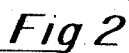
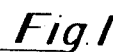


3,342,481

Filed Dec. 14, 1964

2 Sheets-Sheet 1



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3,342,481

SHEET ITEM HANDLING AND STACKING APPARATUS

Filed Dec. 14, 1964

2 Sheets-Sheet 2

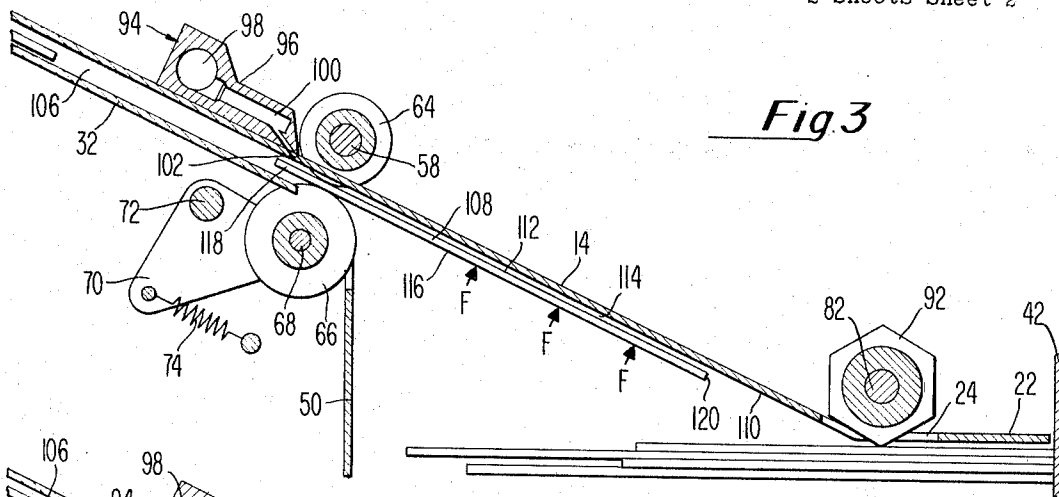


Fig 3

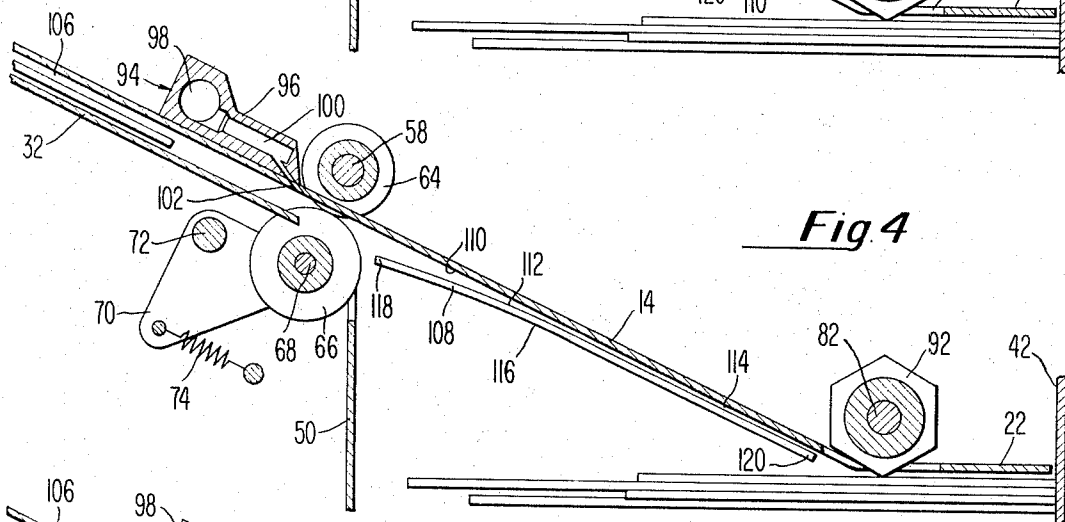


Fig 4

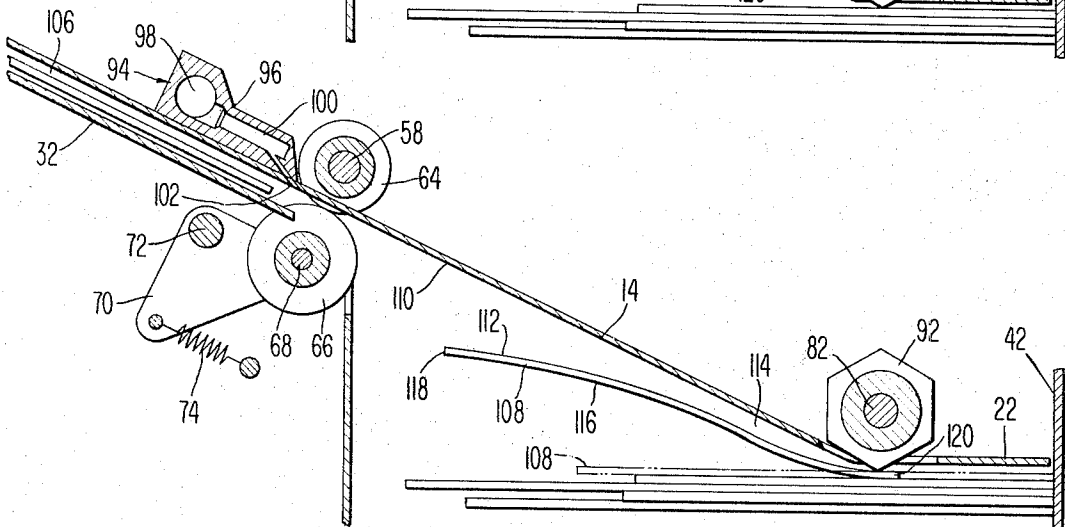


Fig 5

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3,342,481

SHEET ITEM HANDLING AND STACKING APPARATUS

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Filed Dec. 14, 1964, Ser. No. 418,071

5 Claims. (Cl. 271—71)

The present invention relates to item handling and stacking apparatus, and, more particularly, although not necessarily exclusively, to item handling apparatus for stacking individual items from a constantly moving stream of items with space between them, moving at a rate of six per second, into a stacker-hopper without rear-end collisions or item jams caused by one item impinging or curling against another item thereby blocking the inflow of succeeding items.

Still more particularly, the invention has to do with item stacking apparatus for use with postage mail of letter type and with means for stacking mail of intermixed size, thickness, height and weight by causing the mail to move into a stacking hopper at a relatively high rate of speed.

The sorting of individual sheet items involves the passage of such items through means for separating the items one from another and maintaining such separation until such time as the items have been stacked at a terminal location. Where all of such items are of any single thickness as sheets of paper or cardboard, etc., stacking can be accomplished relatively easily. Where, however, the items vary in both thickness as well as length, and weight, then the conventional item handling apparatus fails to provide an efficient means for stacking items in a continuous flow.

It is an important object therefore of the present invention to provide a new and novel and heretofore unknown apparatus for stacking individual items of varying length, breadth and thickness.

Another object of the invention is to provide means for assuring that each item entering the stacker-hopper is end registered with a stacking abutment within the hopper.

Still another object of the invention is to provide a unitary means for simultaneously moving the item into the stacker-hopper and deflecting the trailing portion of one item out of the way of the leading portion of the next succeeding item thereby to avoid any collision between the two items.

In accordance with the foregoing objects and first briefly described, the present invention comprises an item stacker-hopper including a canted input guiding surface terminating adjacent a multi-faceted rotatable element disposed adjacent to a movable stacker-hopper back-up plate. Means is provided adjacent to the guiding surface for directing the items at high speed into the stacker-hopper. Further, pressure differential means is provided adjacent to said guiding surface whereby, as a result of the Bernoulli effect, each incoming item is caused to adhere to and slide over a thin film of air along the canted surface during a major portion of its travel into the stacker-hopper and thereafter to have its trailing edge portion deflected transversely out of the way of an incoming item thereby to effect an ordered, progressive, consecutive stacking of individual items without attendant rear-end collision or jams of the apparatus.

