June 7, 1966 E. D. NYSTRAND 3,254,889

STACKING AND HANDLING APPARATUS

Filed Dec. 14, 1962 7 Sheets-Sheet 1

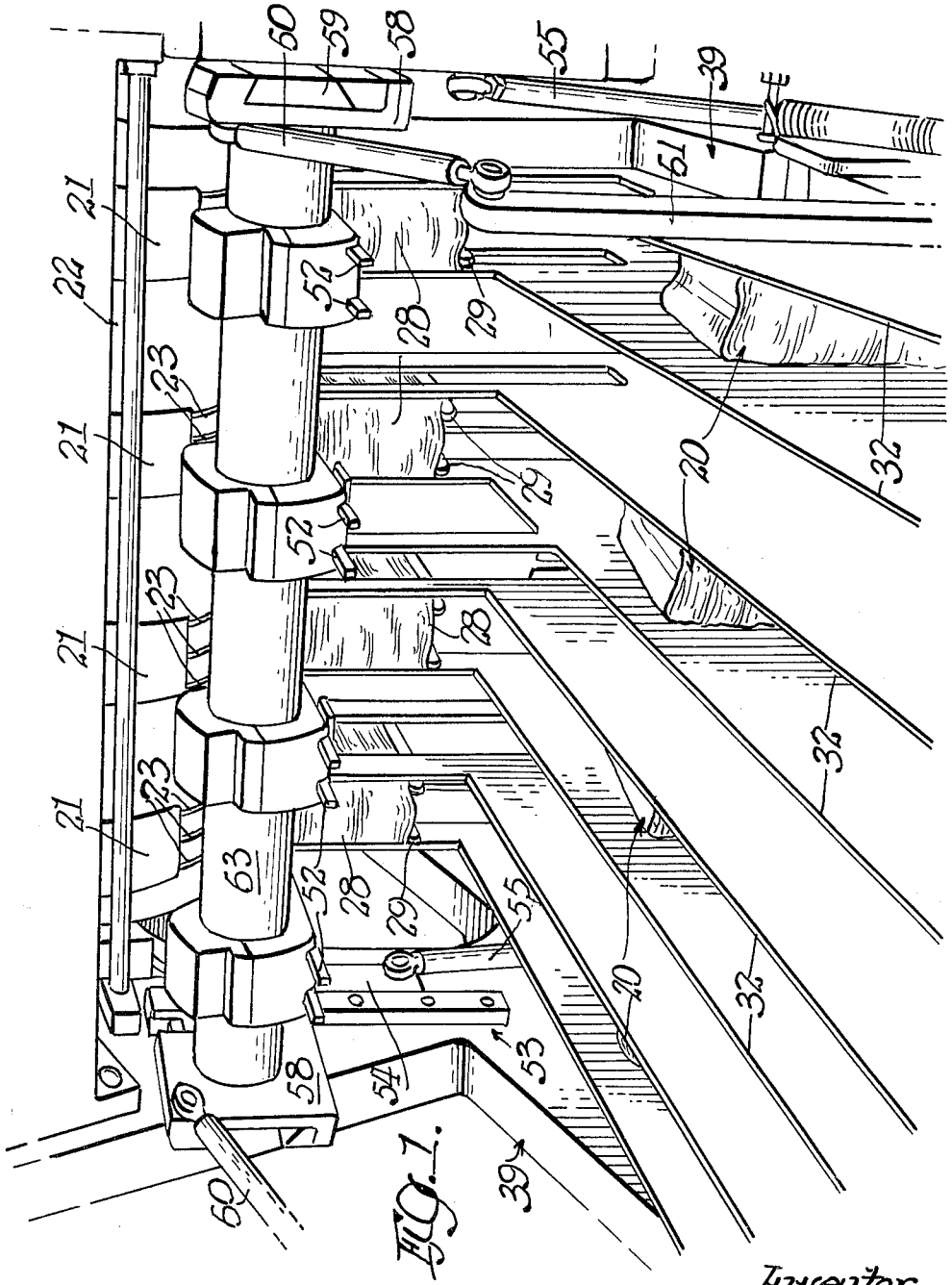


FIG. 1.

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STACKING AND HANDLING APPARATUS

