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(54) Machine and method for loading a plurality of articles into a carton

(57) A packaging machine for loading a plurality of articles into a carton which mechanism comprises carton erecting means for part erecting said carton to define a first article receiving cell, means for selecting a group of articles comprising at least two articles, means for separating said grouped articles from an adjacent like group of articles, means for loading said grouped articles into said first article receiving cell through an open end thereof in the packaging carton and a means for completing the construction of the carton. There also comprises a mechanism for forming a carton including a pair of article receiving cells comprising complementary die members, each said die member being mounted to a rotating wheel wherein each said complementing die member is adapted to inter engage when a blank is positioned between the two members, such that said die members cause the blank to be folded to define said article receiving cells.

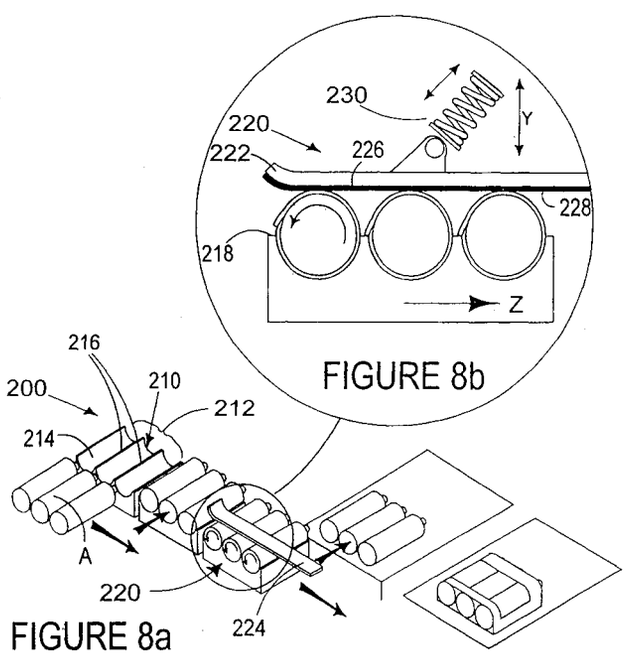

FIGURE 8b

FIGURE 8a

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Description

[0001] This invention relates to a packaging machine which is especially suitable for processing multiple package cartons from blank form to be completed filled multiple unit cartons and to a method of forming such cartons. The machine can be readily adjusted to accommodate a wide range of carton sizes without undue time being taken to adapt the machine for running one size of carton to running a different size of carton.

[0002] The majority of known packaging machines are dedicated machines which construct only one size or one type of carton. Therefore, it is necessary to use a plurality of packaging machines to package different carton types, each machine taking up considerable floor space and being expensive to both purchase and operate.

[0003] In packaging machines which are required to construct cartons comprising internal compartments for holding a given number of articles, the construction of these cartons is usually complex and often dictates the speed of the machine . What is required is a packaging machine which can construct compartments within a carton with a minimum number of folding operations.

[0004] A further problem arises when loading the articles into the compartments and in particular where those compartments are in a spaced arrangement. It is known to provide article metering mechanisms which continuously load a group of articles into cartons, for example, wrap-around cartons used in beverage multiple packs. However,
where carton compartments are in a spaced relationship, it is necessary for some form of article grouping to be adapted.

[0005] It is an object of the present invention to provide a packaging machine which overcomes the technical and commercial disadvantages of known packaging machines.

[0006] In cartons where a display portion is provided, it is often desirable for display indicia to be shown through the display portion. The majority of known packaging machines are not able to orientate the display indicia on an article, for example, a label, so that it can be displayed. A limited number of packaging machines incorporate equipment to orientate the containers. However, this equipment is usually complex or extremely costly for example, use of survey motors or optic fibre and a printed colour spot on the label to identify (i) a suitable reference point and (ii) to align the reference point at the correct position.

[0007] Thus it is a further object of the present invention to provide a mechanism for incorporation into a packaging machine which is capable of orienting containers for example, batteries, using equipment which is relatively inexpensive and simple.

[0008] A first aspect of the invention provides a mechanism for causing a label affixed to an article to be oriented to a predetermined display position wherein the article includes a portion protruding outwardly of the article in a fixed position relative the label, wherein the mechanism comprises support means adapted to support an article, orientation means adapted to cause the article to rotate in the support means until the protruding position is restrained by abutment means formed in the support means. Preferably, one edge of the label affixed to the article overlays an opposed edge of the label to define the protruding portion.

[0009] According to an optional feature of this aspect of the invention, the support means may comprise a channel including a support surface to retain part of the article within the channel. Preferably, the support surface may substantially correspond to the exterior surface of the retained part of the article.

[0010] According to another optional feature of this aspect of the invention the orientation means may comprise an elongate member connected to resilient means, wherein the elongate member is adapted to abut a portion of the article as the support means is moved in a substantially parallel plane to the elongate member such that a tangential force is applied to the abutting portion of the article to cause the article to rotate. Optionally, the resilient means may be adapted to reduce the tangential force when the protruding portion is restrained by the abutment means.

[0011] According to a further optional feature of this aspect of this invention, the abutment means may be formed from an upper edge of the channel.

[0012] A second aspect of this invention provides a method of orienting to a predetermined display position wherein the article includes an outwardly protruding portion in a fixed position relative the label a label affixed to an article which method comprising the steps of supporting the article in support means during forward movement, rotating the article within the support means until the protruding portion abuts a portion of the support means and retaining the article in its desired orientation for loading into a carton.

[0013] A third aspect of the invention provides a mechanism for grouping a plurality of articles which mechanism comprising an endless series of channels along which articles may be transferred into a plurality of article receiving cells of a carton wherein the channels are organised into groupings whereby each grouping corresponds to a given number of articles to be loaded in the carton.

[0014] According to an optional feature of the third aspect of the invention the channels may be adapted to be substantially parallel to one another and then diverge into sub-groupings wherein each sub-group is spaced to align an article held in each sub-group with one of the article receiving cells corresponding to each one of the cells of each carton and wherein the sub-groupings are each substantially parallel to one to provide in line parallel access to the cells.

[0015] According to a fourth aspect of the invention there comprises a packaging machine for loading a plu-

rality of articles into a carton which mechanism comprises carton erecting means for partly erecting said carton to define a first article receiving cell, means for selecting a group of articles comprising at least two articles, means for separating said grouped articles from an adjacent like group of articles, means for loading said grouped articles into said first article receiving cell through an open end thereof in the packaged carton and a means for completing the construction of the carton characterised in that said carton erecting means comprises complementary die members, each said die member being mounted to a rotating wheel wherein each said complementary die member is adapted to inter engage when a carton blank is positioned between the two members, such that said die members cause the blank to be folded to define said article receiving cells. Preferably, the carton erecting means may comprise a device which effects a change in configuration of the carton from an inoperative configuration in which said first article receiving cell is formed to receive said grouped articles.

