

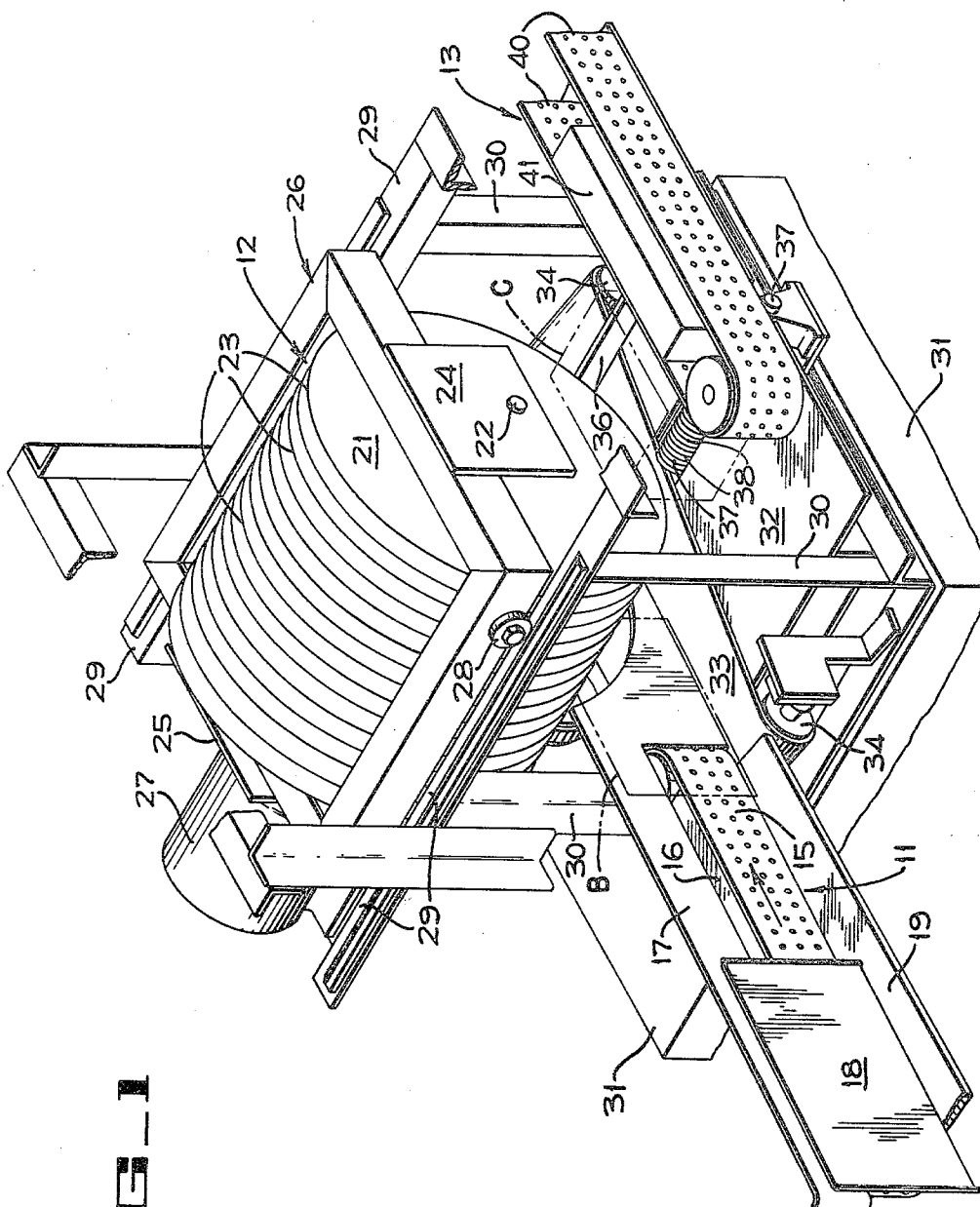
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ARTICLE HANDLING APPARATUS