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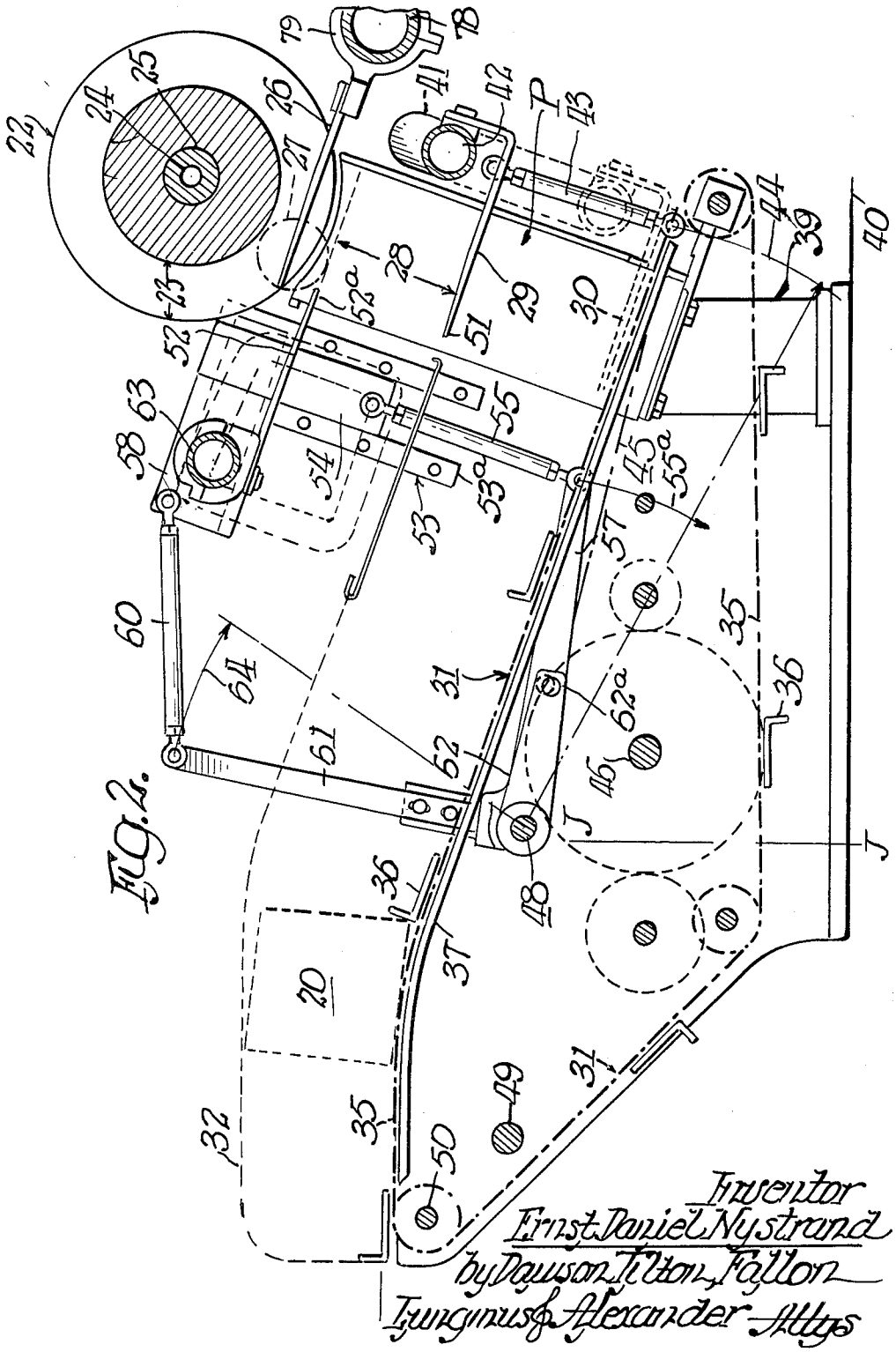


FIG. 2.

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STACKING AND HANDLING APPARATUS

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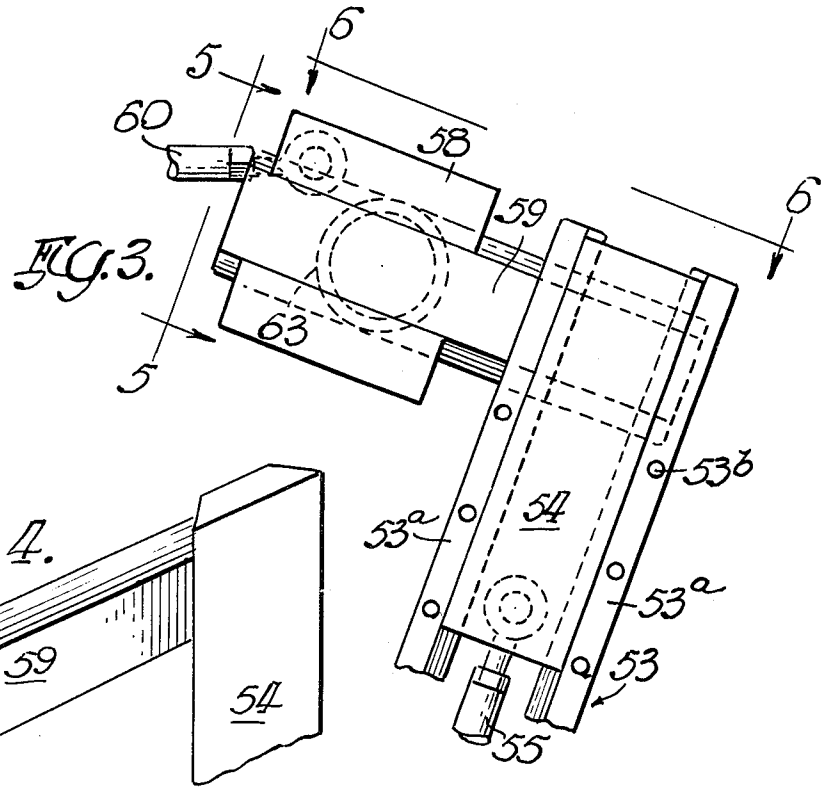


FIG. 3.

FIG. 4.

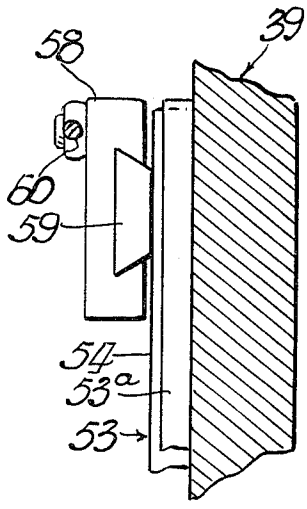


FIG. 5.

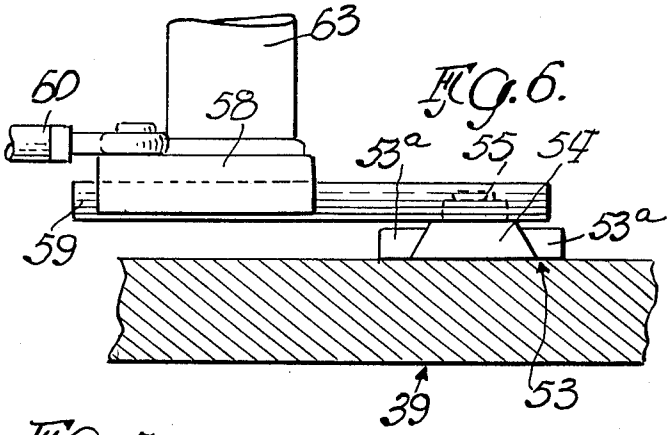


FIG. 6.