[0016] Exemplary embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a perspective view of a selection of "blister pack" type cartons packaged by a machine according to one or more aspects of the invention;

FIGURE 2 is a plan view of a unitary blank used to construct one type of carton capable of being used with a machine according to the invention;

FIGURE 3 is a perspective view of the carton formed from the blank shown in Figure 2;

FIGURE 4 is a perspective view of a machine according to one or more aspects of the invention;

FIGURES 5a and 5b are perspective views of the carton supply in-feed and set-up stations of the machine shown in Figure 4;

FIGURE 6 is a perspective view of the carton conveyor and loading station of the machine-shown in Figure 4;

FIGURES 7 illustrates an example of an article to be packaged by the machine according to one ore more aspects of the invention; and

FIGURES 8a, and 8b illustrate a mechanism according to another aspect of the invention for orientating the labels affixed to an article.

[0017] The machine according to the present invention is capable of loading cartons comprising compartments for retaining a given number of articles within each compartment. A selection of cartons(CA1 to CA6) suitable for being packaged by such a machine is illustrated in Figure 1.

[0018] Figure 2 shows one example of a blank for forming a carton to be constructed and loaded by a packaging machine of one or more aspects of the present invention formed from paperboard or other suitable material. In this embodiment, there is a unitary blank 10 comprising a series of panels hinged one to the next. Thus, support panel 12 is hingably connected to top panel 14 along fold line 30. Top panel 14 is connected to side panel 16 by way of fold line 32. Side panel 16 is foldably connected to base panel 18 along fold line 34 and base panel 18 is hingably connected to second support panel 20 along fold line 36. In a set up condition, support panels 12, 20 are connected together in a face to face relationship by glue or other suitable means known in the art.

[0019] There further comprises an end panel 22 hingably connected along a first edge to side panel 16 along fold line 38 and glue flap 24 is hingably connected by means of fold line 40 to the opposing edge of end panel 22. Likewise, end panel 26 is hingably connected to side panel 16 along fold line 42 and glue flap 28 is hingably connected to the opposing side of end panel 26 along fold line 44.

[0020] In a set up condition, top panel 14, side panel 16, base panel 18 and a portion of support panel 20 are folded out of alignment and into an angular relationship to form a display carton shown in Figure 3. More particularly, support panel 20 is folded into face contacting relationship with front support panel resulting in top panel 14, front panel 16, base panel 18 and back support panel 20 forming a tubular structure. End panels 22, 26 provide closures for the box, which are held in place by glue flaps 24, 28 that are secured by gluing or other suitable means, to support panel 20 to maintain the carton in set up condition. Preferably, side panel 16 provides a display face for the package, while support panel 20 provides a back panel.

[0021] In this embodiment, the carton incorporates two securing cells or display windows C1, C2 constructed from partition sections 96, 98 as illustrated in Figure 3. In other embodiments there may comprise one display window, for example carton CA5 shown in Figure 1. Turning again to the embodiment in Figure 2, partition section 96 is struck from side panel 16 and end panel 22 along opposing cut lines 50, 52. Partition section 96 is hinged to glue flap 24 along fold line 40 and to side panel 16 along fold line 35. When the carton is in a set up condition, this partition section will define an individual cell C1. Likewise partition section 98 is struck from side panel 16 and end panel 22 along opposing cut lines 50, 52. Partition section 98 is hinged to glue flap 24 along fold line 40 and along its opposing edge to side panel 16 along fold line 37. When the carton is in a set up condition, this partition section will define an individual cell C2 shown in Figure 3.

[0022] It is envisaged that the carton can vary depending upon the shape and/or quantity of articles to be packaged and accordingly, a machine in accordance with one or more aspects of the present invention is adjustable in numerous respects so that it can process a wide variety of such cartons and is not limited to the specific example outlined above.

[0023] Referring now to Figure 4 of the drawings, there is shown a machine 50 for processing cartons 52 of the type outlined above. The upstream end of the machine includes a hopper 54 or other suitable storage means in which a multiplicity of cartons 52 in flat collapsed condition held ready for processing. As shown in Figures 4 and 5, the cartons are removed from the hopper 54 sequentially by suitable feeder means for example, a rotary vacuum feeder 56. In this embodiment, the vacuum feeder 56 comprises four pairs of suction cups 58 each being connected to a drive shaft 60 by a drive rod 62. Drive means 64, for example a servo motor, rotates the drive shaft 60. A cam track and cam rod (not shown) may be provided to define a uniform path for the suction cups as the drive shaft 60 is rotated.

[0024] The hopper 54 is, in this embodiment, a 'gravity feed' type whereby the carton blank 52 are held on the hopper at an incline to provide a positive feed. Thus, as shown in Figure 5, a carton 52 in flat collapsed condition is removed from the hopper 54 and is rotated by the vacuum feeder 56 to the in-feed end of the machine 54. The blank is placed onto suitable conveying means, for example, a pair of endless side lug chains 66, 68, and is conveyed downstream by suitable support means, for example leading and trailing lugs 70, 72 mounted upon the endless chains 66, 68 respectively. The lug sets 70, 72 convey the carton blank downstream to the set-up station shown generally at 74.

[0025] At the set-up station 74, shown in Figure 5, there comprises carton erecting means to part erect the carton blank to define at least one cell. In this embodiment the carton erecting means is provided by a pair of rotating wheel units 76, 78 which, are preferably positioned above and below the carton blank. Of course, the position of the units is not limited to their position shown in the drawings. The rotating wheels 76, 78 can be powered by known drive means, for example a servo motor. In this embodiment, each rotating wheel unit 76, 78 comprises a pair of die members 80, 82, 84, 86 mounted in opposed positions to each rotating wheel by a drive shaft 88, 90 driven by the drive means. In some embodiments, there is a cam track and cam to move the die members through a pre-determined path as described below. In other embodiments, the rotating wheels 76, 78 can comprise more than two die members, if manufacturing requirements or the packaging speed dictate that such a modification be preferable.

[0026] The die members 80, 82 of the upper wheels 76, in this embodiment are identical in construction, so only one of the members 80 is now described in any greater detail. As illustrated in Figures 5a and 5b, the upper rotating wheel 76 comprises the (male) die member 80 formed from a substantially rectangular block 92 mounted to the rotating wheel 76. A protruding portion 94 extends downwardly from the lower surface 100 of the male block. In this embodiment, the protruding portion is shaped to correspond to the width "W" between adjacent fold lines 35, 37, shown in Figure 3, and the remaining portion of the lower surface 100 (only visible in a profile view) is shaped to correspond to partition sections 96, 98 defining the article receiving cells C1, C2.

[0027] Likewise, the lower rotating wheel 78 comprises the corresponding (female) die members 84, 86, each is formed from a substantially rectangular block 102 and mounted to the rotating wheel 78 by a shaft (not shown). The upper surface of the female block comprises a recessed portion 106 (not optionally visible) which is shaped to receive the corresponding protruding portion 94 from the lower surface 100 of male block 92. It can be seen from Figures 5a and 5b that the lower surface is sized to correspond to the shape of the panels forming the internal structure of the cell. Thus, in this embodiment the lower surface of each side of the recessed portion corresponds to dimensions L1 and L2 shown in Figure 3.

