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 drawings, 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 line 5—5 applied to FIG. 3;

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

FIG. 7 is a sectional view taken along the line 7—7 applied to FIG. 3;

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 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, with particular reference to FIG. 1, the numeral 20 generally designates completed stacks of C-folded towering 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 as seen 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 pin 43, is engaged over the arc designated 44 to which the cam arm 45 is connected. To this cam arm 45, 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 45a (see FIG. 17) operating against the periphery of a cam 47 mounted on the cam shaft 46. The cam arm 45 is pivotally mounted on a pivot shaft 48 (see FIG. 14). In FIG. 17, the high and low surfaces of the cam 47 are seen, designated 47a and 47b.

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 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 carried on 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 53a. 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 53b (seen only in FIG. 3) for securement to the side frame 39.

The cam arm 55 is moved over an arc designated 55a (again see the bottom portion of FIG. 2) through a suitable cam follower arm 57 (see FIG. 18) which is pivotal mounted on the cam follower arm pivot shaft 48 and equipped with a cam follower 57a. For moving the cam follower 57a, a second cam arm 45b is provided on the cam shaft 46, the high and low surfaces of the cam 56 being designated 56a and 56b 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 slidable 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 60a mounted on the cam shaft 46. The cam arm 60 is 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 62a following a cam 62b mounted on the cam shaft 46. Thus, the cam arm 55 develops, in effect, a vertical reciprocation of the second fingers 63 (see FIGS. 2, 3, and 4), 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 stacking cycle. At such time, the second fingers 29 are carrying a completed stack and move down relatively quickly, as can be appreciated from the portion designated 64 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, 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 52a (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 the 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 position-
ing the uppermost object in the stack at about the same horizontal level. When the fingers 52 have penetr-
ted 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 39 are then withdrawn from 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, it is the moment when the fingers 29 rapidly descend with a complete stack that is then stripped off by means of one of the spacers 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 90. The journal 90 is carried by the frame 39, with the journal 90 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 90 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 pivoted 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 coil portion 91a 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-sup-
porting 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 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 operatively associated with 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-sup-
porting 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 jour-
neled 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 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 journeled for reciprocation on 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 whereby said first assembly is in said path, said second assembly 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

Ernst Daniel Nystrand

Patented June 7, 1966

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.