An apparatus for de-stacking flexible, planar products has a support for supporting a product stack in a de-stacking position adjacent a product exit and a picking head movably mounted above the de-stacking position for movement up and down between an upper position and a lower position. The picking head is first driven downwards to a location adjacent an upper product in the stack. The picking head is rotatable and has a series of spaced picking members, and is driven so that picking members as they rotate engage successive products in the stack at the trailing edge and peel the product forwardly over itself and off the stack into the product exit. A control unit controls operation of the picking head assembly so as to repeatedly index the picking head assembly downwards into new product engaging positions as the height of stack is reduced.
FIG. 13

OPERATOR CONTROL PANEL 57

CONTROLLER 1 58

LOCATOR MOTOR 36

PHOTO SENSOR 55

CONTROLLER 2 60

ROTATOR MOTOR 45

CONTROLLER 3 62

CONVEYOR MOTOR 17
START STACK CONVEYOR MOTOR 62
RAISE PICKING HEAD TO UPPER POSITION 64
DETECT ARRIVAL OF STACK AT DESTACK POSITION 65
STOP STACK CONVEYOR MOTOR 66
START PICKING HEAD ROTATOR MOTOR 68
DETECT ROTATION SUFFICIENT TO DESTACK ONE PRODUCT 72
ACTIVATE LOCATOR MOTOR TO MOVE PICKING HEAD DOWN BY ONE PRODUCT THICKNESS 74
LAST PRODUCT REMOVED FROM STACK? 76
STOP PICKING HEAD ROTATOR MOTOR 77
MORE STACKS TO BE DESTACKED? 78
END 79
DE-STACKING APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

[0001] This application is directed to an apparatus and method for de-stacking relatively thin, flat items such as tortillas, egg roll skins, pizza blanks, pastray sheets, or similar products.

[0002] Many thin, flat food products such as tortillas, egg roll skins, and the like are packaged in stacks. When these products are to be used in a further food manufacturing process, they must be de-stacked one-by-one and placed onto a conveyor or other transportation device for further processing, such as filling, coating, wrapping, or the like. Currently, such products are normally de-stacked manually by a worker, which is relatively slow and labor-intensive, and can slow down an automated production line.

[0003] De-stacking of products such as tortillas and egg roll skins is a difficult task, because the product is not uniform in shape and thickness, is very fragile, and tends to be “sticky”, in other words, adjacent products or sheets in the stack have a tendency to stick together or adhere to one another. Attempts have been made to de-stack such products automatically, generally using suction cups or vacuum heads to lift the top product or sheet in a stack vertically upwards from the stack. In some cases, a single suction cup or vacuum head is applied at the leading edge of the stack, i.e. the edge closest to the location where a separated product is to be deposited after de-stacking. In other cases, multiple suction cups are applied around the periphery of the product.

[0004] The vacuum method of de-stacking is not consistent in lifting one product at a time from a stack. When such a method is used to de-stack tortillas, the tortillas at the top of the stack will lift off relatively easily. The bottom part of the stack has had the weight of the top part of the stack on top of it, so that the tortillas in the bottom part will tend to stick together, making them more difficult to lift off. This sometimes results in lifting of more than one tortilla at a time from the stack. Attempts to overcome this problem by increasing the vacuum applied at the bottom of the stack can sometimes cause damage by sucking holes in the tortillas. In general, machines using vacuum for de-stacking of thin food products have not been widely accepted in the industry due to their inconsistent operation and lack of production speed.

SUMMARY OF THE INVENTION

[0005] It is an object of the present invention to provide a new and improved apparatus and method for de-stacking relatively thin, flat items from a stack.

[0006] According to one aspect of the present invention, an apparatus for de-stacking flexible, planar products is provided, which comprises a support for supporting a stack of relatively flat products to be de-stacked in a de-stacking position, the support having a leading end, products in a stack in the de-stacking position having an edge closest to the leading end and a trailing edge remote from the leading end, a product exit adjacent the leading end of the support for receiving items as they are de-stacked from the stack, a picking head assembly movably mounted above the de-stacking position, a first drive device for moving the picking head assembly to a selected position between upper and lower end positions dependent on the height of the stack, the picking head assembly comprising a rotatable device and a series of spaced picking members projecting outwardly from the rotatable device, a second drive device for rotating the rotatable device, whereby picking members as they rotate engage successive products in the stack at the trailing edge of the stack and roll the product forwardly off the forward edge of the stack and into the product exit, and a controller for controlling operation of the first drive device so as to index the picking head assembly downwards into new product engaging positions as the height of stack is reduced.

