices mentioned above will become more apparent from a description of a typical carton lowering operation with particular reference to the electrical schematic diagram of FIG. **8**.

Initially, when the machine **10** is empty and the track assemblies **12** and **14** and reciprocating plates **90** and **92** are in their rest positions of FIG. **1**, the various contacts are positioned as shown in FIG. **8** by appropriately setting the switches mounted on switch box **159** at the loading station **20**. With no cartons **18** on plates **90**, **92**, photocell **154** will be conducting light to maintain contacts PE-154 open and relay CR**6** deenergized, with relay controlled contacts CR**6**-1 and CR**6**-2 positioned as shown. Lock stop switch "X" and main switch "A" are closed, switch "B" is in its carton "lower" position, and switch "C" is in the "load" position. Contacts LS158-1 will be open since a tab **32** engages the limit switch **158** in the rest position. Assuming no cartons are in magazine **22**, photocell **140** will be conducting light to maintain contacts PE-**140** closed to energize relay CR**1** when switch CR**6**-1 has been closed indicating that there are cartons resting on plates **90** and **92**.

With the apparatus positioned as shown in FIG. **1** with main switch "A" closed, current passes through forward starter coil W, of motor "M" to continuously rotate the motor at a slow speed so that when the clutch **89** is engaged, the inner flights of chains **24**, **26**, **28**, and **30** will move downwardly to lower the cartons supported on tabs **32**. Time relay TR**1** is also energized to instantaneously close contacts TR**1**-**1** and open contacts TR**1**-2. Contacts TR**1**-2 are time-delay-to-close contacts and, after deenergization of relay TR**1**, require a period of time to close, thus preventing instantaneous reversal of motor "M" should the position of switch "B" be quickly changed.

An operator then loads the machine by sliding a first group of flattened cartons, e.g., forty in number, over the top of the shelf center portion **86** onto opposed aligned cooperating tabs **32** positioned approximately as shown in FIGS. **1** and **5**. Cycle button "D" is then depressed to pass current from conductor "L," through contacts LS**150**-**1**; CR**6**-**2**; switches "C" and "D"; time-delay-to-open contacts TR**4**-**1** controlled by time relay TR**4**; and contacts TR**1**-**1**, which have already been closed as above described, to energize relay CR**5** and close contacts CR**5**-**1**. Closure of contacts CR**5**-**1** causes the clutch engaging coil **89***a* to become energized to establish a drive connection between the motor shaft and gear shaft **88** and thereby suitably drive chains **24**, **26**, **28**, **30** so that their inner flights move downwardly to lower the cartons between the track assemblies. Movement of the chains also causes the tab **32** engaging limit switch **158** to be released therefrom which results in closure of contacts LS**158**-**1** to establish a holding circuit for relay CR**5** through contacts LS**158**-**1**, CR**5**-**1**, and TR**1**-**1** independent of cycle button "D," which is then released.

The chains will continue moving until the next tab **32** on the upward flight of chain **26** engages limit switch **158** to open contacts LS**158**-**1** and deenergize relay CR**5**, thereby deenergizing clutch coil **89***a* and energizing brake coil **89***b* to apply a braking force to shaft **88**, thereby stopping movement of the chains while still permitting rotation of the shaft of motor "M." . The operator then places another group of forty cartons upon the next aligned cooperating set of tabs **32** and repeats the described cycling operation until the machine is fully loaded.

In the embodiment of FIG. **1**, the machine will be fully loaded when the operator has placed nine groups of forty cartons on successive cooperating chain tabs and when the first group of cartons is resting on plates **90** and **92**. When this occurs, photocell **154** will become nonconductively dark to close contacts PE-**154**, which energizes relay CR**6** to close contacts CR**6**-**1** and open contacts CR**6**-2.

The machine is now fully loaded and is placed under automatic control by moving switch "C" to its upper "automatic" position, whereby cartons are supplied to magazine **22** automatically upon demand in response to the height of the stack **23** in the magazine as sensed by photocell **140**.

Initially, with an empty magazine, or whenever the stack **23** drops below a predetermined level established by the height at which photocell **140** is positioned, the cell becomes conductively light to close the contacts PE-**140** as shown in FIG. **8**. Since contacts CR**6**-**1** are closed because relay CR**6** has been energized as above described, relay CR**1** will be energized and contact CR**1**-**1** closed to establish a holding circuit for relay CR**1**, time relay TR**3**, and solenoid S-**1** which actuates tandem cylinders **96** and **116** to extend piston rods **94** and **114**, respectively, and thereby lower plates **90** and **92** and the cartons supported thereon.