[0028] The construction of the carton by the carton erecting means is now described in more detail. As the carton blank 52 is moved forward by the endless chains 60, 68, the lower surface of the carton blank 52 comes into contact with the (female) die member 84 or 86. The block 92 mounted to the upper rotating wheel 76 is rotated in unison with the lower block 102 to come into contact with the upper surface of the carton blank 52. The conveyor 66, 68 and the upper and lower rotating wheels are controlled by suitable control means to coordinate the position of the blank and to control its speed through the set up station to ensure the blank is correctly aligned with respect to the die members. The positions and speeds of the devices can be put in manually or a specific pre-written programme can be loaded into the central processor for control of the packaging machine. The upper and lower blocks 92, 102 continue to rotate, and the cam track and cam arrangement within the rotating wheels 76, 72 cause the blocks to move towards each other and to interengage, whereby the protruding portion 94 is received in the corresponding recessed portion 106. Those portions 96, 98 of the side panel 16 forming the partition structure are thereby pushed in an upward direction and folded about fold lines 35, 37 to erect a pair of display windows or cells C1, C2, as shown in Figures 5a and 5b. In this embodiment, folding the partition panels 96, 98 causes the end panels 22, 26 to be automatically folded about fold lines 38 and 42 respectively and into a substantially perpendicular relationship with side panel 16. The upper and lower blocks 92, 102 are then separated to release the carton blank 52 as it moves forward to the loading station 150 by the leading and trailing lugs 70, 72 on the endless chains

66, 68. It is envisaged that the setting up station 74 and the process of "punching" the carton into a part erected form is a continuous process so that the carton is moved in a continuous forward direction as the carton erecting operation is performed.

[0029] If an alternative type of blister pack is required to be packaged, then the blocks 92, 102 are connected to the rotating wheel units by suitable detachable securing means (not shown), for example quick release mechanism, so that the blocks can be interchanged with a second pair of differently configured blocks which can be used to part erect a second carton type.

[0030] After the cartons have been part erected to define article receiving cells, they are successively transferred to the loading station 150 shown in Figures 4 and 6 by which the cartons move downstream by the pair of side lug chain sets 66, 68.

[0031] At the loading station 150, articles (A), for example batteries, are fed into the machine 50 by an infeed conveyor 152. The line pressure of the batteries is controlled by suitable control means for example, an in feed star wheel 154, as is well known. Thereafter, the articles may be transferred from the infeed conveyor 152 to an article grouping means, for example a conveyor 156, shown in Figure 6. In this embodiment, the article grouping conveyor 156 separates the articles into groups of the desired number for each carton, by means of a series of channels 158 mounted to an endless chain 160. The articles (A) are then transferred into the plurality of article receiving cells, C1, C2 (for example, two) of the carton by suitable means.

[0032] As shown in Figure 6, the channels 158 are organised into groupings, whereby each grouping 162 corresponds to a given number, for example four, of articles to be loaded into the carton. Suitable guide means (not shown), for example, a guide rail or static guide, are used to push the articles into the respective cells C1, C2, and the grouping conveyor 156 is controlled by suitable control means so that endless chains 160, 165 move in unison so that the flow of articles (A) can be introduced to the carton blank 52 at the same rate as the carton blank flow.

[0033] In the class of embodiments which include cartons with more than one article receiving cell, the channels 158 are adapted to diverge into sub-groupings 164 whereby each sub-group 164 is spaced to align an article or articles (A) held in each sub-group (164) with one of the article receiving cells C1, C2. As shown in Figure 6, each sub-grouping is shaped to provide channels 158 which are substantially parallel to corresponding article receiving cells C1, C2 in order to provide in-line parallel access to the aforesaid cells.

[0034] Optionally, the machine may include a device 200 shown in Figure 8 for causing a label 202 affixed to an article (A) to be oriented to a pre-determined display position. Preferably, the articles to be packaged include a portion protruding 204 outwardly of the article in a fixed position relative said label. As shown in Figure 7, the protruding portion 204 is formed by the side edges 206, 208 of the label 202 being placed in an overlapping relationship. As the articles are moved forward, they are inserted into support means 210 adapted to support the articles (A). As shown in Figure 8a, the support means 210 comprises a group of channels (or holding combs) 212 adapted to receive part of an article. In this embodiment, each channel comprises a support surface 214 which substantially corresponds to the shape and configuration of the outer surface of the article (A). Of course, the different profiles of channel can be used, for example, a square section, without departing from beyond the scope of the invention. Adjacent each channel 212 there comprises abutment means 216 adapted to restrain the protruding portion 204 of the article. In this embodiment, abutment means 216 is provided by a surface 218 connecting adjacent channels 212 that is used as the pre-set stop or obstacle, shown in Figure 8b.

[0035] Referring again to Figure 8a, each channel 204 is loaded with an article by suitable guide means and the grouped articles are successively moved forward to the orientation means 220 which is adapted to cause the articles to rotate in the support means 210. The orientation means 220, illustrated in greater detail in Figure 8b, comprises an elongate member 222 held in a fixed position relative to the channels 212. The elongate member 222 (or static member) can comprise a strip including a working surface 226. Alternatively, the elongate member 222 can comprise a flexible belt (not shown) held in a fixed position, or driven in a direction substantially opposed to direction "Z" shown in Figure 8b. The working surface 226 preferably includes a layer of friction inducing material 228, for example, rubber or other suitable plastic materials. The strip is connected to a support frame (not shown) by resilient means 230, for example, a spring mechanism. Preferably, the length of the strip 224 should be equal to or greater than the circumference of the article (A) being rotated to ensure that each article can be rotated by up to 360 degrees.

[0036] As shown in Figure 8b, the articles in the channels 214 are moved in direction "Z" and are brought into contact with the orientation means 220. The elongate member 222 comes into contact with the upper portion of the article and as it is fixed relative the articles and channels 214 a tangential force is applied by the orientation means 220 to the articles which makes them rotate. The channels 214 continue to move forward and the articles (A) continue to rotate until the leading edge of the protruding portion 204 comes into abutment with the abutment means 216. Thus, the article is orientated to the correct position and can then be loaded into the cartons.

[0037] Once the article (A) has been oriented to its correct position, the increased resistance of the article when it ceases to rotate applies an upward force to the strip 224. The resilient means 230 is used to reduce the tangential forces applied to the article (A) by the orientation means 220, whereby the elongate member 222

can be moved by small amounts in a vertical plane "Y" in order to prevent or at least minimise the prospect of a carton label 202 being torn or damaged.

[0038] It is envisaged that the article orienting device can be incorporated into a machine described above, for example, at the upstream end of the grouping conveyor.

[0039] At the loading station 150 shown in Figure 6, the groups of articles or sub-groupings are introduced to the carton from one side as the carton and article group are moved forward in unison. The lateral movement of the carton in the loading station is controlled by a pair of guides 159, 161 positioned adjacent the end panels 22, 26 of each carton. It is envisaged that in other embodiments a pressure belt could replace fixed guides or, where appropriate, those particularly mounted endless chain and lug sets could be used.