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STACKING AND HANDLING APPARATUS

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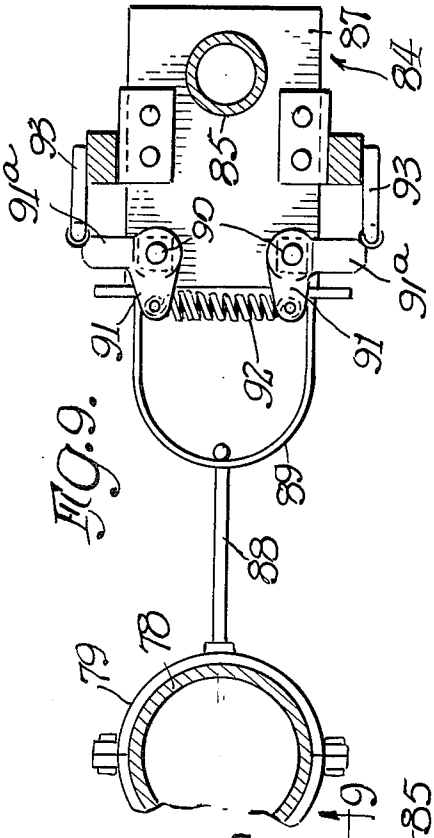


FIG. 9.

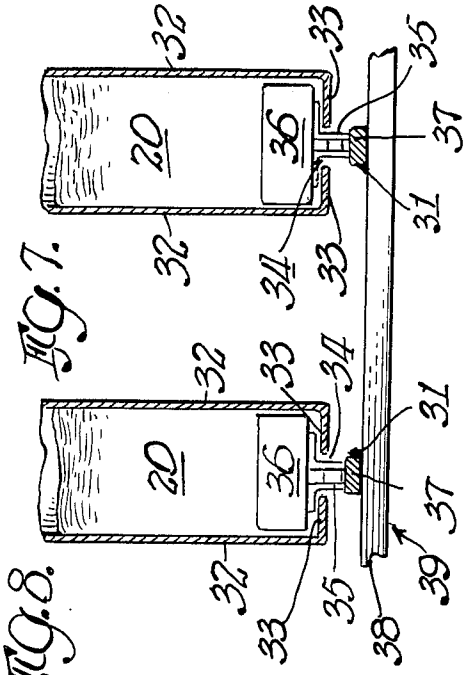
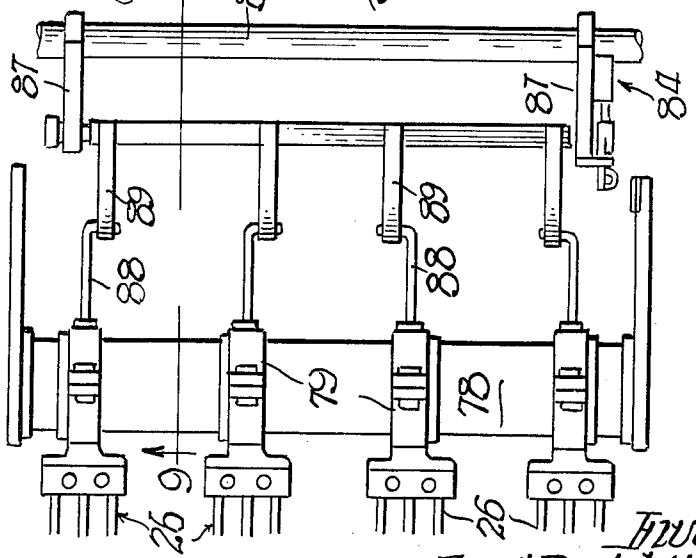


FIG. 7.

FIG. 8.



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STACKING AND HANDLING APPARATUS

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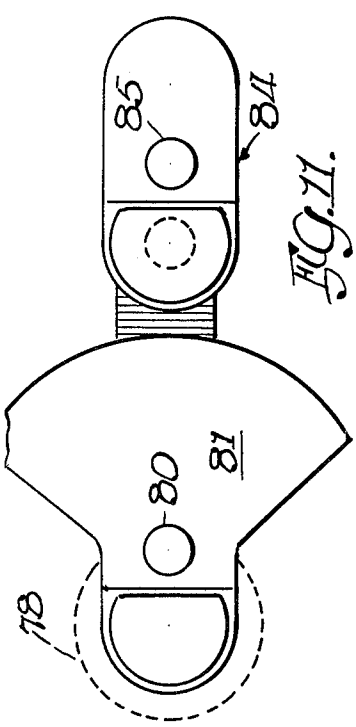


FIG. 11.

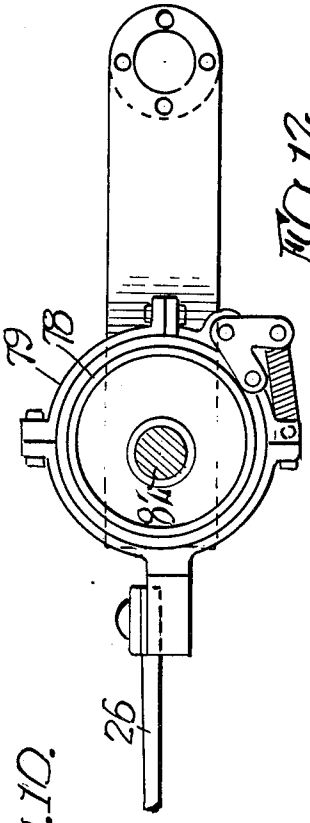


FIG. 12.