[0007] The support may comprise a conveyor for conveying stacks of flexible, planar products one-by-one to a de-stacking position, and a collection device such as a conveyor or other processing equipment may be located beneath the product exit for collecting products one-by-one as they are de-stacked. The rotatable device may comprise a rotating drum of circular or other cross sectional shapes, but in an exemplary embodiment this device comprises an elongate conveyor having first and second end rollers and an endless chain or conveyor belt extending around the rollers, with the picking members projecting outwardly from the belt at predetermined intervals. The elongate picking conveyor is supported on one side by a support plate which in turn is mounted on the drive shaft of the first drive device. The second drive device is mounted on the support plate and rotates the first end roller. The roller and chain assembly has a longitudinal axis between the centers of the rollers and parallel to the travel paths of the lengths of chain or belt extending between the rollers, and this axis is oriented at a downward angle from the first end roller to the second end roller. In the operative position, the second end roller is located adjacent the trailing or rear edge of the uppermost product of a stack in the de-stacking position. This means that picking members will engage the trailing edges of successive products in the stack as they pass around the second roller, peeling or rolling the engaged products forwardly towards the front edge of the stack until they roll completely off the stack and onto the collection device.

[0008] In this invention, no attempt is made to lift products vertically upwards and off the stack, which can lead to product damage and to products sticking together so that two or more products are lifted at once. Instead, the product is peeled or rolled over itself in a direction from the trailing edge forward, and then falls off the stack.

[0009] A sensor may be provided for detecting when a stack reaches the de-stacking position, and when there is no product left to be de-stacked, i.e. when the stack is depleted. This sensor is connected to the controller, which will turn off the drive to the stack conveyor when a stack reaches the de-stacking position. When the stack is completely de-stacked, the controller will actuate the first drive device to raise the picking head assembly to its uppermost position, then will actuate the drive to the stack conveyor to advance the next stack on the conveyor to the de-stacking position.

[0010] Each picking member may comprise a spaced pair of parallel picking feet, and the picking members are spaced apart at a distance less than the diameter of the product to be de-stacked. This distance may be of the order of one third of the product diameter.
According to another aspect of the present invention, a method of de-stacking flexible, planar products one-by-one from a stack is provided, which comprises the steps of:

- positioning a stack of products in a de-stacking position below a picking head assembly, the stack having a leading edge and a trailing edge;
- driving a picking head assembly to move a series of picking members along a path having a first end adjacent the trailing edge of an uppermost product in the stack and a second end spaced forwardly from the first end, the picking members moving from the first end to the second end and then back to the first end;
- positioning the picking head assembly relative to the stack such that a picking member engages the trailing edge of an uppermost product and peels the product forwardly over itself as the picking member moves towards the second end of the path, until the product falls off the leading edge of the stack; and
- continuing to engage successive products in the stack with successive picking members and peeling each product forwardly over itself and off the stack, while indexing the picking head assembly down the stack height is reduced with removal of products from the top of the stack, until de-stacking is complete.

The method may also comprise the steps of detecting when all product has been de-stacked from a stack, and then raising the picking head assembly to a raised start position before moving another stack into the de-stacking position. The picking head assembly is then lowered until a picking member can engage the uppermost product in the new stack, and the procedure is repeated until the second stack is de-stacked. This process can be repeated for a plurality of stacks of products, providing an automatic and efficient de-stacking process. Product may be de-stacked one-by-one onto a conveyor positioned adjacent the leading edge of the stack for conveying the products to processing stations.

The picking head assembly may be a rotating head or may be a conveyor extending around spaced rollers defining first and second ends of the path. In the latter case, the conveyor may be inclined upwardly between the first and second ends to ensure that the picking members engage product only at its rear edge, so that it can be rolled forwardly.