These and other objects and advantages of the present invention will become more apparent from a reading of the following description of apparatus embodying the principles of the present invention when taken in conjunction with the appended claims and the accompanying drawings wherein:

FIGURE 1 is a top plan view of the present invention; FIGURE 2 is a view taken along the line 2—2 of FIGURE 1 of the stacker-hopper;

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FIGURES 3 through 5 inclusive are views taken along the line 3—3 of FIGURE 2 illustrating consecutive steps in the advancement of an item into the stacker-hopper apparatus embodying the present invention.

Referring now to the drawings and particularly to FIGURES 1 and 2 thereof, apparatus 10 embodying the present invention is seen to comprise a rigid platform or base 12 of metal, e.g., aluminum, on which is diagonally, vertically mounted a relatively thin, rigid, flat guidance plate member 14 which is secured to the base 12 by means of an angle bracket 16 mounted thereto by one or more screws 18. The left portion 15 of member 14, as viewed in FIGURE 1, is provided with a series of rectangular apertures 20 disposed in parallel spaced apart relationship, as seen more clearly in FIGURE 2. The rightward end portion 22 of member 14 is bent angularly out of the plane of the main portion thereof as indicated and is provided with a plurality of apertures 24, as seen more clearly in FIGURE 2. A supporting angle bracket or tab 26 secures the rightward extension of member 14 to base 12 by means of screw 28. A secondary vertically disposed guide plate 30, attached to base 12 by means of a bracket 32 and screws 34, extends for a short distance parallel (as seen in FIGURE 1) to the upper left-hand portion of guide member 14 adjacent to the leftward edge of the row of apertures 20, FIGURE 2.

Extending along the right-hand portion of base 12 and vertically disposed relative to the base is a follower plate 36 which is rockably journaled by means of bearings 38 on a horizontal guide bar 40 secured to the base by means of a vertically disposed bracket 42 and adapted to be moved slidably to and fro along bar 40. A biasing member 44 secured to a projecting stud 46 in the journal of the member 36 is adapted to cause the follower 36 to move in the direction of the arrow 48.

Along the left side portion of the base member 12 is mounted a vertically disposed plate or wall forming member 50 attached to the base by means of angle bracket 52 and screws 54. The bracket 50 is disposed normal to the follower plate 36 and includes a portion which projects into relatively close proximity with the wall forming member 30. Member 50 is provided with an undercut portion 56 for clearance purposes which will be explained hereinafter.

As seen more particularly in FIGURE 2, a vertically extending shaft 58 provided with bearing member 60 is attached to the underneath surface of member 12 in a suitable manner by means of the flange 62. Shaft 58 projects vertically upwardly through an aperture (not shown) provided in member 12 and carries four parallel spaced apart drive rollers 64 which are adapted to project slightly into and through apertures 20 with which they are associated and into surface contact with a series of four idler rollers 66 disposed on and rotatable about shaft 68. Two triangularly shaped rock plates (one top and one bottom) designated 70, pivotally mounted on a shaft 72 attached to the base 12, permit rollers 66 to be arcuately movable via clearance opening 56, toward and away from the drive rollers 64. A spring 74 biases the rock plates 70 in a direction to bring the idler rollers into contact with the surface of the associated rollers.

Shaft 58 carries a pulley 76 at its opposite (lower) end over which a drive belt 78 is disposed so as to engage a pulley 80 secured to shaft 82. One end of shaft 82 is provided with a second pulley 84 driven by belt 86 from a source of rotative torque, such for example, as an electric driving motor, not shown. Shaft 82 is journaled in bearing member 88 attached in a suitable manner by flange 90 to the lower portion of the mounting plate 12 and projects vertically upwardly through an opening (not shown) in plate 12. The upper end of shaft 82 carries

four hexagonally shaped, spaced apart, beater rollers 92 which are adapted to project slightly into and through the apertures 24, for purposes to be explained hereinafter.

Disposed adjacent pinch rollers 64 and 66 is a pressure establishing means 94, which includes a rigid block 96 provided with an internal hollow chamber 98 (FIGURES 3-5) and an outlet passage 100 leading to an outlet orifice 102 which is disposed adjacent an area substantially midway between the two centermost apertures of the group of apertures 20 (see FIGURE 2) and slightly displaced to the left of the vertical axis of rollers 64 and 66. An inlet pipe or tube 104 enables fluid under pressure such to be introduced into and through member 94. The exiting air from outlet orifice or nozzle 102 provides an aerodynamic condition hereinafter referred to as the Bernoulli effect.