[0040] In order to load the cartons, those panels of the blank between the cells and articles are folded downwardly by suitable guide means to allow the grouping device to be juxtaposed the cells. In this embodiment, support panel 12 and top panel are folded into a substantially perpendicular relationship with front panel 16 about fold line 32 as shown in Figure 6. Once the cartons have been loaded with articles, they are transferred by means of a conveyor 163 and/or a pressure belt to a further set of endless chains 165 with side lugs which are used to transfer the carton to the outfeed end of the machine, shown in Figure 4. During this stage, the second support panel 20 is folded upwardly, and around the articles, by means of guide means, for example a fixed guide (not shown) and the support panel 12 is folded back upwards so that top panel 14 is folded to abut the loading end of the cells C1, C2. The end panels 22, 26 are folded about fold lines 38, 42 to enclose the article receiving cells C1, C2 by suitable folding means, for example a folding wheel 167 and glue flaps 24, 28 are connected to the partition panels 96, 98 respectively by glue or other means known in the art. Support panel 12 is then folded into face contacting relationship with panel 20 and are secured together by suitable securing means, for example glue or other means known in the art. Thereafter, pressure belts 169 can be applied to the carton to firmly secure the support panels 12, 20 in place and to complete the forming process.

[0041] It is envisaged that the devices of the present invention and, in particular, the carton erecting means, the article selecting and grouping means, the article separating and loading means and label aligning means can be incorporated into a variety of other packaging machines. Alternatively, these devices can be sold as an individual module to be fitted to new equipment or to existing equipment on a retrofit basis.

[0042] Further modifications may be made without departing from the scope of the present invention. In particular, alternate sensors and alternate means of positioning each of the moveable articles may be utilised without departing from the scope of the invention as claimed in the accompanying claim. In addition, while the preferred embodiment described herein is for loading batteries into cartons, it will be recognised that the invention is not limited to cartons for batteries. The invention may be used with the machines for packaging cans, paperboard bricks, bottles and other containers into cartons. Further, the present invention is able to process cartons comprising numerous configurations of groups of articles covering a range of carton sizes and shapes, for example two , four, six or eight articles, without undue time being spent in adjusting the mechanism.

Claims

1. A mechanism for causing a label (202) affixed to an article (A) to be oriented to a predetermined display position wherein the article includes a portion protruding (204) outwardly of the article in a fixed position relative said label, wherein the mechanism comprises support means (210) adapted to support an article, orientation means adapted to cause the article to rotate in the support means (210) until the protruding position is restrained by abutment means (216) formed in said support means.

2. The mechanism as claimed in claim 1 wherein one edge of the label (202) affixed to the article overlays an opposed edge of said label to define said protruding portion (204).

3. The mechanism as claimed in claim 1 or claim 2 wherein the support means (210) comprises a channel (212) including a support surface (214) to retain part of the article within said channel.

4. The mechanism as claimed in claim 3. wherein said support surface (214) substantially corresponds to the exterior surface of said retained part of the article.

5. The mechanism as claimed in any of claims 1 to 4 wherein the orientation means (220) comprises an elongate member (222) connected to resilient means (230), wherein said elongate member is adapted to abut a portion of said article as said support means (210) is moved in a substantially parallel plane to said elongate member such that a tangential force is applied to said abutting portion of the article to cause the article to rotate.

6. The mechanism as claimed in claim 5 wherein said resilient means (230) is adapted to reduce said tangential force when said protruding portion (204) is restrained by said abutment means (216).

7. The mechanism as claimed in any of claims 1 to 6 wherein the abutment means (216) is formed from

an upper edge of said channel (212).

8. A method of orienting to a predetermined display position wherein the article includes an outwardly protruding portion (204) in a fixed position relative said label (202) a label affixed to an article (A) which method comprising the steps of supporting the article in support means (210) during forward movement, rotating the article within the support means until the protruding portion abuts a portion of the support means and retaining the article in its desired orientation for loading into a carton.

9. The method as claimed in claim 8, further comprising the step, prior to step (ii) of orienting a label (202).

10. A mechanism for grouping a plurality of articles which mechanism comprising an endless series of channels (158) along which articles may be transferred into a plurality of article receiving cells (CI, C2) of a carton wherein the channels are organised into groupings (162) whereby each grouping corresponds to a given number of articles to be loaded in the carton.

11. The mechanism as claimed in claim 10 wherein the channels (158) are adapted to be substantially parallel to one another and then diverge into sub-groupings (164) wherein each said sub-group is spaced to align an article held in each said sub-group with one of said article receiving cells corresponding to each one of the cells of each carton and wherein the sub-groupings are each substantially parallel to one to provide in line parallel access to the cells.

12. A packaging machine for loading a plurality of articles (A) into a carton (52) which mechanism comprises carton erecting means for part erecting said carton to define a first article receiving cell (C1), means for selecting a group of articles comprising at least two articles, means for separating said grouped articles from an adjacent like group of articles, means for loading said grouped articles into said first article receiving cell through an open end thereof in the packaged carton and a means for completing the construction of the carton **characterised in that** said carton erecting means comprises complementary die members (80, 82, 84, 86), each said die member being mounted to a rotating wheel (76, 78) wherein each said complementary die member is adapted to inter engage when a carton blank (10) is positioned between the two members, such that said die members cause the blank to be folded to define said article receiving cells.

13. A packaging machine as claimed in claim 12 further comprising the mechanism of any of claims 1 to 7 to orientate said group of articles prior to loading the articles into the carton.