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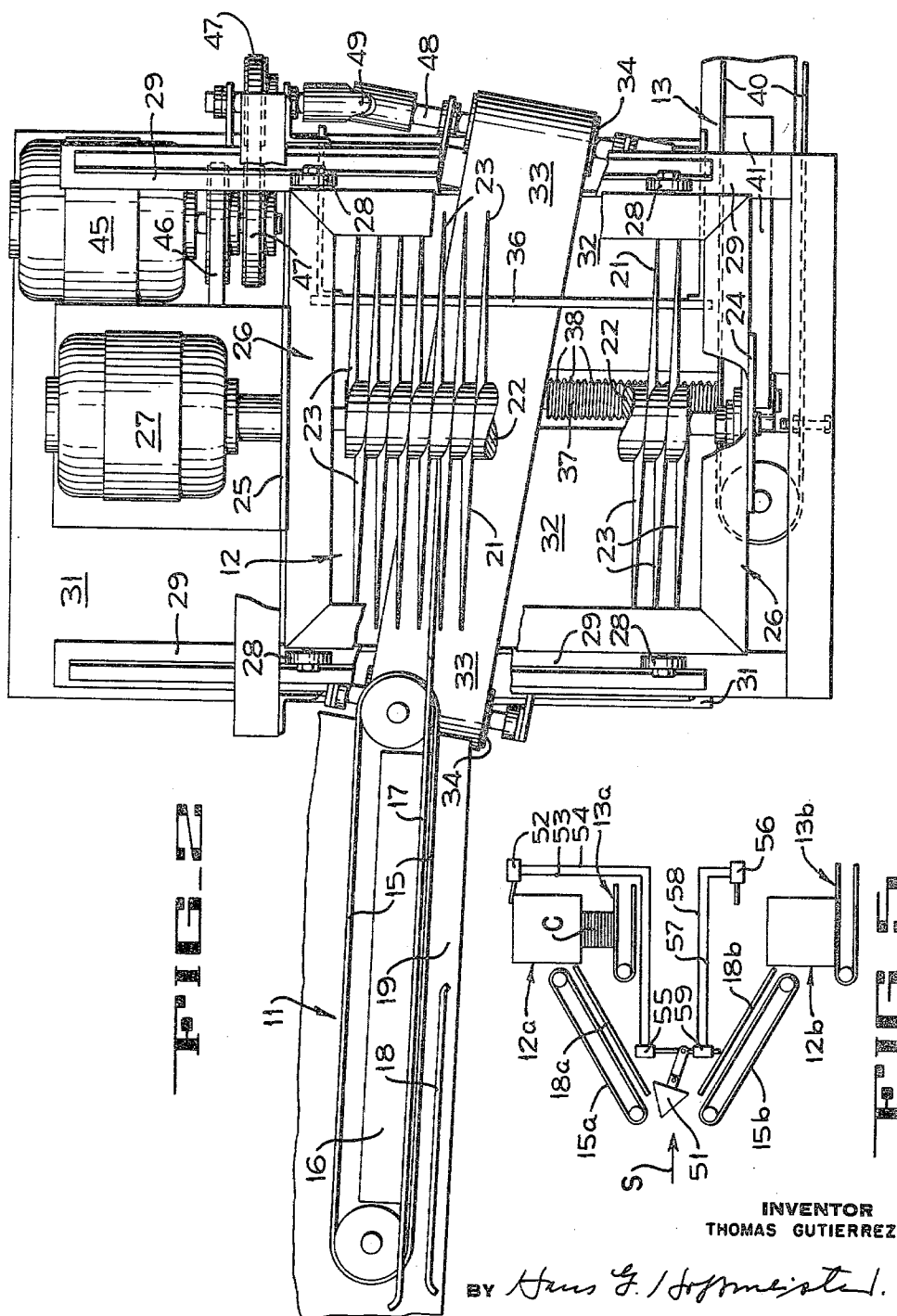
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ARTICLE HANDLING APPARATUS

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The present invention pertains to article handling apparatus, and more particularly to apparatus for the rapid stacking of flat articles, such as letters or the like.

In processing systems for articles, having a flat or substantially flat shape, such as blanks, cards, or letters, devices for the cumulative stacking of such articles are common. The particular functions of these devices vary from system to system, but the typical purpose of these stackers is to serve as a collecting station for the processed articles either at the terminal stage of the processing system or in some intermediary stage. It is with the latter situation that the device of the present invention is primarily concerned.