Initial downward movement of plate **90** will result in the release of limit switch **150** to open contacts LS**150**-**1** and close contacts LS**150**-**2**. The plates will continue to move downwardly until the limit switches **146** and **148** engage the top carton of stack **23** to close the respective contacts LS**146**-**1** and LS**148**-**1**, thereby energizing relays CR**2** and CR**3** to close holding circuit contacts CR**2**-**1** and CR**3**-**1**. Also energized are solenoids S-**2** and S-**3** which actuate air cylinders **108** and **128**, respectively, to pull piston rods **106** and **126** and thereby pivot the cylinders **96** and **116** and plates **90** and **92** connected thereto outwardly about pivot support connections **98** and **118**. The group of cartons **18** are thereby released from plates **90** and **92** and gently deposited on stack **23**.

Energization of relays CR**2** and CR**3** also opens respective contacts CR**2**-**2** and CR**3**-**2** to deenergize relay CR**1** and solenoid S-**1** to deactivate cylinders **96** and **116**, thereby causing the cylinders and plates **90**, **92** to be raised toward their uppermost rest position of FIG. **1**.

It is to be noted that contacts CR**2**-**2** and CR**3**-**2** are placed in parallel to ensure that both plates **90** and **92** have been pivoted outwardly and the cartons fully released therefrom and deposited on the stack before solenoid S-**1** is deenergized to deactivate and raise cylinders **96** and **116**. If this precaution

were not taken, a condition may arise, e.g., if the top of the stack was slightly inclined to cause one of the limit switches **146, 148** to make contact therewith before the other, whereby the tandem cylinders may be prematurely deactivated to raise plates **90** and **92** before the cartons carried thereby have been fully released.

When tandem piston rods **94** and **114** are fully drawn up and plates **90** and **92** fully raised, plate **90** again engages and raises limit switch **150** to again close contacts LS150-1 and open contacts LS150-2, the latter causing solenoids S-2 and S-3 to be deenergized to deactivate air cylinders **108** and **128** and thereby move the plates inwardly to their rest position of FIG. **1**, wherein they may receive the next group of cartons from chain tabs **32** as the chains are cycled.

Closure of contacts LS150-1 causes the chains to be cycled to lower the next group of cartons and place them on the plates **90** and **92** in the same manner as occurred when the operator was initially fully loading the machine.

Specifically, after the plates have deposited a group of cartons on stack **23** and have been returned to their rest position, there are, of course, no cartons supported on the plates. Thus, photoelectric cell **154** will again be conducting light causing relay CR6 to be deenergized and contacts CR6-1 and CR6-2 to be opened and closed, respectively, as shown in FIG. **8**. Since switch "C" is in the upper automatic position, current will pass therethrough to energize relays TR4 and CR5 and close contacts CR5-1, thereby causing energization of clutch coil **89***a* to drive the chains and lower the cartons until the next group is placed on plates **90** and **92**. After this occurs, photocell contacts PE-154 will again close as photocell **154** becomes nonconductively dark, thus energizing relay CR6 to close contacts CR6-1 to place the machine once again under the control of the demand photocell **140**. Contacts CR6-2 will be opened and, when limit switch **158** has again been engaged by a tab **32** to open contacts LS158-1, the clutch coil **89***a* will be deenergized and brake coil **89***b* energized to stop the chains.

The machine will then remain in its rest position until the photocell **140**, again sensing a drop below the predetermined level of the stack, becomes light to repeat the carton lowering and cycling operation.

The time relay TR4 is provided to prevent the chains from being continuously driven through the clutch mechanism **89** when all the cartons have been lowered and deposited in the magazine and the machine is empty. After being energized for a period of time, time relay TR4 will open time-delay-to-open contacts TR4-1 to deenergize relay CR5, thereby opening contacts CR5-1 to deenergize clutch coil **89***a* and energize brake coil **89***b* to stop the chains. Relay TR4 will also close time-delay-to-close contacts TR4-2, thereby lighting a reload indicated light "R" located on switch box **159** to inform an operator of the empty condition of the machine.

The relay TR4 is set so that during the normal carton lowering operation the cycle time required to lower the next group of cartons onto the plates **90** and **92**, and thus effect opening of contacts CR6-2 and LS158-1, is less than the delay period for actuating contacts TR4-1 and TR4-2. Hence, the latter contacts will not be actuated unless the machine is empty under which condition photocell **154** remains light and contacts CR6-2 remain closed.