The method and apparatus of this invention allows products to be more consistently taken off a stack one at a time and placed on another conveyor or another piece of process equipment for further processing. Because the product is peeled forwardly from its rear edge, rather than being lifted vertically upwardly off the stack, there is less risk of damage to the product and less tendency for adjacent products in the stack to stick together. This makes the apparatus and method ideal for de-stacking of relatively fragile, thin food products such as tortillas and egg roll skins. This invention reduces the expense incurred when a worker must lift product from a stack one-by-one and manually place such products individually on a conveyor or piece of equipment, and also produces more consistent and faster line speeds. There is currently no machine in the food industry that can de-stack product as consistently and rapidly as is possible with this invention.
de-stacking of relatively thin, flexible, flat or sheet-like food products such as tortillas, egg roll skins, pizza bases, pastry, and the like. However, it will be understood that this apparatus may be used to de-stack any relatively flat product from a stack, whether food or non-food.

[0035] FIGS. 1 to 6 and 9 to 12 illustrate a de-stacking apparatus 10 according to an exemplary embodiment of the present invention. The apparatus 10 basically comprises a frame 12 on which a stack support comprising a first, horizontal conveyor 14 is mounted for conveying flat, flexible products in stacks 15 to a de-stacking position, and a picking head assembly 16 adjustable mounted above the de-stacking position for movement between lower and upper end positions, the lower position being illustrated in FIGS. 10 and 11, and the upper position being illustrated in FIG. 12. A second conveyor 18 is positioned below and in front of the forward end of the conveyor 14 for receiving products de-stacked from the stack 15 and falling through an exit opening in front of the forward end of conveyor 14 (see FIG. 5) and onto conveyor 18. Conveyor 18 then conveys products one-by-one to further processing stations. It will be understood that conveyor 18 need not be part of the apparatus 10 but the apparatus may simply be adapted to drop de-stacked products onto this conveyor or onto any other adjacent piece of processing equipment. Stack feed conveyor 14 may be made longer than illustrated in the drawings or may receive stacks fed onto it from an adjacent conveyor positioned end-to-end with conveyor 14 so that stacks can be continuously fed to the de-stacking position after each stack is completely de-stacked. Conveyor 14 is driven by conveyor motor 17 (see FIGS. 10 and 13). The conveyor and picking head assemblies may be mounted on separate frames, as indicated in FIGS. 9 and 10, if desired. FIGS. 11 and 12 illustrate the picking head assembly 16 alone.

[0036] In the illustrated embodiment, the picking head assembly 16 comprises an elongate, endless loop belt, conveyor or chain device having a first, drive wheel or sprocket 20 at one end of the looped path, a second, driven wheel or sprocket 22 at its trailing end, and a continuous belt or chain 24 extending around the two end wheels. The picking head assembly has an outer frame comprising spaced, elongate side plates 25 secured together by a central bolt 26 and a pin 28 extending between the plates at the trailing end, on which sprocket 22 is rotatably mounted. The frame is mounted at its leading end on mounting plate 30, as best illustrated in FIGS. 9 to 12, such that the conveyor device is inclined downwardly from its leading end to its trailing end, as best illustrated in FIG. 1. The angle of the conveyor device is adjustable by means of an angle adjustment screw 31 (FIG. 11) and will be adjusted based on the diameter of the product to be de-stacked. In the case of 12 inch diameter tortillas, an angle of around 22 degrees has been found to be appropriate.

[0037] A series of spaced picking feet or pins 32 project outwardly from the belt or chain 24 at spaced intervals. The picking feet in the exemplary embodiment are arranged in pairs (i.e., two spaced pins at each picking position on the belt), as best illustrated in FIG. 11. The picking feet may be provided on two separate chains secured together by a central belt section, as indicated in FIG. 8. However, single picking feet on a single chain may be used instead of two feet at each picking location, or additional conveyor chains may be used if three or more spaced feet at each picking location are desired. The picking feet in this embodiment comprise generally spaced, flat ended or blunt pins. However, picking feet of other shapes may be used in other embodiments, such as picking feet with bent ends. The picking feet should not have pointed ends which could potentially cause damage to the product being de-stacked, which is generally relatively fragile. The longitudinal spacing between the picking feet and thus the total number of picking feet will be dependent on the dimensions of the product to be de-stacked. For twelve inch flour tortillas, for example, nine pairs of equally spaced picking feet may be provided, at four inch center to center spacings. The picking feet will be closer together for smaller diameter products.