Specifically, the illustrated embodiment of the stacking device of the present invention is designed for the rapid stacking of letters in an automatic mail processing system in which connection it will be presently described, although it will be understood that such use is in no way a restriction upon the scope of the invention since the stacking device may have many other uses of a similar nature, such as in the stacking of cards or blanks received from forming or cutting machines, or in connection with a processing system for such articles.

Generally, the stacking device comprises a rotating wheel having a helical thread or blade wound thereon which is adapted to receive flat articles, such as letters or the like, between the turns on the thread and which serves to feed such articles in one direction towards the forward end of the wheel into an ever-increasing stack. Such devices of this type are well known and have been in use for a long period of time. However, they generally have been usable only to place the letters or similar flat articles in stacks for collection such as at the conclusion of some processing operation, and they are generally not adaptable to other types of very brief or continuous stacking operations such as might develop in the median stages of an article processing system when the articles must be allowed to accumulate only temporarily.

In automatic mail handling operations, by way of example, there are times when letters must be allowed to accumulate in stacks during a continuous processing operation. This occurs when the letter input rate exceeds the rate with which one of the letter handling mechanisms within the overall system can properly handle the letters. For example, facing and cancelling machines or weighing mechanisms used in automatic mail preparation systems can handle letters only at certain maximum rates due to the inherent limitations of their component parts, but the input of letters to such machines may vary widely, sometimes exceeding the operating rate of the machines, while during other periods the input may be considerably under the handling rate of the machines. This is due to the fact that the letters conveyed to such machines are not necessarily evenly spaced and sometimes may be in groups of two or more, all of which must be regrouped or stacked and then fed one by one at regularly spaced intervals into the machines at the prescribed rate. Of course, the average input rate to the system over a sufficient period of time must not exceed the capacity of the machines even though the instantaneous or short-interval flow rate may exceed that capacity, but it can be appreciated that the irregularity of the initial feeding of the letters will cause momentary excess feeding rates to the machines as described. There

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is therefore a need for a mechanism which will stack articles for necessary periods of time when the input rate is greater than normal so that the flow rate to the cancelling or weighing machines will remain constant and not exceed the maximum handling capacity.

It is therefore an object of the present invention to provide a device for stacking letters, blanks, or the like, before they are singulated into a further processing mechanism to allow for surges and fluctuating input rates in the overall processing system.

Another object is to provide an article stacking mechanism which will continuously place a plurality of flat articles into a stack from which they may be continuously removed.

Another object is to provide article collecting apparatus capable of accommodating articles which are fed at varying rates and removed in a singulated manner at a fixed rate so that varying accumulations of articles may be handled by the apparatus without disturbing the input or output rates.

Another object is to provide an article handling system including a movably mounted stacking device with the input feed of articles responsive to such movement to control the size of the stack formed thereby.

Another object is to provide an article handling system including a pair of stacking devices having means responsive to the loading of each device to control the input feed and prevent the overloading of one of the devices.

Other objects and advantages of the present invention will become evident from the following description and the accompanying drawings in which:

FIG. 1 is a perspective showing the device of the present invention in a position wherein a plurality of letters have been accumulated into a stack.

FIG. 2 is a plan of the apparatus of FIG. 1, with parts broken away, showing the device in a second position.

FIG. 3 is a side elevation of the device of FIG. 1.

FIG. 4 is a fragmentary perspective showing a modification of the restraining bar and guide panel structure.

FIG. 5 is a diagrammatic illustration showing a pair of the stacking devices of the present invention used in cooperative relationship in an article feeding system.

Referring now more specifically to the drawings, which show an embodiment of the present invention, there is illustrated (FIGS. 1 and 2) a portion of the operating line for a mail handling system. This portion includes a vacuum belt feed device 11, a helical wheel stacking mechanism 12, and a vacuum belt removal device 13 which operate in conjunction with each other to carry mail from an input conveyor to a cancelling machine or the like (not shown) accepting letters at a maximum rate from the vacuum belt device 13 which may be less than that at which the letters may be fed from the belt mechanism 11 into the stacking device 12 during any brief time interval.