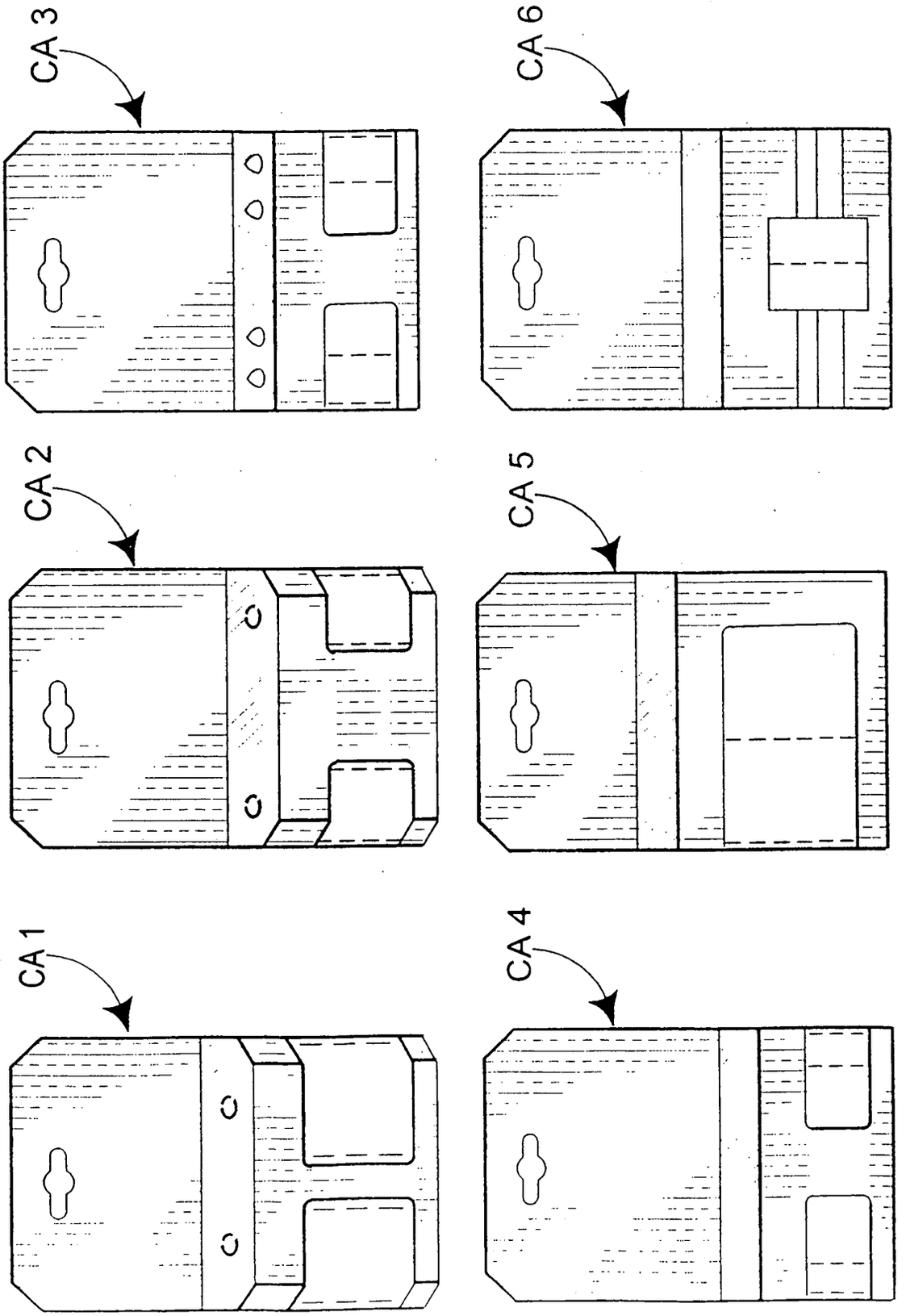

FIGURE 1

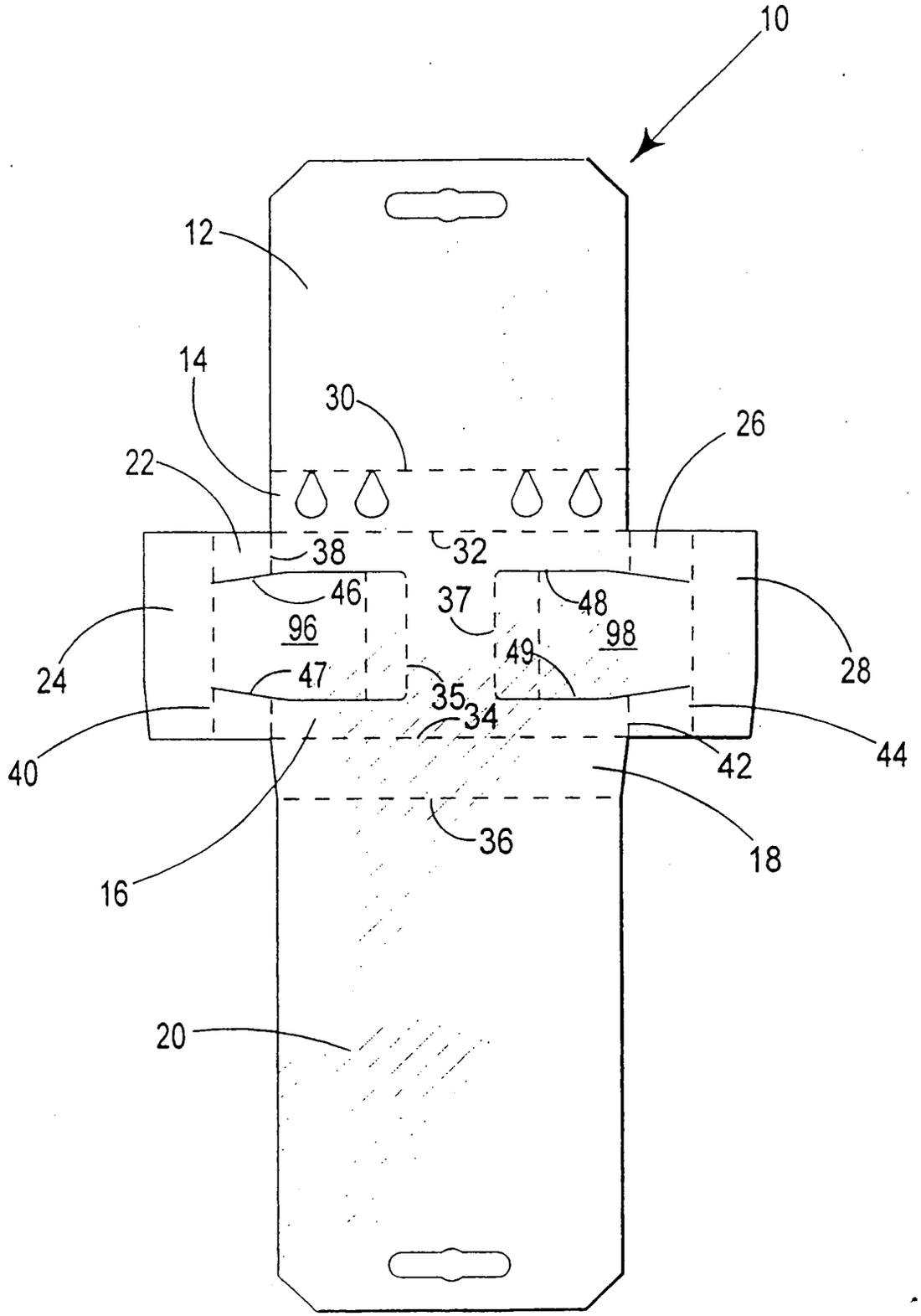
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FIGURE 2