[0038] The picking head assembly 16 is supported via a rigid support frame 34, as best illustrated in FIGS. 9 to 12. The support frame 34 has an upper support plate 35 with a central opening (not visible in the drawing). A drive or locator motor 36 is mounted beneath the support plate via mounting bolts 38, with a drive shaft 40 projecting upwardly through the opening in plate 35 and secured to the mounting plate 30 by Allen screw 42. The motor 36 is a linear servomotor and operates to drive the picking head assembly up and down between the lowermost or down position illustrated in FIG. 11 and the uppermost or raised position of FIG. 12. Frame 34 may be supported on caster wheels 44 as indicated in FIG. 9, for easy transport from one position to another. FIGS. 1 to 8 illustrate a sheet metal safety shield 37 which may be bolted onto the machine frame in order to surround the picking head drive assembly. The safety shield is omitted in FIGS. 9 to 12 in order to reveal the drive assembly in more detail.

[0039] A second drive motor or rotator motor 45 is mounted on the picking head assembly mounting plate 30 via support flange 46, and the drive of motor 45 is connected via shaft coupling 47 to a rotating drive shaft 48. Motor 45 is a rotary servomotor. Shaft 48 extends through a series of shaft bearings 50, through the plate 25, and is connected to the drive wheel or sprocket 20 so as to rotate the wheel and thereby move the chain or belt 24 around both end wheels or sprockets 20, 22. The outer end of shaft 48 is rotatably secured to the outer side plate 25 of the support frame of the picking head assembly via bearing 52 and collar 54. Motor 45 will rotate wheel 20, causing picking feet to travel along a lower de-stacking path facing stack 15 and having a first end at drive wheel 22 and a second end at drive wheel 20. FIG. 1 illustrates the operative position of the picking head where the first end of the de-stacking path is adjacent the rear or trailing edge of an uppermost product 69 in the stack 15.

[0040] A photo sensor or detector 55 is mounted on the outer surface of frame 34 facing the conveyor 14 so as to detect when a stack of products reaches the de-stacking position, as best illustrated in FIG. 10. A programmable control unit 56 is mounted on the outer surface of the frame and has an outer control panel 57 for user control of the operation of the various motors, as generally illustrated in FIGS. 9 to 12. The control unit contains various motor controllers and wiring for the system. As illustrated in FIG. 13, the control unit has three programmable drive controllers, 58, 60 and 62 for controlling the operation of the locator motor 36, the rotator motor 45 which moves the picking head belt 24, and the conveyor motor 17 which
moves the stacks of product to be de-stacked, respectively. Any suitable programmable motor controllers may be used, such as Allen-Bradley Ultra 3000™ Digital Servo Drives, as manufactured by Rockwell Automation of Milwaukee, Wis. The motor controllers may be set up to operate in the desired sequence using a lap top computer programmed using Ultraware™, which is off-the-shelf software available from Rockwell Automation for control of the Ultra 3000 motor controllers or drives. The system set up will determine the sequence of operation of the three motors to de-stack tortillas, as best illustrated in FIG. 14. Alternatively, the control unit may have a computer or central processing unit used to control operation of the three drive motors according to program instructions and operator input.

[0041] The control panel or user input 57 allows an operator to start and stop the de-stacking process and also to vary several parameters. The input device or panel 57 has a start button, an emergency stop button, an off button, a selector switch for selecting the incremental step spacing of the locater motor, i.e., the down and up indexing distance of the picking head assembly, and a controller for varying the rotator motor speed. A pilot light is also provided to indicate when the apparatus is turned on. The locater step spacing switch will be connected to controller 58, and the speed control switch will be connected to controller 60. Photosensor 55 is connected to the rotator motor controller 60 and to the conveyor motor controller 62.