Time relay TR3, which after a predetermined period of time closes time-delay-to-close contacts TR3-1 and TR3-2 to energize relays CR2 and CR3 and solenoids S-2 and S-3 and thereby activate cylinders **108** and **128** is provided to ensure that cylinders **108** and **128** are activated should the rods of the tandem cylinders **96** and **116** in the extended position not be long enough to reach the top of stack **23** in which case limit switches **146** and **148** would not be closed as they are during normal operation.

It has been found advantageous to provide the chain track assemblies with a reversible drive system including a reverse starter coil W2 which is effective to suitably drive the chains to raise, rather than lower, the cartons supported between the chain tracks on cooperating tabs **32**. This is particularly useful during an automatic carton lowering operation described above when an operator may, during a free time period, desire to fully reload the track assemblies which have been partially unloaded. For example, when a single operator is responsible for maintaining several machines in operation, he may periodically wish to fully reload a partially unloaded machine and thereby save time and promote optimum efficiency.

To raise the cartons remaining on the partially unloaded chain tracks, the operator need only to place switch "B" in its "raise" position when there is no demand for cartons from magazine **22** or when there are no cartons on plates **90, 92**. This disconnects forward starter coil W1, stopping motor "M," and also deenergizes time relay TR1 which effects closure of time-delay-to-close contacts TR1-2. Motor "M" is then driven in a reverse direction through reverse starter coil W2 at a speed about twice the forward speed, thus raising the cartons approximately twice as fast as the speed at which they may be lowered.

Time relay TR2 is energized to instantaneously open contacts TR2-2, the closing of which after deenergization of relay TR2 is delayed to prevent any instantaneous reversal in the direction of rotation of motor "M" due to a sudden repositioning of switch "B."

When there is no demand for additional cartons from magazine **22**, photocell **140** will be light and contacts PE-140 will be open to maintain relay CR1 deenergized and contacts CR1-2 closed as shown. Current then passes through conductor **170** and contacts TR2-1, which are instantaneously closed by energization of relay TR2, to energize relay CR5 which closes contacts CR5-1, thereby energizing coil **89***a* to engage clutch **89** to drive the chains and move cartons upwardly. This movement continues until the uppermost group of cartons contact a limit switch **160** (FIGS. **1** and **2**) mounted at the top of guide bar **84** to open contacts LS160-1 and thereby stop motor "M," disengage the clutch, and apply the brake.

The drive may also be reversed to raise cartons immediately after plates **90, 92** have deposited a group of cartons on stack **22** and have been returned to their rest position. At this time, photocell **154** will be light and contacts PE-154 open, thereby maintaining relay CR6 deenergized and contacts CR6-1 open. Consequently, relay CR1 is deenergized and contacts CR1-2 closed to pass current through conductor **170** when switch "B" is moved to its "raise" position as above described.

Following a reverse carton raising operation, the operator then merely places switch "B" in the "lower" position and fully reloads the machine as hereinabove described.

Of course, the operator may, if desired, completely unload the machine **10** by raising the cartons and simply removing each group of cartons immediately after limit switch **160** has been actuated and the machine stopped.

While the invention has been illustrated with respect to the specific embodiment and structure of FIGS. **1—8**, it is to be understood that it is not limited thereto and that any suitable equivalent structure capable of functioning as required may be substituted therefor. For example, the track sprocket shafts **48** may be rotated by a chain or belt drive assembly and photocells **140** and **154** may be replaced by equivalent electrical sensing devices, such as conventional limit switches.

Furthermore, instead of using the photocell **140** or a limit switch to sense the presence of cartons within magazine **22**, any suitable indicating system, such as a weight responsive device, which will indicate the number of cartons in the magazine may be used.

Thus, it is apparent that the invention provides a very compact and reliable sheet lowering machine upon which a large number of sheets may be initially loaded and stored and subsequently automatically deposited into a supply magazine upon demand. The machine is effective in decreasing labor costs by substantially reducing the amount of manual handling of the sheets by the operators, thereby reducing the number of operators required and enabling a single operator to supervise a group of machines.

The invention also promotes efficiency and reduces plant overhead by eliminating the need for special elevators, or at least making them available for other purposes, and by more effectively utilizing floor space. In this regard, the machine is completely supported from an upper floor. It does not require any support structure on the lower floor which might interfere with operation of the manufacturing equipment located thereon. An operator is relatively free to move around the supply magazine and has ready access to the associated processing equipment without being unduly obstructed by the carton lowering machine.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What I claim and desire to be secured by Letters Patent is:

1. Apparatus for handling sheetlike material comprising vertically movable endless conveyor means having spaced members therealong for carrying a plurality of sheets, material support means adjacent the lower end of said conveyor means, said material support means serving as a sheet supply source from which sheets are removed as needed for usage, reciprocative transfer means adjacent said lower end and said support means, said transfer means being reciprocative between an upper position in which it receives said sheets from said conveyor members and a lower position in which it places said sheets on said support means, and control means including means responsive to an inadequate supply of sheets on said support means for automatically cycling said transfer and conveyor means to automatically supply sheets to said support means and thereby provide an adequate supply of sheets thereon.