The feeding device 11, the details of which form no part of the present invention, is designed to feed singulated letters onto the helical wheel stacker 12, although it may feed letters in pairs or larger groups, since such feeding will not affect the operation of the stacker. The feeding device comprises, in general, an endless rotating belt 15 having a plurality of perforations throughout its length to allow the application of a vacuum through the belt by means of a vacuum source 16 placed within the belt loop. As seen in FIG. 1, a letter B indicated in phantom line is conveyed by the belt toward the stacker. Guide plates 17 and 18 support the letter laterally during the feeding operation, and support plate 19 supports the bottom edge of the letter. The guide plate 17 continues to support the letter as it is propelled into the helical wheel stacker mechanism.

The stacker 12 receives the letters from the feed device 11 and continuously conveys them to a stack C indicated in phantom lines in FIG. 1, from which they may again be singulated. The major component of the stacker is a helical wheel 21 which includes a rotatable shaft 22 having a thread or helix 23 wound thereon. The ratio of the maximum width of the helix to the diameter of the shaft is high enough so that the stacker wheel may handle and guide letters of various sizes and shapes. The shaft is mounted by a pair of brackets 24, 25 which are provided at opposed ends of a rectangular carriage 26 to receive the opposite ends of the shaft. The bracket 25 is angled to also support a motor 27 attached to one of the ends of the shaft to drive the wheel 21. The carriage 26 which, therefore, carries both the helical wheel and its driving mechanism is itself movably mounted by rollers 28 which are adapted to roll upon the tracks 29. These tracks are mounted by angled support members 30 upon a flat supporting base 31.

The letter is supported on its bottom edge as it is conveyed by the helical wheel 21 by the smooth flat bed plate 32 which is mounted slightly above the supporting base 31. Extending across the bed plate at an angle of about 80° with the axis of the helical wheel is a flat belt 33 which is adapted to assist in propelling the letters into the wheel by frictionally engaging their edges and urging them laterally as well as forwardly toward the stack C (FIG. 1) in a manner which will be more fully described hereinafter. The belt 33 is driven by the usual rollers 34 which are mounted upon the base 31, and the upper run of the belt lies directly on top of the bed plate 32 so that the bottom riding edge of the letter may easily be transferred from belt to bed plate as it is linearly propelled toward the vacuum belt mechanism 13. Extending parallel to the bed plate at one side thereof is a restraining or edger bar 36 which is mounted upon the support members 30 at an elevation slightly above the bed plate to serve as a restraining means for the letters which are fed into the mechanism and to align or edge their leading edges. Extending parallel to this bar and in the plane of the bed plate is a rotatable, threaded shaft 37 suitably mounted upon the support structure 31. As best seen in FIG. 3, the bottom of the threads 38 on the shaft are aligned with the upper surface of the bed plate so that the bottom edges of the letters will be engaged thereby to assist the helix 23 of the wheel in conveying the letters to the stack. The distance between the threaded shaft 37 and the restraining bar 36 is such that it will accommodate the shortest letter which the system is designed to process.

It can thus be seen that letters fed into the wheel are continuously conveyed by the rotating helical thread 23 to the forward end of the wheel where they are stacked against the vacuum belt removal device 13, the details of which form no part of the present invention. As is shown in FIG. 3, the tracks 29 are not parallel with the horizontal support structure 31 but are angled downwardly in the forward direction as noted by the angle A between the axis of the shaft 22 and a horizontal reference axis. This structure gives the helical wheel a forward inclination and biases it toward the accumulating stack and the removal device. If it is desired, however, the tracks may be parallel with the horizontal plane and either a compression spring attached between the carriage 26 and the rearward portion of the tracks or a tension spring attached between the carriage and the forward portion of the tracks to accomplish the same result.

The letter removal and singulating device 13 which forms an abutment for the stack includes an endless perforated vacuum belt 40 which is similar to that of feeding device 11, being continuously driven by suitably mounted rollers and containing a vacuum source 41 located between its inner and outer runs. The restraining bar 36 is extended to terminate at a position spaced a sufficient distance from the vacuum belt 40 to allow

the letters which have been accumulated in the stack to be continuously removed one at a time by the belt.