[0042] As indicated above, FIG. 14 indicates the programed sequence of the system to de-stack a series of products, such as tortillas or the like, from a stack. Prior to operation, the operator will select the desired indexing steps of the controller, based on product thickness. There are unlimited adjustments for changing the amount of drop of the picking head assembly after each cycle based on the thickness of the product, as controlled by the motor drive or controller 58 which controls the locater motor 36. The operator will also select the desired rotator motor speed, in other words the time for each complete revolution of the picking belt or chain in order to de-stack one product from the stack. The apparatus can be set up to de-stack products at a rate between 15 and 300 products per minute, depending on the speed desired and the time required for subsequent processing operations.

[0043] Once the system has been properly set up, the operator presses the start button in step 60, which in turn switches on the photosensor 55 and starts the stack conveyor motor 17 (step 62). The locater motor 36 is also actuated to raise the picking head assembly into the upper position of FIG. 12 (step 64). When the photosensor 55 detects the arrival of a stack 15 of product such as tortillas at the de-stacking position beneath the picking head assembly (step 65), the stack conveyor motor 17 is turned off (step 66).

[0044] The rotator motor 45 is then turned on (step 68) so as to de-stack product one at a time from the stack. FIGS. 1 to 5 illustrate the sequence of operation to de-stack one product from the stack. In FIG. 1, the stack 15 has arrived at the de-stacking position, the conveyor motor has been turned off, and the picking head assembly is in the raised position ready to engage and de-stack a product from the stack. In FIG. 2, the rear most picking foot, or picking foot pair 32a, has moved forwardly to a location close to the rear edge of the stack 15. In FIG. 3, picking foot 32a has engaged the upper tortilla or other product 69 in the stack and has started to roll the rear edge 70 forward. In FIG. 4, the picking foot 32a has advanced further forwards towards the leading or drive roller 20, and has also peeled the top tortilla forwards as indicated. Finally, in FIG. 5, the picking foot 32a has rolled the upper tortilla 69 completely off the stack, so that it falls onto the product conveyor 18 beneath it. Therefore it takes approximately half of one complete revolution of the conveyor belt or chain 24 in order to de-stack one product from stack 15.

[0045] Once controller 60 determines that the rotator motor 45 has rotated the conveyor belt through about one half rotation or cycle (step 72), it will signal the controller 58 to index the picking head 16 down by a distance equal to the approximate thickness of one product (step 74), and the next tortilla in the stack will then be engaged at its rear edge by the closest picking head 32, and rolled off the stack in exactly the same way as illustrated in FIGS. 1 to 5. The product thickness selected may be between thirty five and sixty five thousandths of an inch, or more. This process continues until the entire stack is de-stacked. FIG. 6 illustrates a point in the sequence in which only a few tortillas are left in the stack 15 and the picking head assembly is approaching its lower position, and the upper tortilla 75 has just been engaged by one of the picking feet 32 and rolled forward a short distance. When the photosensor 55 detects that the last product has been removed from the stack (step 76), the rotator motor 45 will be turned off (step 77). If there are more product stacks remaining to be de-stacked (78), the stack conveyor motor will be turned on again, and the process will be repeated until the next stack of product is de-stacked. When a processing operation is complete, the operator turns off the machine and the sequence ends (79).

[0046] FIGS. 7 and 8 illustrate an optional vacuum head 80 which may be added for de-stacking of more “sticky” products or products which are non-uniform so that they are more difficult to pick up. The apparatus of FIGS. 7 and 8 is otherwise identical to that of FIGS. 1 to 6 and 9 to 12, and like reference numerals have been used for like parts as appropriate. A vacuum supply pipe 82 extends from the rear of the picking head assembly through an opening provided for this purpose in the side plate 25 and into the space between the upper and lower runs of the conveyor belt 34, at a location adjacent the rear or driven roller 22. The pipe is bent down to provide vacuum head 80 facing the product stack 15, but not actually contacting the uppermost product in the stack. An on-off valve 84 is provided for turning the vacuum supply on and off. When the vacuum is on, the suction at vacuum head 80 will tend to lift the top product 85 at its trailing edge 86 so that the trailing edge can be more easily engaged by the picking feet 32, as indicated in FIG. 8. The vacuum head 80 can be turned on or off by the operator based on whether or not the picking feet are successful in picking up and separating product from the stack on their own.