2. Apparatus as in claim 1, said endless conveyor means including opposed chain track assemblies each having vertically spaced tab members therealong cooperating with substantially aligned opposed tab members of the other track assembly, said cooperating tabs adapted to carry at least one sheet therebetween, at least one of said track assemblies being movable toward and away from the other to permit the handling of various sized sheets.

3. Apparatus as in claim 1, wherein said sheets are stacked on said support means, and said responsive means responds to the height of said stack to cycle said transfer and conveyor means.

4. Apparatus as in claim 3, said responsive means being a photoelectric cell.

5. Apparatus as in claim 1, said transfer means comprising vertically reciprocating plate elements positioned to receive said sheets from said conveyor members as said conveyor means is moved downwardly, and actuator means for lowering said plate elements to deposit sheets on said support means.

6. Apparatus as in claim 5, said plate elements being pivotally mounted, and operative means for pivoting said plate elements outwardly when they have been lowered to deposit said sheets on said support means.

7. Apparatus for handling sheetlike material comprising vertically movable endless conveyor means having spaced members therealong for carrying a plurality of sheets, material support means adjacent one end of said conveyor means, transfer means adjacent said one end and said support means for receiving said sheets from said conveyor means and placing them on said support means, said transfer means comprising vertically reciprocable, outwardly pivotable plate elements positioned to receive said sheets from said conveyor members as said conveyor means is moved downwardly, actuator means for lowering said plate elements to deposit sheets on said support means, operative means for pivoting said plate elements outwardly when they have been lowered to deposit said sheets on said support means, and control means including first means responsive to an inadequate supply of sheets on said support means to energize said actuator means and then to lower said plate elements, second means mounted on said plate elements and actuatable when said plate elements reach a lowered position to actuate said operative means to thereby pivot said plate elements outwardly, depositing a sheet on said support means, and deenergize said actuator means to move said elements upwardly, third means responsive to the upward movement of said plate elements to deactivate said operative means and move said plate elements inwardly and to drive said conveyor means to place at least the next sheet from said conveyor spaced members on said plate elements, and fourth means operative when said next sheet has been placed on said plate elements to stop movement of said conveyor means.

8. Apparatus as in claim 7, wherein said sheets are stacked in said support means, and said second means comprises switch means actuated by contacting the top one of said stacked sheets to pivot said elements outwardly and deposit additional sheets on said stack.

9. Apparatus as in claim 7, said first and fourth means comprising photoelectric cells responsive respectively to the presence of sheets on said support means and said plate elements.

10. Apparatus for supplying flattened articles to a supply magazine from which articles are periodically withdrawn as needed comprising a pair of opposed vertically movable endless conveyor tracks mounted above said supply magazine, each track having laterally spaced endless chains with a plurality of vertically spaced lug members therealong cooperating with substantially aligned lug members of the other track to support a group of flattened articles therebetween, said conveyor tracks when fully loaded having a plurality of groups of articles supported therebetween on said cooperating lug members in substantial vertical alignment with said supply magazine, reciprocative transfer means located adjacent the bottom of said conveyor tracks and above said supply magazine, said transfer means being reciprocative between an upper position in which it receives a group of articles from said lug members and a lower position in which it deposits the group of articles in said magazine, and control means including means responsive to an inadequate supply of flattened articles in said magazine for automatically cycling said transfer means and said conveyor tracks to automatically supply a group of articles to said magazine on demand, thereby providing an adequate supply therein.

11. Apparatus as in claim 10, said transfer means comprising fluid-operated cylinder means mounted adjacent the bottom of each of said conveyor tracks, each said cylinder means having a vertically reciprocable piston rod mounting on its lower end a plate element positioned to receive said groups of articles from said lug members, said cylinder means being pivotally mounted to swing outwardly from said tracks and magazine, operating means for pivoting said cylinder means outwardly, said responsive means initiating actuation of said cylinder means to lower a group of articles into said magazine and of said operative means to pivot said cylinder means outwardly and thereby release and deposit said group of articles into said magazine.

12. Apparatus as in claim 10, reversible drive means for driving said conveyor tracks in a normal article-lowering direction or in an article-raising direction.