The power system for the mechanisms of the stacking device includes the aforementioned movably mounted motor 27 for driving the helical wheel 21 and a motor 45 which is fixed upon the support base 31 for driving the threaded shaft 37 and the belt 33. The motor 45 supplies power to these latter two structures through a belt drive 46 to the shaft 37 and through a belt drive 47 to a shaft 48 which is provided with a universal joint 49 to connect it with one of the rollers 34 and the associated belt 33.

In operation, the stacking device 12 is designed to handle letters which are fed into the helical wheel 21 at varying rates at times exceeding the approximately constant rate at which the letters are removed in a singulated manner by the belt 40. The belt 40 thus serves to singulate the letters from a stack and convey them to a particular mechanism, such as a cancelling machine, which can accept letters only at prescribed maximum rates. The input vacuum belt 15 is driven in the direction of the arrow (FIG. 1) to carry the letters between the guide plates 18 and 17 and to allow them to be received by the helix 23. As best seen in FIG. 2, this belt is not arranged exactly perpendicularly to the axis of the helical wheel 21 but is angled rearwardly to a slight extent so that the letters will enter the wheel with their flat surfaces inclined toward the forward portion or stacking end of the wheel. This angle may be about 2 or 3 degrees, by way of example. The purpose of the angle is to serve to prevent a trailing letter from getting in front of its lead letter and causing possible jamming or damage to the letters. As the first letter enters the wheel, the belt 33 exerts a lateral force on the letter to pull it toward the restraining bar 36 at a speed greater than its input speed in that direction. This causes the leading edge of the letter which is gripped first by the belt to swing the trailing edge of the letter forward and away from the next following letter to straighten out the letter to a position normal to the axis of the wheel and force the following letter to be received behind it in the wheel. The belt 33, which is also angled with respect to the axis of the wheel in the direction of the belt 15, therefore, cooperates with the structure of the feeding device and brings the letter into contact with the restraining bar 36 while giving it some forward momentum along the axis of the helical wheel. The belt 33 also serves to remove any "limp" letters or other articles which cannot be received between the turns or flights of the helical thread.

Each letter is therefore propelled along the bed plate by the helix 23 and by the threads 38 of shaft 37 which engage the bottom edge of the letter as it leaves the belt 33. The driving motors 27 and 45 are both synchronous motors and are designed to run at related speeds so that the feed of the threaded shaft and helical wheel will be the same. It is also of advantage to set the speed of the belt 33 such that the forward frictional force component of the belt will push the letters in the forward direction with the same speed as the threaded shaft 37 so as to provide for a smooth transfer of the bottom edge of the letter between the belt and shaft.

As the letters arrive at the forward end of the wheel they are brought into abutting relation with the vacuum belt 40 which removes them singly and in regularly spaced intervals at a pre-set rate, as previously described. When the letters are fed into the wheel faster than they are removed by belt 40, they accumulate into a stack C (FIG. 1) and force the helical wheel back along the tracks 29. The size of the stack that may accumulate is, of course, determined by the axial length of the helix 23 and the tracks 29.

FIG. 4 shows a modification of the guide plate and restraining bar arrangement to eliminate adverse "bounce-back" effects which may occur if the letters are fed into the wheel too rapidly so as to strike the straight restraining bar 36 with sufficient force to damage the letters or

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disturb the otherwise smooth operation of the helix. For this purpose the guide plate 17a has been extended into a smooth arced portion 49 and integrally joined with a restraining bar 36a. The structure serves to greatly reduce the striking force of the letter against the restraining bar since the letter will be guided gradually through the curved connecting portion 49 until it is aligned on the straight portion of the restraining bar.

FIG. 5 illustrates a possible use of the helical stacking device in a processing system for mail or similar flat articles. In this system, two stacking devices 12a and 12b are operated in conjunction with one another. Each stacker is provided with an input feeding belt 15a, 15b and a guide plate 18a, 18b between which the letters are guided and fed into the stackers. The feed belts are both fed from a common input source S where a diverting member 51 serves to divert and divide the incoming letters between the two stackers. The stackers are then allowed to accumulate the letters in a stack C against the output singulating devices 13a, 13b in the manner above-described in accordance with the present invention. As seen in FIG. 5, one of the helical wheel stackers 12a may acquire a large stack which will move it rearwardly a distance equal to the width of the accumulated stack causing it to come into contact with a sensing switch 52. The sensing switch is connected by lines 53, 54 to a solenoid 55 which actuates the diverter 51 causing it to shift toward the guide plate 18a and the feed belt 15a to partially block the flow of mail into the stacker 12a and cause the bulk of the mail to be diverted to the stacker 12b. As the stack C is decreased in the stacker 12a, the wheel will move out of contact with the sensing switch and the diverter will return to a position where the mail is more evenly divided. It is to be noted that the stacker 12b is also provided with a sensing switch 56 which is connected by lines 57, 58 to a second solenoid 59 which will actuate the diverter 51 in the opposite direction if the stack upon the output feed belt 13b becomes too great. One of the important features of this tandem system is that it minimizes the width of stack necessary for each stacker and will be of definite economic advantage where it is otherwise necessary that two stackers be used in the processing system.