[0047] Although the picking head assembly in FIGS. 1 to 12 is a conveyor belt carrying a series of spaced picking feet, it may alternatively comprise a rotating cylindrical drum or head which may carry a user specified number of spaced picking feet, depending on the type and size of product to be de-stacked. The picking feet project radially outwards from the outer surface of the drum. Other parts of the apparatus in this embodiment will be identical to the previous embodi-
The de-stacking apparatus and method of this invention is an improvement over the prior art techniques of manually de-stacking, or methods using suction cups which were subject to many disadvantages. The apparatus of this invention is easy to use, reliable, and efficient, and provides much more consistent de-stacking than previously proposed automated de-stackers. It is suitable for use in de-stacking many types of relatively thin and flat, flexible products, including food products such as any type or size of tortilla, egg roll skins, pizza blanks, and the like. The apparatus may be readily modified for de-stacking of any products typically packaged in stacks, whether food or non-food. In the case of relatively thin, flexible products, the product is lifted relatively gently at its rear edge and peeled forward over the top of itself until it rolls off the forward end of the stack. This reduces the risk of damaging the product or lifting more than one product when two products are stuck together, as can happen with relatively sticky products, particularly towards the bottom of a stack. The picking apparatus is automatically indexed down after each product is removed from the stack. When a stack is depleted, a new stack is automatically positioned for de-stacking.

The main difference between the apparatus of this invention and prior art de-stacking proposals using vacuum is that this apparatus does not use vacuum to try and lift the top product directly upwards from the stack. Instead, the product is gently peeled forward from its rear edge and off the stack. The picking head can be of various designs, from a conveyor with picking feet to a rotating head with picking feet, and can be customized for specific products to be de-stacked. The number, spacing, and shape of the picking feet can also vary based on the size and type of product to be de-stacked. This apparatus takes one product at a time from the stack substantially consistently and at a constant speed, and places the product on another conveyor or another piece of process equipment. The de-stacking speed does not vary unless manually altered by the controller. The apparatus is particularly suitable for the food processing industry where thin, flat food products are typically provided initially in stacks that must be de-stacked one by one for further processing.

Although some exemplary embodiments of the invention have been described above by way of example only, it will be understood by those skilled in the field that modifications may be made to the disclosed embodiments without departing from the scope of the invention, which is defined by the appended claims.

What is claimed is:

1. An apparatus for de-stacking flexible, planar products, comprising:
   a stack support for supporting a stack of products in a de-stacking position, the stack support having a forward end;
   a product exit adjacent the forward end of the stack support;
   products in a stack in the de-stacking position having a forward edge closest to the product exit and a trailing edge remote from the product exit;
   a picking head assembly movably mounted above the de-stacking position for movement up and down between an upper position and a lower position;
   a first drive device for driving the picking head assembly back and forth between the upper and lower positions;
   the picking head assembly comprising a rotatable device and a series of spaced picking members projecting outwardly from the rotatable device;
   a second drive device for rotating the rotatable device, whereby picking members as they rotate engage successive products in the stack at the trailing edge and peel the product forwardly over itself and off the stack and onto the collection device, and
   a control unit for controlling operation of the first drive device so as to repeatedly index the picking head assembly downwards by a predetermined indexing step distance into new product engaging positions as the height of stack is reduced.

2. The apparatus as claimed in claim 1, wherein the rotatable device comprises a rotating drum.

3. The apparatus as claimed in claim 1, wherein the rotatable device comprises first and second end rollers and an endless conveyor belt extending around the rollers, and the picking members project outwardly from the belt at predetermined intervals.

4. The apparatus as claimed in claim 3, wherein the rotatable device has a longitudinal axis between the centers of the rollers and parallel to the travel paths of the lengths of belt between the rollers, the longitudinal axis being oriented at a predetermined downward angle from the first end roller to the second end roller, with the second end roller being positioned adjacent the rear edge of a stack in the product engaging position.

5. The apparatus as claimed in claim 4, wherein the angle of the rotatable device is adjustable.

6. The apparatus as claimed in claim 4, wherein the angle of the rotatable device is in the range from 20 degrees to 25 degrees.

7. The apparatus as claimed in claim 6, wherein the angle is approximately 22 degrees.

8. The apparatus as claimed in claim 4, wherein the belt comprises at least one chain.

9. The apparatus as claimed in claim 4, wherein the belt comprises a pair of parallel chains, and the picking members comprise a first series of spaced pins projecting outwardly at spaced intervals along one of the chains, and a second series of spaced pins projecting outwardly at equally spaced intervals along the other chain, each pin in the first series being aligned with a corresponding pin in the second series.