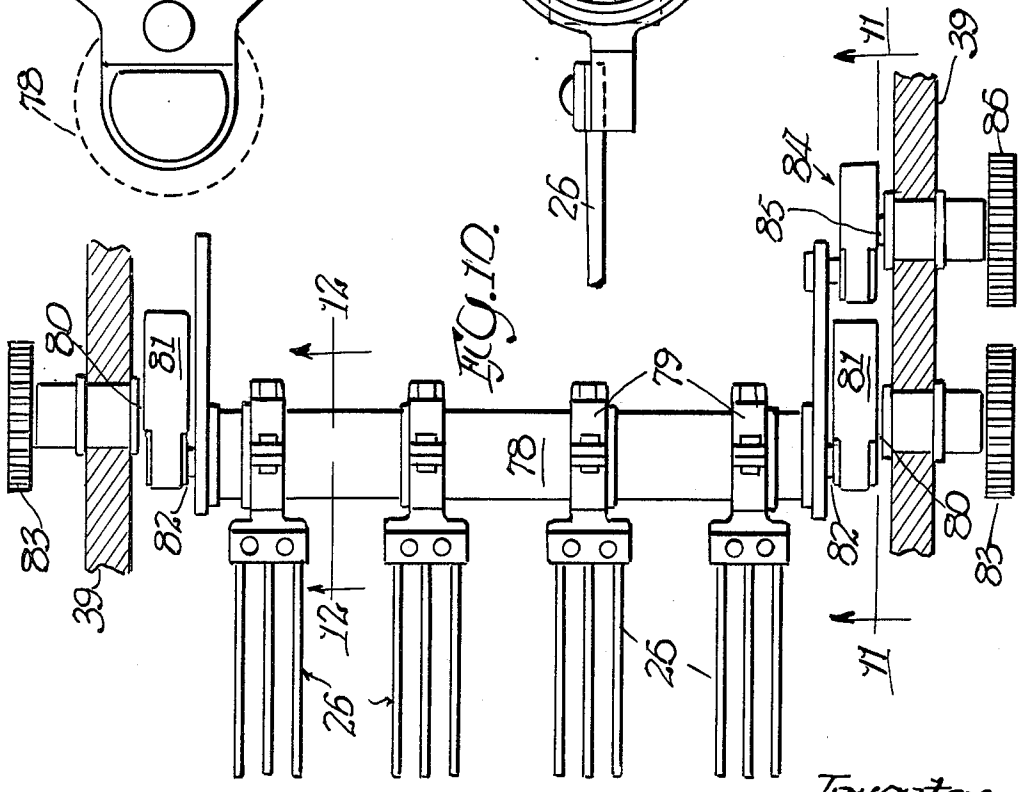


FIG. 10.

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STACKING AND HANDLING APPARATUS

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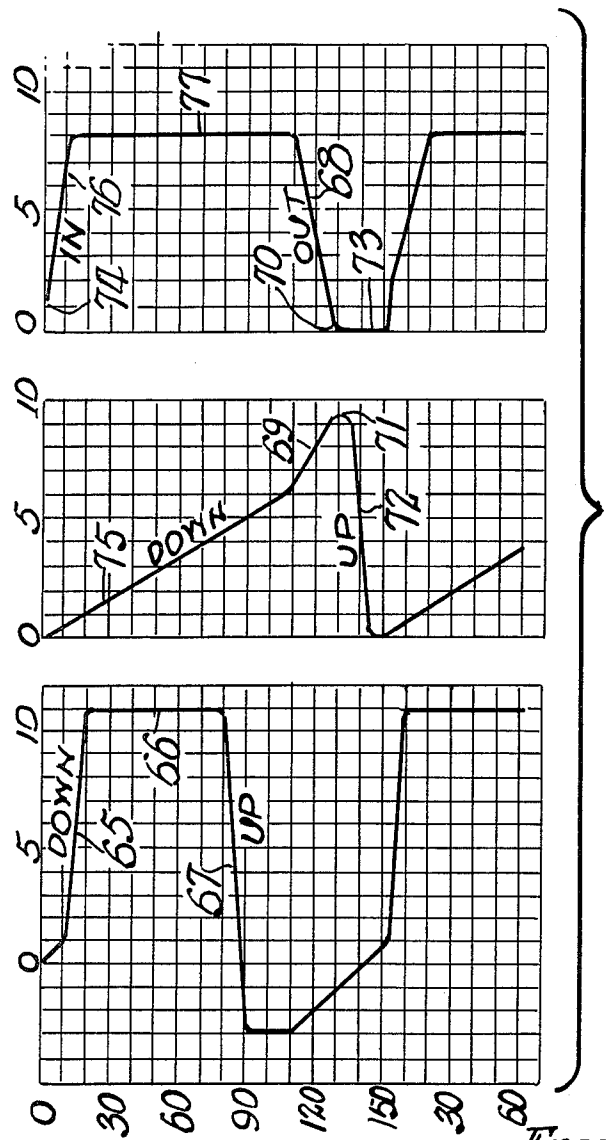