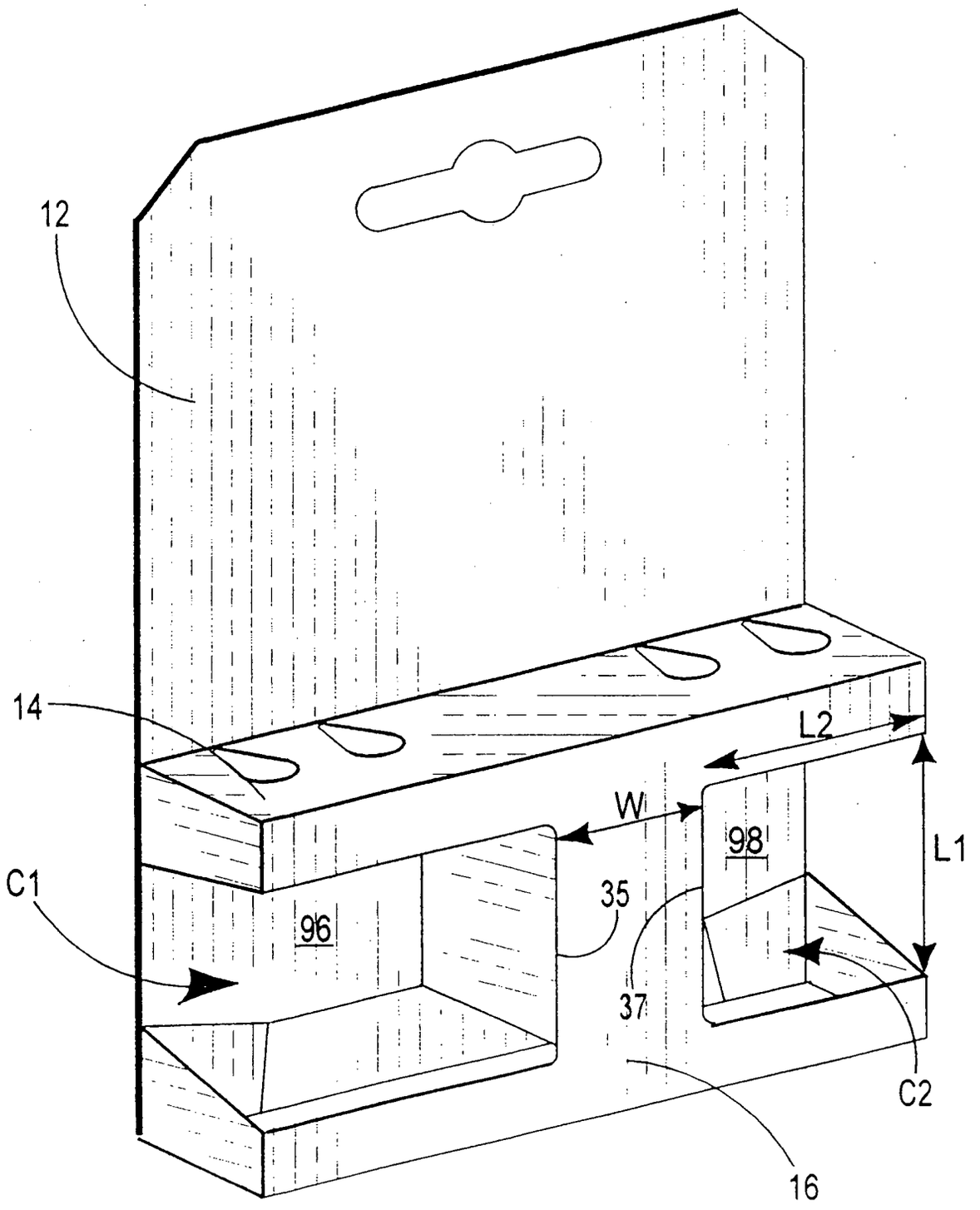

FIGURE 3

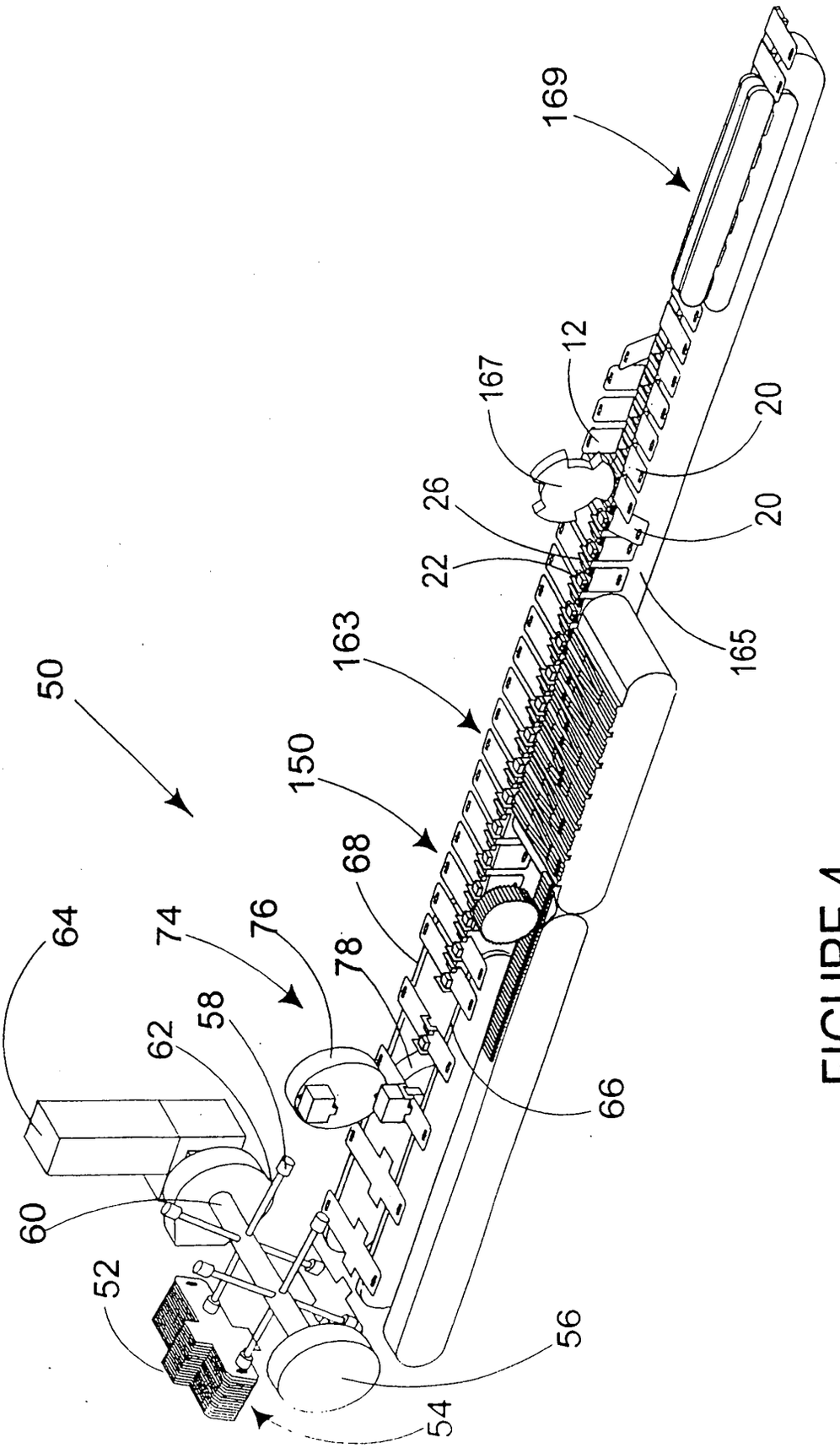
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FIGURE 4