From the foregoing description it is apparent that the structure of the present invention presents a stacking device for rapidly stacking letters or other articles of a similar, thin flat shape. The device has particular utility in article handling systems where processing rates in two parts of the system are not always equal and allowance must be made for "surges." The device will also perform adequately to continuously place articles in a stack from which they can be removed manually, if desired. In addition, a pair of such devices can be operated in a tandem arrangement with the use of a diverting member to present a balanced output from both devices regardless of minor fluctuations in input volume.

While what is essentially one embodiment of the present invention has been shown and described, it will be understood that various changes and modifications may be made therein without departing from the spirit of the invention or the scope of the appended claims.

The invention having thus been described what is believed to be new and desired to be protected by Letters Patent is:

1. Apparatus for handling thin, flat articles such as letters, comprising a frame, an article stacking wheel having a generally horizontal axis, means for mounting said wheel on said frame for axial motion of the wheel relative to the frame between a forward and a rearward position, said wheel comprising a helix, the turns of said helix being substantially radial and closely spaced, means for turning said helix, substantially horizontal means for supporting articles on edge in said helix comprising an

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endless edger belt conveyor mounted beneath said helix and running transversely of the helix axis, means for driving said edger conveyor so that its upper reach moves in the direction of rotation of the lower portions of the turns of said helix, a generally horizontal, fixed article restraining and edger bar mounted on said frame above the upper reach of said edger conveyor and below the axis of said helix, said edger bar being disposed downstream of the helix axis for edging articles presented to the edger bar by said edger conveyor, said edger bar having a linear portion that is substantially parallel to the helix axis, the linear portion of said edger bar terminating in substantial alignment with the delivery end of said helix when the helix is in its forward position, a conveyor for removing the leading article of an edged stack of articles mounted on said frame, said conveyor comprising an endless vertically disposed belt, said belt having an article removal reach running transversely of the helix axis and being disposed closely adjacent the end of the linear portion of said edger bar, means for driving said article removal conveyor, and means for delivering articles endwise on edge to said edger conveyor.

2. The apparatus of claim 1, wherein said edger conveyor is inclined from a plane normal to the helix axis in the direction of advance of articles by said helix, said angle of inclination being a relatively small acute angle.

3. The apparatus of claim 1, wherein said means for mounting the article stacking wheel on the frame comprises means for biasing the helix toward its forward position adjacent said article removal conveyor.

4. The apparatus of claim 1, wherein said edger conveyor is inclined from a plane normal to the helix axis in the direction of advance of articles by said helix, said angle of inclination being a relatively small acute angle, said means for mounting the article stacking wheel on the frame comprising means for biasing the helix toward its forward position adjacent said article removal conveyor.

5. The apparatus of claim 1, wherein the portion of said edger bar that initially restrains articles delivered thereto by said edger conveyor is inclined from the linear portion of the edger bar toward the helix axis for smoothly decelerating the incoming articles.

6. In an article handling system for accumulating stacks of flat articles the combination comprising two stacking devices, each of said devices including a helix mounted for axial movement; individual means for feeding flat articles endwise into said helices, each helix being operable to accumulate a stack of articles adjacent one end thereof and to be axially positioned in accordance with the thickness of the accumulated stack; means for feeding articles; means for diverting all incoming articles to a selected one of said stacking devices; means for sensing the axial position of each of said helices; and control means governed by said sensing means and connected to said diverting means for selectively positioning said diverting means in accordance with the axial positions of said helices.

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