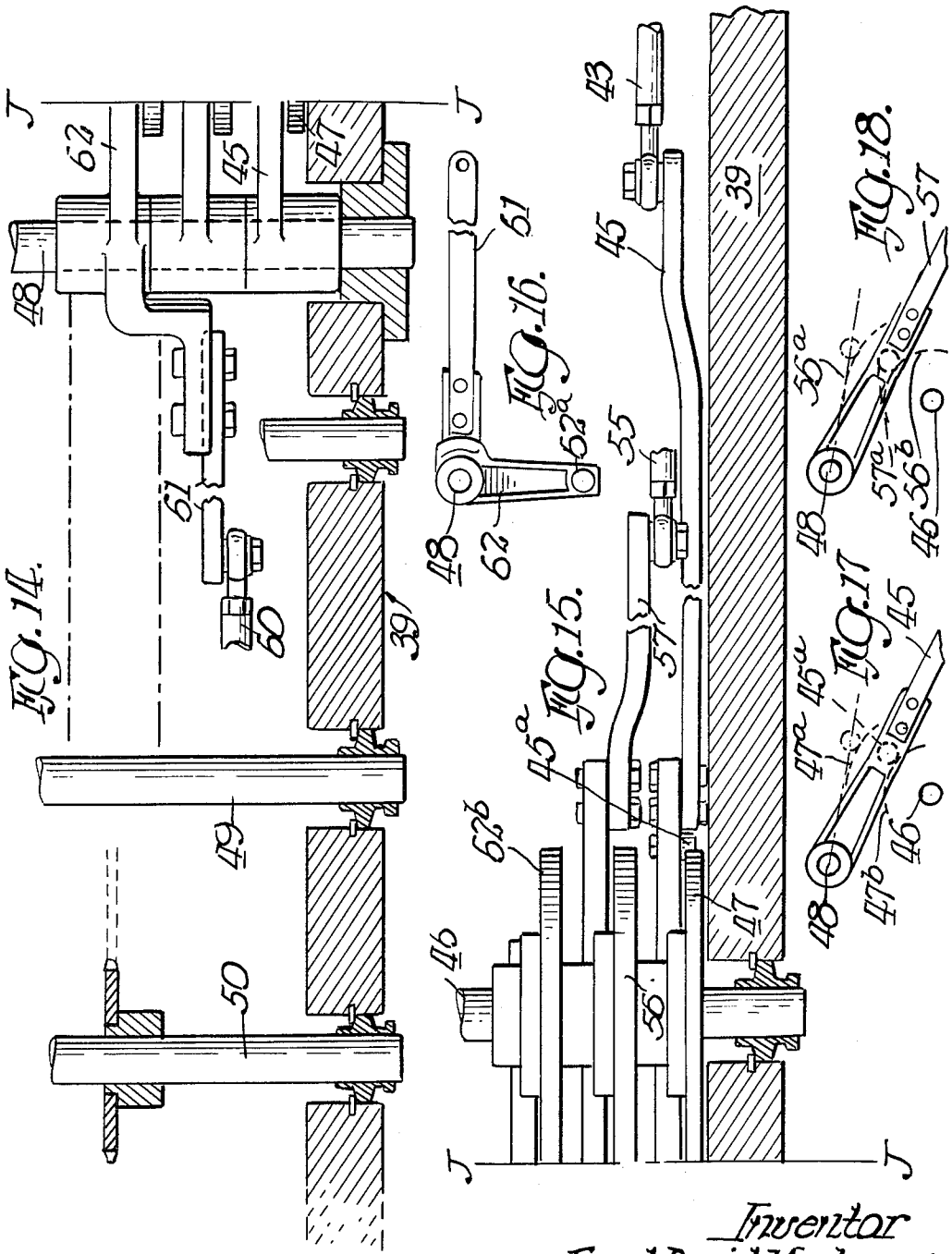
FIG. 13.

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STACKING AND HANDLING APPARATUS

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United States Patent Office 3,254,889 Patented June 7, 1966

3,254,889

STACKING AND HANDLING APPARATUS

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Filed Dec. 14, 1962, Ser. No. 244,815
8 Claims. (Cl. 271—69)

This invention relates to a stacking and handling apparatus and method, and, more particularly, to an apparatus and method useful in the handling of relatively flat objects, such as paper towels.

A specific application of the invention lies in the handling of C-folded paper towels which are usually provided in stacks of 150, with the stack maintained in this arrangement either by a band, box, or other securing means. However, there has been a problem in providing the towels in the form of stacks. Prior art equipment usually developed a flow of towels where the towels were stood on their ends, with a "marker" towel being elevated relative to the rest of the flow every 150 towels. This necessitated manual removal of the towels from the chute or carrier in which the towels were provided by the forming equipment, and repositioning the "marker" towel. This led to improperly arranged stacks of towels, improper count, and other operational deficiencies in addition to being time-consuming.

Through the instant invention, a way is provided which avoids these difficulties, and the provision of such apparatus and method constitutes an important object of the invention.

Another object of the invention is to provide an apparatus and method capable of stacking towels with their flat faces facing generally downwardly (as contrasted to the previous vertical orientation) and wherein exact counts are obtainable without the interposition of any manual labor.

Still another object of the invention is to provide stacking and handling apparatus and method wherein novel arrangements of stack-supporting means are operated in sequence to transfer objects issuing sequentially from a source into completed stacks ready for packaging, or the like.

Yet another object is to provide web handling equipment useful in converting a continuous web into discrete sheets, i.e., paper towels, and thereafter repositioning the sheets in stacked form.

Other objects and advantages of the invention may be seen in the details of construction and operation set down in this specification.

The invention will be explained in conjunction with an illustrative embodiment in the accompanying drawing, in which:

FIG. 1 is a fragmentary perspective view of apparatus embodying the inventive teaching and shown in the course of forming stacks of C-folded paper towels;

FIG. 2 is a fragmentary side elevational view of the apparatus seen in FIG. 1;

FIG. 3 is an enlarged fragmentary side elevational view of certain linkages employed in the operation of the apparatus seen in FIGS. 1 and 2;

FIG. 4 is a fragmentary perspective view of the linkage apparatus seen in FIG. 3;

FIG. 5 is a sectional view taken along the sight line 5—5 applied to FIG. 3;

FIG. 6 is a sectional view taken along the sight line 6—6 applied to FIG. 3;

FIG. 7 is an enlarged fragmentary cross-sectional view of the exit conveyor portion of FIGS. 1 and 2;

FIG. 8 is a fragmentary plan view of apparatus employed to deliver objects sequentially to the stacking apparatus seen in FIG. 1, the mechanism of FIG. 8 being partially seen in side elevation in the extreme upper right-hand corner of FIG. 2;

FIG. 9 is an enlarged sectional view taken along the line 9—9 of FIG. 8 and additionally showing certain safety features of the mechanism;

FIG. 10 is a plan elevational view of the mechanism seen in FIG. 8 but showing additional details of construction;

FIG. 11 is a a sectional view, taken along the line 11—11 applied to FIG. 10;

FIG. 12 is a sectional view taken along the line 12—12 applied to FIG. 10;

FIG. 13 is a graph showing the movement of the various stack-supporting fingers;

FIG. 14 is a fragmentary plan elevational view of the apparatus to the left of the junction line J—J of FIG. 2, while FIG. 15 is a similar view to the right; and

FIGS. 16–18 are fragmentary side elevational views of various cam follower arms seen in FIGS. 14 and 15.

In the illustration given and with particular reference to FIG. 1, the numeral **20** generally designates completed stacks of C-folded toweling which are being conveyed out of the stacking portion of the machine for the purpose of banding or other packaging.