Apparatus embodying the present invention may be employed for example, as an item stacking hopper in a high speed Post Office mail reader sorter. Such apparatus handles letter mail at a rate of six per second at a velocity of 120 inches per second which effectively produces a 20-inch pitch separation between items. Letter mail varies in overall size, weight, thickness, etc. To the end that each item is forwarded to the item stacker in orderly progression, with each item following the preceding item in consecutive order, means is provided for moving the incoming item out of the way of the next succeeding item quickly enough so that the succeeding item does not collide with the previous item.

The present invention utilizes the so-called Bernoulli effect as described hereinbelow, in which a relatively high velocity stream of pressurized fluid, e.g., air is introduced via inlet 104 to nozzle 102 adjacent to the rollers 64, and 66, so as to exit from the nozzle in a direction rightwardly (FIGURES 1-3, 4 and 5) between the center pair of rollers 64, FIGURE 2, toward the hopper or stacker area.

A number of dimensions are considered in the structure heretofore described and each is more or less operably associated with the others to form a useful and efficient combination. Dimension X refers to the width of the stacker-hopper and to the actual item impact area wherein the mail is to be received and stacked. This dimension must be at least as wide as the longest item which is to be handled by the apparatus. Dimension Y is the distance between the axial center of the rollers 92 and the registration plate member 42 against which the items finally come to rest in edge alignment. This dimension must be less than the length of the shortest item to be handled by the present invention. Dimension Z is the distance an incoming item travels before this item clears the rear edge of the preceding stacked item. This distance is not fixed but will necessarily vary with the length of the already stacked item—the shorter the stacked item the longer is this dimension and vice versa.

The present invention, as is seen most clearly in FIGURES 3 through 5 inclusive, locates the uppermost set of rollers so as to project a slight distance into an item channel or guideway 106 formed between the member 14 and member 32. When an item e.g., item 108 passes into this channel and subsequently is gripped between rollers 64 and 66, it is caused to move forwardly thereof, that is, rightwardly, the lower surface 110 of the plate 14 and the top surface 112 of the item together form a second very narrow channel 114 through which the pressurized air from the jet or nozzle flows with a relatively high velocity. The pressure of the air changes with its velocity and therefore in the narrow channel 114 it is less than that of the atmosphere on the lower side 116 of the item. As a consequence, as long as the letter item is in the grip of the rollers 64-66, the high velocity air is caused to flow therebetween in a manner such that the higher atmospheric pressure provides a force F causing the envelope or letter to move along on a thin film

of air closely hugging the plate 14 during its movement along the lower surface 110 thereof.

This so-called Bernoulli effect continues to cause the item or items to move as described until the trailing edge 118 of the latter has passed the outlet nozzle 102 preparatory to the item leaving the bite of the rollers 64-66. By this time the item is sufficiently far into the stacker-hopper to start to slide over or across the top of the previously stacked item. Leaving the rollers 64-66, the item's forward momentum carries it toward the hexagonal beater rollers 92.

As the item approaches the rollers 92 it encounters the point of tangency of these wheels in the existing stack of items (i.e., the alternate flats and points of the wheels relative to either the back-up plate 36 or the exposed surface of previously stacked items). The leading edge 120 of the item is then pinched in that region under the hexagonal rollers. As the item is driven further into the stack area the combination of the bent portion 22 of plate 14 and the pressure of back-up plate 36 cause the trailing portion of the item to sweep or bend through the angle theta θ swinging the rear end out of the way of the next incoming item.

At this point, since the item has passed the wheels 64-66, air from the nozzle 102 is no longer constrained to move between the plate 14 and the top surface 112 of the item but now passes between the pinch rollers so as to strike the trailing edge 118 of the item with a sufficient force to aid in moving the item downwardly, FIGURE 2, through the angle theta θ effectively moving the trailing edge of the incoming item out of the way of the succeeding or following item, which is approaching the stream of air. Thus by the time the leading edge of the following item intersects the axis of the air jet and is received within the bite of the pinch rollers 64-66, the original item has landed flat on the pile of items previously stacked and edge aligned (if any), or, flat on the follower plate 36 if it is the first item to be moved into the stacker-hopper.