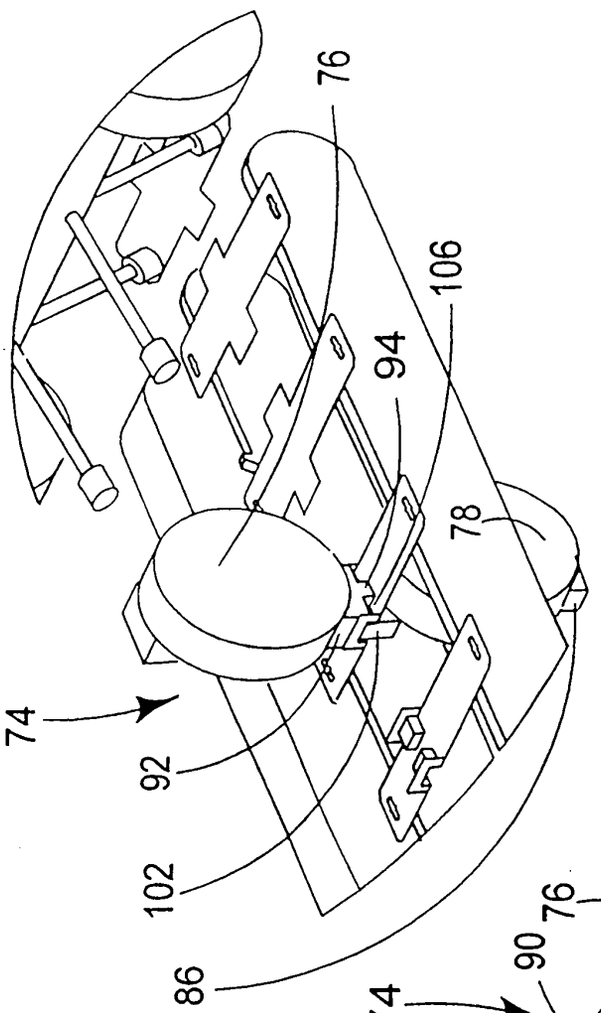

FIGURE 5b

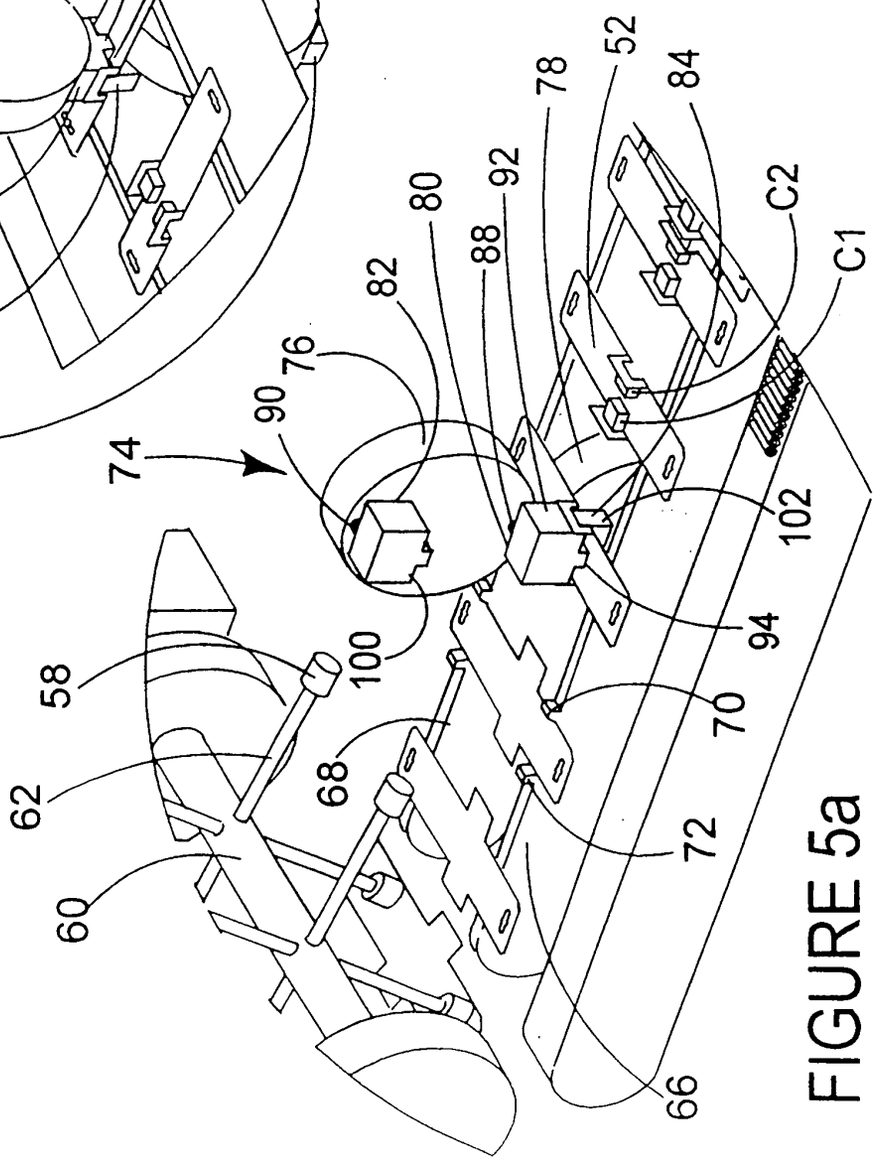

FIGURE 5a

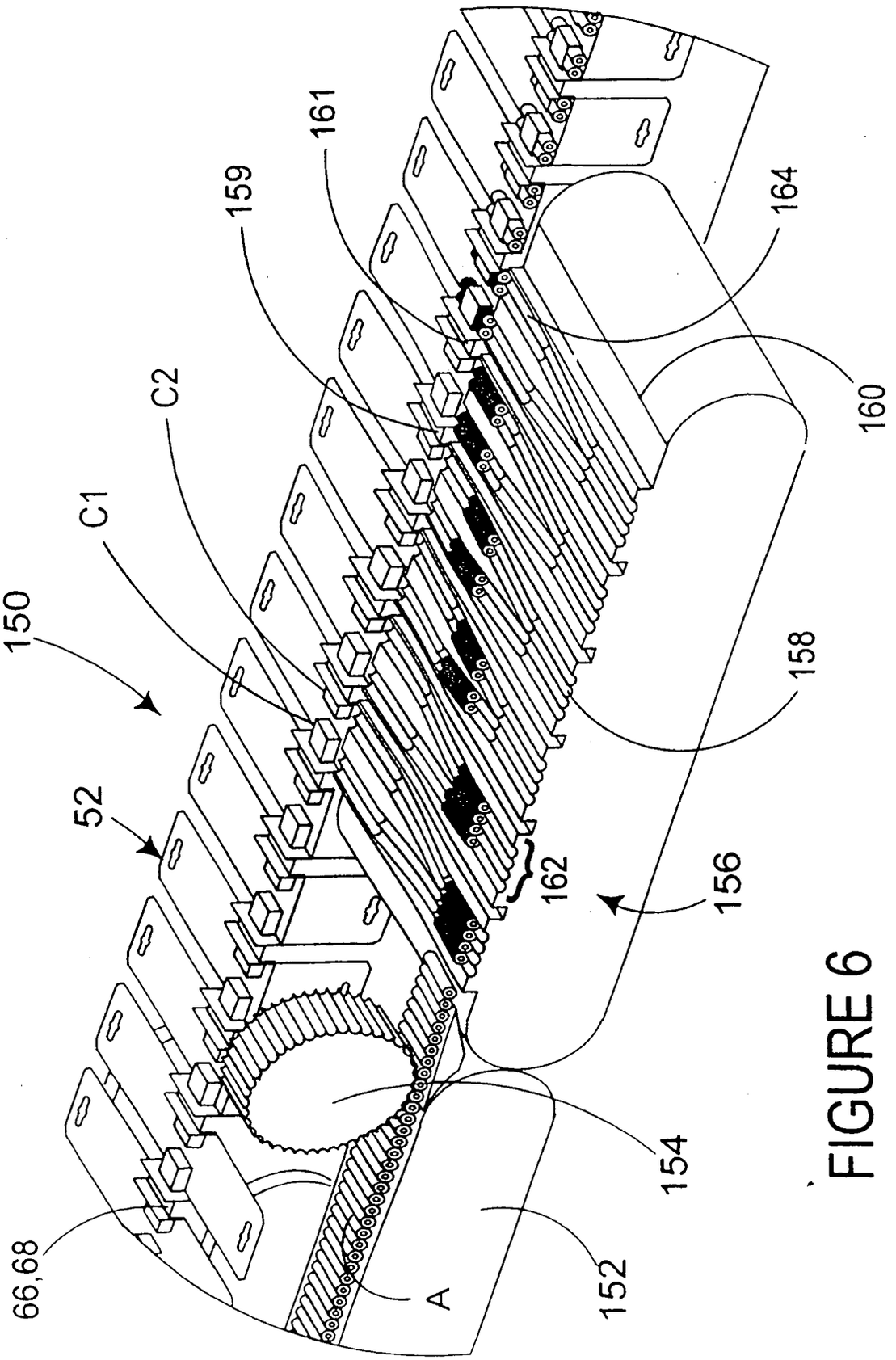

FIGURE 6