The towel for the stacks **20** are provided sequentially as at **21** on the surface of a packer roll **22**—also seen in the extreme upper right-hand corner of FIG. 2. The roll **22** is equipped with circumferential grooves as at **23** (in the illustration given, three grooves **23** are seen provided for each towel **21**). The grooves **23** are connected to a source of vacuum (not shown) through a conduit **24** (see FIG. 2) provided in the journal **25** of the packer roll **22**. Thus, the individual towels **21** are caused to adhere to the surface of the roll **22** until removed by packer fingers **26** (see FIGS. 2, 8, 10 and 12).

The fingers **26** are moved in an orbital path designated **27** in the upper right-hand corner of FIG. 2 and operate to strip or remove the individual towels **21** from the surface of the roll **22** and position them at the top of a stacking path generally designated P in FIG. 2.

The result of this operation can be appreciated from FIG. 1, where just-completed stacks of towels are designated by the numeral **28**. The stacks **28** are also seen in FIG. 2, where each stack **28** is supported on a pair of first stack-supporting fingers **29**.

The fingers **29** are caused to reciprocate over a generally vertical path corresponding to the stacking path P with the lowest point of the reciprocation being designated by the numeral **30** in FIG. 2, wherein the finger is shown in dotted line. At this lower position **30**, the conveyor generally designated **31** removes the stack **28** from the fingers **29** and thereafter moves the completed stack **20** out of the stacking path.

In the illustration given, four stacks **20** are developed simultaneously, requiring the use of four sets of stack-supporting fingers **29** and, therefore, four conveyors **31**. Each conveyor **31** takes the form of the showing in FIG. 7, where a fragmentary cross section of the FIG. 2 apparatus is seen, illustrating two of the conveyors **31**. The stacks **20** are seen to be confined between side sheets **32** (also clearly visible as troughs in FIG. 1). The side sheets **32** have inwardly-extending flanges **33** at the lower ends thereof, with the flanges **33** providing a slot **34** in which a chain **35** moves. The chain **35** is equipped with flights **36** (see especially FIG. 2) which act as pushers for the stacks **20**. Additionally, the chain **35** rides on a chain rail **37** mounted on a portion **38** of the frame of the machine which is generally designated **39** in both FIGS. 2 and 7. The frame **39** is seen to be mounted on a floor or other surface **40**, with the inclination of the conveyor **31** being about 15°. The generally vertical

stacking path P is at right angles to the path of conveyor travel, and thus is at about 15° to the vertical.

To provide the reciprocation for the first stack-supporting fingers **29**, the frame **39** is equipped with an elongated slot **41** (see the right-hand portion of FIG. 2), which serves as a guide for a cross head **42**. The cross head **42**, by means of a block (not shown), is connected to a cam arm **43**, the cam arm **43** being moved over an arc designated **44** through a suitable connection with a cam follower arm **45** equipped with a cam follower **45***a* (see FIG. 17) operating against the periphery of a cam **47** mounted on the cam shaft **46**. The cam follower arm **45** is mounted on a pivot shaft **48** (see FIG. 14). In FIG. 17, the high and low surfaces of the cam **47** are seen, designated **47***a* and **47***b*.

Thus, the first stack-supporting fingers **29** move through a generally vertical path, with the lowest point of movement being in general horizontal alignment with the conveyor **31**, so that as the conveyor **31** is advanced, the stack **28** becomes the stack **20** after being transferred from the fingers **29** to the conveyor **31**. Facilitating this transfer is the tapered ends **51** provided on the fingers **29**. For the purpose of coordinating the movements of the various portions of the machine and apparatus, a main indexing shaft **49** (FIGS. 2 and 14) is provided that is operative to step the conveyor drive shaft **50** in synchronism with the cam shaft **46**. Thus, each cycle of reciprocation of the first stack-supporting fingers **29** is accompanied by a step of the conveyor **31**.

As indicated previously, the showing in FIG. 2 corresponds to the point in apparatus operation where a stack has just been completed, and at this instant a second set of stack-supporting fingers generally designated **52** comes into operation. These are also seen in FIG. 1 and serve two purposes. First, their initial introduction into the stacking path P serves to separate one stack from another, eliminating the need for marker towels, and the second purpose is to support the new stack just commenced while the previously-developed stack is being moved downwardly on the fingers **29** for transfer to the conveyor **31**.

For this purpose, the second fingers **52** are caused to move through an orbital path wherein the generally vertically downward portion of the orbit is the part of the orbit wherein the fingers **52** are in the stacking path. The second fingers **52** are used for stack support primarily during the portion of a stacking cycle that the first fingers **29** are in movement. This movement is to move the stack **28** downwardly for transfer to the conveyor **31** and then return to stack-supporting position, as seen in solid line in FIG. 2.

For the purpose of developing this orbital movement of the second fingers **52**, a pair of cross head mechanisms is employed which can be seen on the third sheet of drawings (FIGS. 3–6). In FIG. 6, for example, the main frame of the machine is generally designated **39**, and this is seen to be equipped with a generally vertically oriented guide **53** made up of wedge-shaped members **53***a*. The guide **53** is also seen in FIGS. 3–5. Sliding in the guide **53** is a cross head **54** which is seen to be generally trapezoidal in cross section. The cross head **54** is seen connected to a cam arm **55** which is also seen in FIG. 2. The guide **53** may be equipped with bolt holes as at **53***b* (seen only in FIG. 3) for securement to the side frame **39**.

The cam arm **55** is moved over an arc designated **55***a* (again see the bottom portion of FIG. 2) through a suitable cam follower arm **57** (see FIG. 18) which is pivotally mounted on the cam follower arm pivot shaft **48** and equipped with a cam follower **57***a*. For moving the cam follower **57***a*, a second cam **56** is provided on the cam shaft **46**, the high and low surfaces of the cam **56** being designated **56***a* and **56***b* in FIG. 18.