The present apparatus has the additional desirable feature that since only the angled tips of the hexagonal rollers 92 are actually in contact at any particular time with the top surface of the item, there is a continuously available space between the flat surface of the hexagonal rollers and the flat surface of the already stacked items into which the succeeding item may proceed for stacking, edge alignment and registration against member 42. In this manner it can be seen that high speed stacking can be accomplished quite readily without the problem of rear-end collisions between the first and any succeeding item or items that are stacked in the hopper. As the hopper accumulates individual items, the follower plate 36 is caused to move downwardly in FIGURE 1, or parallel to the bed of the hopper against the constant tension of the biasing member 44.

A secondary plate member (not shown) disposed parallel to the plate member 36 and operable in substantially similar fashion to this plate i.e., arcuately movable about the rod member 40, so as to be insertable into the stack of items, permits the stack of items to be effectively separated into two parts. As the hopper fills with items the first follower member is arcuately moved out of the stack and reinserted at the head or front thereof thereby making it possible and practical to unload a large number of items from the stacker-hopper during the stacking operation without interfering with the incoming items or necessitating the shutting down of the apparatus.

There has thus been described a novel item stacker-hopper apparatus including means for directing items at high speed into a stacker area by means of the so-called Bernoulli effect whereby the items are caused to hug a contact guide plate and glide along on a thin film of air therebetween during their entry into the stacker-hopper thereby controlling the item movement while simultaneously reducing to a minimum the free flight condition of

the item. The higher the velocity of the air stream along wall member 14 the lower the pressure between the item and the guide plate 14 and thus the greater is the force F which tends to hold or push the items in a direction toward the surface of the wall 14 over which the air is flowing.

By virtue of the foregoing the item is assured of being within the so-called target area, i.e., between the rollers 64-66 and the last stacked item so that it cannot abut the rear edge of the previously stacked item. Additionally, as the Bernoulli effect is cut off when the item leaves the bite of the pinch rollers, the blast of air from the nozzle 102 in striking the rear end or trailing edge portion of the item drives it downwardly toward the stacker follower effectively moving the item out of the path of the next "incoming" item and avoiding any rear-end collisions.

What is claimed is:

1. Item handling and stacking apparatus comprising:

- (a) means forming a stacking area into which items are directed at high speed,
- (b) means for driving items into said stacking area,
- (c) means adjacent to said driving means for directing a stream of air at high velocity at an acute angle relative to said items into said stacking area,
- (d) rigid, stationary guiding means adjacent to said driving means extending from said driving means into said stacking area adjacent to said air directing means and operably associated therewith so that exiting high velocity air is caused to strike each item at an acute angle relative to the surface of such item effective to induce a Bernoulli effect between said guiding means and said item whereby a pressure differential is created between said guiding means and said item effective to produce a thin film of air between said item and said guiding means so as to cause said item to move on the thin film of air moving along the surface of said guiding means in close proximity thereto until the item is beyond said driving means whereupon said air directing means is effective to cause said high velocity air to strike the trailing edge of said item and thereby to deflect the trailing edge of said item through an angle relative to said guiding means moving said trailing edge out of the path of the next succeeding incoming item, and
- (e) rotatable means having portions intermittently engageable with said items as said means is rotated, located adjacent a terminal portion of said guiding means in said stacking area operably associated with said rigid guiding means for aligning and registering said items as they are directed thereinto at high speed.

2. Item handling and stacking apparatus comprising:

- (a) means providing a collection area into which items may be received and stacked in a desired serial consecutive order,
- (b) a plurality of rotatable means for entraining and moving items serially one at a time at high speed into said area,
- (c) a rigid stationary guidance means extending angularly away from said moving means and terminating in said collection area,
- (d) a high pressure nozzle acutely angularly oriented relative to said guidance means adjacent to said guidance means for expelling air at a high velocity toward said collection area so as to create a pressure differential relative to the atmosphere between said guidance means and an item being moved into the stacking area for producing a thin film of air between the item and the guidance means and effective to cause said items to move on said film in a straight line path along said guidance means toward said stacking area,
- (e) a back-up plate in said stacking area operably associated with the terminal portion of said guidance means effective to cause the trailing edge of each

item to be deflected angularly out of the path of movement of succeeding items entering said stacking area, and

- (f) a plurality of beater rollers including projecting portions intermittently engageable with said items as said rollers are moved, located adjacent a terminal portion of said rigid guidance means in said collection area operably associated with said last named means and said rigid guidance means for edge aligning and stacking one item after the other in registration.