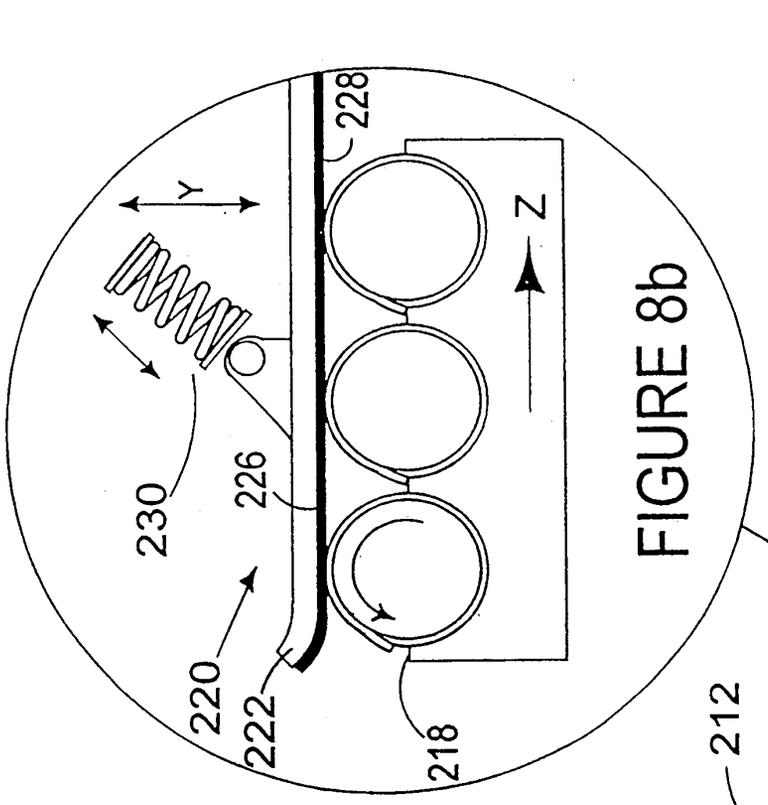

FIGURE 8b

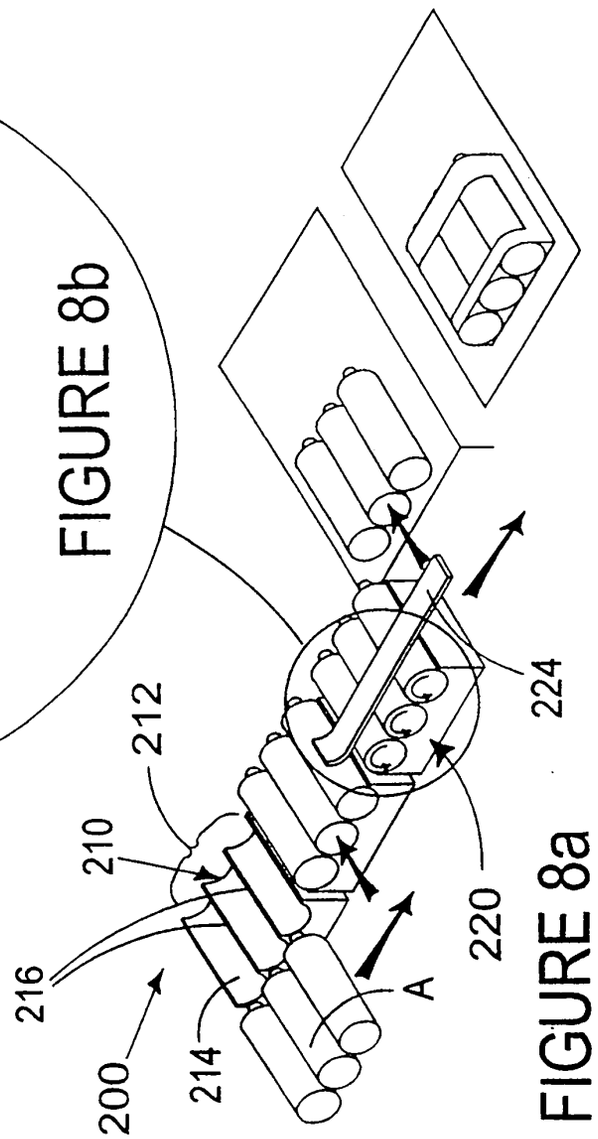

FIGURE 8a

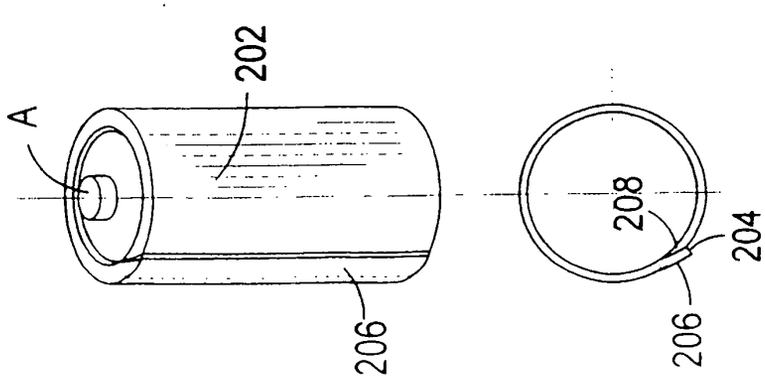

FIGURE 7