To convert the reciprocating movement of the fingers **52** which is provided by the operation of the cam arm **55**, a second cross head **58** is provided (see FIGS. 2 and 3). The cross head **58** is seen to be slidably mounted on a guide **59** which is fixed to the cross head **53** (see especially FIG. 4). The movement of the cross head **58** is provided by a cam arm **60** (see FIGS. 2 and 3–5) which is connected to a cam follower arm **61** (see FIG. 16) pivotally mounted on the pivot shaft **48** (see FIG. 2). An angular extension **62** of the cam follower arm **61** (see FIGS. 2 and 16) is equipped with a cam follower **62***a* following a cam **62***b* mounted on the cam shaft **46**. Thus, the cam arm **55** develops, in effect, a vertical reciprocation of the finger cross shaft **63** (see FIGS. 2, 3 and 6), while the cam arm **60**, in moving over the path designated **64** in FIG. 2, converts this vertical reciprocation into an orbital movement by providing a horizontal component of movement.

Operation

The precise movements of the first and second fingers **29** and **52**, respectively, have been plotted on FIG. 13. Reference to that figure shows that the first fingers **29**, i.e., those that merely reciprocate, are moving down at the beginning of a new stepping cycle. At such time, the fingers **29** are carrying a completed stack and move down relatively quickly, as can be appreciated from the portion designated **65** in FIG. 13. The completion of the downward movement of the cycle of the first fingers **29** is completed prior to the time 20 of the 150 count have been stacked. Thereafter, the first fingers **29** remain in their lowermost position until about half of the stacking cycle is completed, this position being designated **66** on the graph seen in FIG. 13. During this time, the conveyor **31** removes the completed stack **28** from the fingers **29** and advances to remove the stack from the stacking path P. Thereafter, when about one-half of the stacking cycle is completed, the first fingers **29** move upward rapidly, as indicated by the portion of the graph marked **67** so as to be ready to take over the next stack. This take-over occurs when about four-fifths of the next stack is completed, as can be appreciated from the fact that the second fingers **52** move outward rapidly as at **68**. However, at this time it will be seen that the second fingers are also moving downwardly as at **69**, so that there is a smooth transfer when about 120 of the 150 count is achieved. Once the fingers **52** have been moved completely outward as at **70**, there is only a slight further downward movement as at **71**, whereupon the fingers **52** move upward rapidly, as is designated by the numeral **72**. During this portion of the cycle, the fingers **52** are completely out, as can be appreciated from the portion designated **73**.

When the 150 count is achieved, the fingers **52** move inward very rapidly, as can be appreciated from the portion designated **74** in FIG. 13. Meanwhile, however, the fingers **52** are moved downward gradually, as can be appreciated from the portion designated **75**. The inward movement of the upper or second fingers **52** is achieved rather rapidly, within 10% of the stacking cycle, as can be appreciated from the portion **76**, after which the fingers **52** remain in for the major portion of the stacking cycle—see the portion **77** of FIG. 13.

As with the fingers **29**, the fingers **52** are tapered at their forward ends as at **52***a* (see FIG. 2). The fingers **29** need not be tapered if they descend below the part of the conveyor which receives the stack for removal from the stacking path.

From the foregoing, it will be seen that the second fingers **52** perform an important function at the point of entering the stacking path. As the fingers **26** associated with the packer roll **22** deposit an object such as a paper towel on the partially completed stack, the tips of the fingers **52** follow closely above the object being deposited. This is a rather rapid inward and downward movement, so that the fingers **52** on the very next stroke of the packer fingers **26** are entirely below the packer fingers **26**. Each packer stroke thereafter finds the fingers **52** farther into the stack and lower by an amount approximately equal

to the thickness of the object being packed, thereby positioning the uppermost object in the stack at about the same horizontal level. When the fingers **52** have penetrated to the far end of the stack, the forward movement stops, but the downward movement continues until the fingers **29** have come up to take over support of the stack. The fingers **52** are then withdrawn out of the stack and elevated, to be ready for the next forward thrust toward the stack at the right count. During this cycle, when the fingers **52** have penetrated to the far end of the stack, is the moment when the fingers **29** rapidly descend with a complete stack that is then stripped off by means of one of the pushers on the conveyor.

As soon as the stack is stripped off, fingers **29** ascend to the bottom of the next stack being formed, whereupon they slowly travel downward at a rate approximately equal to the thickness of the object being packed for each packer finger stroke.

Delivery apparatus

The portion of the apparatus having to do with delivery of individual towels **21** will now be described. For this purpose, reference will be first made to FIG. 2, where the stripping fingers **26**, in going through the orbit designated **27**, not only strip the individual towels **21** (see FIG. 1) from the packer roll **22**, but additionally press the towels **21** into the stack which ultimately becomes the stack **28**. As mentioned previously, these fingers **26** operate within grooves **23** in the roll **22**, which grooves are under vacuum to cause the individual towels **21** to adhere to the roll surface.

For the purpose of orbiting the fingers **26**, a cross shaft **78** is provided (see FIGS. 2 and 8–12). As can be appreciated from FIG. 10, the cross shaft **78** is equipped with clamping brackets **79** which carry the stripping fingers **26** and the shaft **78** is equipped with an eccentric journal as at **80**. The journal **80** is carried by the frame **39**, with the journal **80** extending into a counterweight **81** and the counterweight **81** providing a stub shaft **82** which is the physical connection with the orbiting shaft **78** (see FIGS. 10–12). The journal **80** is driven through gears **83** from a suitable power source (not shown).

A safety feature is provided in the form of the mechanism generally designated **84** and which, as can be seen from FIG. 10, is equipped with a journal **85** driven through a gear **86**. The journal **85**, as seen in FIG. 9, carries a block **87** which is rotated in synchronism with the orbital shaft **78**. In FIG. 9, it will be seen that the shaft **78** carries a rearwardly-extending trip member **88** (see also FIG. 8). The trip member **88** is mounted to be in light contact with a trip hoop **89** which is pivotally mounted at the ends thereof as at **90**. For this purpose, the block **87** is equipped with L-shaped arms **91** interconnected by means of a spring **92**. The block **87** also carries microswitches **93** which are connected to the main power source driving the packer roll **22**. Thus, if for any reason the orbiting shaft **78** does not follow its predetermined course, the trip member **88** exerts a pressure against the trip hoop **89** to upset the microswitches, which are held normally closed by virtue of the anvil portions **91***a* of the L-shaped arms **91**. Thus, a signal is delivered to stop the machine.