3. Item handling and stacking apparatus comprising:

- (a) means providing a stacking area into which items may be received and stacked in a desired order,
- (b) a plurality of drive rollers,
- (c) a plurality of driven rollers operably associated with said drive rollers for entraining items therebetween effective so as to move the items serially one at a time at high speed into said stacking area,
- (d) a plurality of hexagonal beater rollers in said stacker area engageable with said items for slowing the entering speed of the items and moving them to a terminal stop in edge aligned condition,
- (e) an angled guide plate forming a planar surface extending from said drive rollers to said stop,
- (f) a fluid outlet in said plate adjacent to said drive rollers including means operably associated therewith for inducing a pressure differential between said guide plate and the item being stacked providing a thin film of air adjacent to said guide plate effective to cause said items to move in a straight line path along said surface in close proximity thereto into said stacking area, and
- (g) means operably associated with said beater rollers for deflecting the trailing edge of each item angularly out of the path of movement of succeeding items entering said stacking area.

4. Item handling and stacking apparatus comprising:

- (a) means forming a stacking area into which items are directed at high speed in serial consecutive order,
- (b) means for driving said items into said stacking area,
- (c) means adjacent said driving means for directing a stream of air at high velocity at an angle relative to each item into said stacking area,
- (d) rigid, stationary guiding means through which said driving means projects to engage said items extending from said driving means into said stacking area adjacent to said air directing means and operably associated therewith effective to induce a Bernoulli effect between said item and said guiding means whereby a pressure differential relative to the atmosphere is created effective to produce a thin film of air along the surface of said guiding means facing said item whereby said item is caused to move on said thin film of air along the surface of said guiding means in close proximity thereto until the item is beyond said air directing means whereupon the high velocity air from said air directing means is directed against the trailing edge of said item and thus is effective to deflect the trailing edge of said item through an angle relative to said guiding means moving said trailing edge out of the path of the next succeeding incoming item, and
- (e) beater roller members adjacent said guiding means and projecting partially therethrough into said stacking area and provided with a plurality of projections intermittently engageable with each item as said beater roller members are rotated for applying suitable pressure to the stacked items to cause the incoming items to be slowed and moved to a terminal position and stopped.

5. Item handling and stacking apparatus comprising:

- (a) means forming a stacking area into which items are directed at high speed in serial consecutive order,

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- (b) a plurality of drive roller means for driving items into said stacking area,
- (c) a high pressure chamber provided with an elongated hollow bore therethrough effectively forming an integral angled nozzle adjacent to said driving means for directing a stream of air at high velocity angularly away therefrom relative to each item and into said stacking area,
- (d) a rigid, stationary angled guide plate through which said drive means project to engage said items extending from said drive means into said stacking area adjacent to said air directing means and through which high pressure air is angularly discharged between said drive rollers toward said stacking area,
- (e) pivotal idler roller means operably associated with said drive means for entraining and moving said items therebetween,
- (f) said air directing means opening outwardly through the surface of said guide plate and being effective to induce a Bernoulli effect between an incoming item and said angled guide plate creating a pressure differential between said guide plate and said item providing a thin film of air close to and along the surface of said guide plate so that said item is caused to move along said film until the item is beyond said air directing means whereupon the issuing air from

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said directing means deflects the trailing edge of said item through an angle relative to said guiding means effectively moving said trailing edge out of the path of the next succeeding incoming item, and

- (g) beater roller means including a plurality of projecting portions intermittently engageable with portions of each item as said beater roller means are rotated in said stacking area adjacent said movable back-up member and rotatable in a plane substantially parallel to said back-up member for slowing and aligning said items as they are directed thereto at high speed.

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