10. The apparatus as claimed in claim 3, further comprising a support plate supporting the picking head assembly adjacent the first end roller, the first drive device driving the support plate up and down, and the second drive device being mounted on the support plate and having a rotatable drive shaft linked to the first end roller so as to drive the first end roller and rotate the conveyor belt.

11. The apparatus as claimed in claim 1, wherein the product support comprises a conveyor for conveying stacks of products to the de-stacking position and a third drive device for driving the stack conveyor, the control unit further controlling operation of the second and third drive devices.
12. The apparatus as claimed in claim 11, further comprising a sensor for detecting the presence of a stack at the de-stacking position, the sensor being connected to the control unit for turning off the second drive device when a stack is detected to have arrived at the de-stacking position.

13. The apparatus as claimed in claim 12, wherein the control unit further comprises means for turning the second drive device when a stack depleted signal from the sensor indicates that a stack at the de-stacking position has been depleted.

14. The apparatus as claimed in claim 13, wherein the control unit further comprises means for controlling the first drive device to raise the picking head assembly to an upper position when a stack depleted signal is received.

15. The apparatus as claimed in claim 13, wherein the control unit further comprises means for turning on the third drive device when a stack depleted signal is received, whereby the third drive device conveys a new stack to the de-stacking position.

16. The apparatus as claimed in claim 11, wherein the first drive device comprises a linear motor, the second and third drive devices comprise rotary motors, and the control unit comprises a first controller for controlling the first drive device, a second controller for controlling the second drive device, and a third controller for controlling the third drive device.

17. The apparatus as claimed in claim 11, further comprising an operator control panel connected to the control unit, the control panel having a start button, a speed control member for varying the speed of the second drive device, and a thickness control member for varying the indexing step distance of the first drive device.

18. The apparatus as claimed in claim 1, wherein each picking member comprises a spaced pair of parallel picking feet.

19. The apparatus as claimed in claim 1, wherein the picking members are spaced apart about the rotatable device by a distance less than the diameter of the product to be de-stacked.

20. The apparatus as claimed in claim 19, wherein the spacing between adjacent picking feet on the rotatable device is equal to approximately one third of the diameter of the product to be de-stacked.

21. A method of de-stacking flexible, planar products one-by-one from a stack, comprising the steps of:

- positioning a stack of products in a de-stacking position below a picking head assembly, the stack having a leading edge and a trailing edge;
- driving a picking head assembly to move a series of picking members along a path having a first end adjacent the trailing edge of an uppermost product in the stack and a second end spaced forwardly from the first end, the picking members moving from the first end to the second end and then back to the first end;

- positioning the picking head assembly in a product-engaging position relative to the stack such that a picking member engages the trailing edge of an uppermost product and peel the product forwardly over itself as the picking member moves towards the second end of the path, until the product falls off the leading edge of the stack; and

- continuing to engage successive products in the stack with successive picking members and peeling each product forwardly over itself and off the stack, while indexing the picking head assembly downwards as the stack height is reduced with removal of products from the top of the stack, until de-stacking is complete.

22. The method as claimed in claim 21, further comprising the steps of detecting when all product has been de-stacked from a stack, raising the picking head assembly to a raised start position, moving a second stack into the de-stacking position, lowering the picking head assembly into a product-engaging position, repeating the de-stacking procedure until the second stack is depleted, and repeating the procedure until a desired number of stacks have been de-stacked.

23. A de-stacking apparatus, comprising:

- a rotatable picking device having a series of spaced picking feet;
- a stack support positioned beneath the picking device for supporting a stack of products to be de-stacked adjacent a product exit, the stack having a leading edge adjacent the product exit and a trailing edge;
- a drive assembly for adjusting the height of the picking device above the stack as the stack is de-stacked;

the picking device having a start position adjacent the trailing edge of an uppermost product in the stack whereby picking members engage successive products in the stack at the trailing edge as the picking device rotates and peel the product forwardly over itself and off the stack and into the product exit.

* * * * *