While, in the foregoing specification, a detailed description of an embodiment of the invention has been set down for the purpose of explanation, many variations in the details herein given may be made by those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. In apparatus for the stacking and handling of paper towels, and the like, a frame equipped with means for delivering objects to be stacked over a generally vertically-disposed path, said frame being equipped with a conveyor and first and second stack-supporting means in said path, means on said frame for reciprocating said first stack-supporting means in said path with the lowest point of reciprocation being generally aligned with said conveyor whereby a stack is transferrable from said first stack-supporting means to said conveyor, and means on said frame for orbiting said second stack-supporting means so that the vertically downward portion of the orbit is in said path and so that said second stack-supporting means, when it is near the lowest point of said orbit portion, is below the first stack-supporting means whereby a partial stack is transferable from said second stack-supporting means to said first stack-supporting means.

2. The structure of claim **1** in which said first and second stack-supporting means each include a pair of spaced-apart fingers, the fingers in each pair being offset relative to each other whereby said second stack-supporting means fingers pass by said first stack-supporting means fingers in transferring a partial stack from said second stack-supporting means fingers to said first stack-supporting means fingers.

3. The structure of claim **1** in which said reciprocating means includes means for maintaining said first stack-supporting means at said lowest point for a majority of the time required to complete one stack.

4. The structure of claim **1** in which said reciprocating means includes a cross head slidably mounted in said frame, cam means connected to said cross head for reciprocating the same, means for actuating said cam means, said orbiting means including a pair of cross heads rectilinearly related and mounted on said frame, said rectilinearly-related cross heads being connected to said cam means.

5. In apparatus for the stacking and handling of paper towels, and the like, a frame equipped with means for delivering objects to be stacked over a generally vertically-disposed path, said delivering means including a roll journaled in said frame, said frame being equipped with a conveyor and first and second stack-supporting fingers in said path, means on said frame for reciprocating said first stack-supporting fingers in said path with the lowest point of reciprocation being generally aligned with said conveyor whereby a stack is transferable from said first stack-supporting fingers to said conveyor, and means on said frame for orbiting said second stack-supporting fingers with the vertically downward portion of the orbit being in said path and with said second stack-supporting fingers, when near the lowest point of said orbit portion, being below said first stack-supporting fingers, whereby a partial stack is transferable from said second stack-supporting fingers to said first stack-supporting fingers.

6. In apparatus for the stacking and handling of paper towels, and the like, a frame equipped with means for delivering objects to be stacked over a generally vertically-disposed path, said frame being equipped with a conveyor and first and second stack-supporting means in said path, said conveyor including longitudinally spaced-apart flights each adapted to receive a stack of objects, means on said frame for reciprocating said first stack-supporting means in said path with the lowest point of reciprocation being generally aligned with said conveyor whereby a stack is transferable from said first stack-supporting means to said conveyor, and means on said frame for orbiting said second stack-supporting means with the vertically downward portion of the orbit being in said path and with said second stack-supporting means, when near the lowest point of said orbit portion, being below said first stack-supporting means, whereby a partial stack is transferable from said second stack-supporting means to said first stack-supporting means, said reciprocating means and said orbiting means including a cam shaft journaled for rotation in said frame, cam follower means operatively associated with said cam shaft and pivotally mounted on said frame, a cross head mounted for reciprocating and coupled to said cam follower and said first stack-supporting means, a pair of cam followers operatively associated with said cam shaft and pivotally mounted on said frame, and a

pair of cross heads connected to said pair of cam followers and also connected to said second stack-supporting means to provide orbital movement thereof.

7. In apparatus for the stacking and handling of paper towels, and the like, a frame equipped with a roll for delivering objects to be stacked over a generally vertically-disposed path, said frame being equipped with a conveyor and first and second stack-supporting assemblies in said path, a cross head on said frame for reciprocating said first assembly in said path with the lowest point of reciprocation being generally aligned with said conveyor whereby a stack is transferable from said first assembly to said conveyor, and cam arm means on said frame for orbiting said second assembly, the vertically downward portion of orbit of said second assembly being in said path, said second assembly, when near the lowest point of said orbit portion, being below said first assembly whereby a partial stack is transferable from said second assembly to said first assembly.

8. In apparatus for the stacking and handling of paper towels, and the like, a frame equipped with a roll for delivering objects to be stacked over a generally vertically-disposed path, said frame being equipped with a conveyor and first and second stack-supporting assemblies in said path, a cross head on said frame for reciprocating said first assembly in said path with the lowest point of reciprocation being generally aligned with said conveyor whereby a stack is transferable from said first assembly to said conveyor, and cam arm means on said frame for orbiting said second assembly, the vertically downward portion of orbit of said second assembly being in said path, said second assembly, when near the lowest point of said orbit portion, being below said first assembly whereby a partial stack is transferable from said second assembly to said first assembly, said first and second assemblies each including a pair of spaced-apart fingers, the fingers in each pair being offset relative to each other whereby said second assembly fingers pass by the first assembly fingers in transferring a partial stack from said second assembly fingers to said first assembly fingers.

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ROBERT B. REEVES, *Primary Examiner.*

UNITED STATES PATENT OFFICE

Certificate

Patent No. 3,254,889 Patented June 7, 1966

Ernst Daniel Nystrand

Application having been made by Ernst Daniel Nystrand, the inventor named in the patent above identified, and Paper Converting Machine Co., Inc., Green Bay, Wisconsin, a corporation of Wisconsin, the assignee, for the issuance of a certificate under the provisions of Title 35, Section 256, of the United States Code, adding the name of John J. Bradley as a joint inventor, and a showing and proof of facts satisfying the requirements of the said section having been submitted, it is this 14th day of September 1971, certified that the name of the said John J. Bradley is hereby added to the said patent as a joint inventor with the said Ernst Daniel Nystrand.

FRED W. SHERLING
Associate Solicitor.