MACHINE FOR MAKING DIAPERS

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Filed: April 6, 1970

Appl. No.: 25,851

U.S. Cl. 270/61, 223/37, 270/69
Int. Cl. B65H 45/00
Field of Search 270/61, 62, 69; 223/37, 38; 128/287

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ABSTRACT

A method and apparatus for folding and packaging diapers is disclosed. The diapers are folded on a collapsible suction plate having hinged sections corresponding to the folded portions of the diapers. At the completion of the folding operation each diaper is fed into the nip of a pair of suction discharge rolls. The suction of the rolls is arranged so that the folded diapers are successively discharged and stacked in alternate corners of an inverted packaging carton placed over the rolls.

16 Claims, 7 Drawing Figures
MACHINE FOR MAKING DIAPERS

This invention relates primarily to sheet folding methods and apparatus and more particularly concerns automated methods and apparatus for folding disposable diapers into substantially child-conforming shape.

In recent years new materials and advanced manufacturing techniques have made possible the mass production of disposable diapers which can effectively compete with conventional laundered diapers. This is particularly true of those disposable diapers which include a fluid-impervious backing sheet that takes the place of the separate plastic or rubber panties normally required for use with conventional launderable diapers. However, the incorporation of such a fluid-impervious exterior for disposable diapers makes it even more essential that the diaper be properly folded into a body-conforming shape in order to enhance the holding capacity of the diaper as well as avoid unnecessary contact of the impervious cover with the infant's skin which might cause irritation.

A disposable pre-folded diaper meeting the foregoing requirements is disclosed in Hrubeczyk U.S. Pat. No. 3,196,874. As disclosed there such diapers are machine embossed or otherwise creased along designated pre-fold lines to facilitate subsequent folding of the diaper into substantially child-conforming and excrement entrapping configuration. This does, of course, make it much easier to pre-fold the diaper; but, nevertheless, even with skilled personnel the number of diapers that can be folded is limited.

Accordingly, it is the primary aim of the present invention to provide a method and apparatus for pre-folding and packaging disposable diapers on a high volume production basis.

It is a more specific object to provide a method and apparatus for quickly and positively folding each diaper in the desired body-conforming shape as the diapers are successively delivered to the folding apparatus.

Another object of the invention is to provide a method and apparatus for packaging the diapers in alternating stacks in a carton with the portions of the diapers in both stacks which are not interfolded arranged in overlapping and interleaved relation to compensate for the thicker interfolded portions of the diapers disposed in the corners of the carton.

A more detailed object is to provide a method and apparatus for packaging diapers as described above which is correlated with the folding apparatus so that the folded diapers are withdrawn from the folding apparatus by the alternate stacking equipment.

Other objects and advantages of the invention will become more readily apparent upon reading the following detailed description and upon reference to the drawings in which:

FIG. 1 is a partial side elevation of the diaper folding and packaging apparatus of the present invention;

FIGS. 2 and 3 are sections taken along lines 2—2 and 3—3 in FIG. 1;

FIG. 4 is an enlarged perspective view of the folding apparatus;

FIG. 5 is a plan view of a diaper blank before folding with the fold lines shown in dash lines;

FIG. 6 is an enlarged fragmentary side elevation, partially in section and somewhat schematic in form, of the folding and stacking apparatus shown in FIG. 1; and,

FIG. 7 is a perspective view of a previously folded diaper, partially unfolded to illustrate the interfolded portions.

Turning now to the drawings, there is shown in FIG. 1 a diaper folding and packaging machine 10 including folding apparatus 11 and packaging apparatus 12 for folding and packaging diapers in accordance with the method of the present invention. This folding and packaging apparatus has particular utility in automatically folding pre-cut diaper blanks 13 (see FIG. 5) into diapers 14 (see FIG. 7) which have a substantially child-conforming shape as disclosed in the previously mentioned Hrubeczyk U.S. Pat. No. 3,196,874 and for packaging the diapers in alternately overlapping stacks (see FIG. 6) in a shipping container or carton 15 (see FIGS. 1 and 3). However, it should be understood that certain aspects of the method and apparatus disclosed also have utility for folding and packaging other precut blanks of material in addition to diapers.

As previously mentioned the preferred form of the prefolded diaper is of a substantially body-conforming and excrement entrapping configuration as disclosed in the above-mentioned Hrubeczyk patent. As illustrated here in FIG. 7, such a pre-folded diaper 14 is formed with front and rear triangularly shaped, body encircling portions A and B joined by a depending excrement trapping pocket C adapted to be disposed centrally in the crotch area and by reversely interfolded leg engaging portions D, only one of which is shown. This is the final product of the folding apparatus 11 disclosed here.

The initial diaper blank 13 is illustrated in FIG. 5 with a preliminary fold line indicated by dash line 16 extending transversely across the diaper blank 13 through its center 17. Diagonally disposed fold lines 18 and 19 which intersect at the center 17 to define the triangular legs of portions A and B are shown in dash lines as are intersecting interfold lines 20 and 21 which separate the pocket C from the leg engaging portions D on each side of the longitudinal center line of the diaper blank 13.

In their preferred form, the diaper blanks 13 are of multi-layer construction such as disclosed in copending Endres application Ser. No. 715,301 filed Jan. 14, 1970, now U.S. Pat. No. 3,520,303, to which reference may be made for further details. Such diaper blanks may be made on a disposable diaper forming apparatus such as disclosed in copending Frick application Ser. No. 776,580, filed Nov. 18, 1968, now U.S. Pat. No. 3,629,038 to which reference may also be made for further details of the blank forming apparatus. Both of the foregoing applications are also assigned to the instant assignee.

The particular construction of the diaper blanks and the apparatus for making them, however, need not follow the teaching of the two above-mentioned applications. Rather the blanks can be of other constructions formed on other types of apparatus and, indeed, as noted above need not be intended for diapers insofar as practicing certain aspects of this invention as described below. Accordingly, only the discharge conveyor portion 22 of a blank forming apparatus is illustrated in FIG. 1 and it will be understood that this could also be a delivery conveyor since the forming apparatus need not be disposed inline with the folding and stacking
machine 10 which is the subject of the present invention.

As seen in FIGS. 1 and 2, the diaper blanks 13 are conveyed to the folding apparatus 11 in spaced-apart, end-to-end relation on a pair of laterally spaced conveyor belts 23 and 24 driven by a power source (not shown). Since the diaper blanks are normally formed with their outside, preferably a fluid-impervious layer, facing down, it is necessary to invert them before they are folded. Such inverting mechanism may take many different forms but, in the illustrated machine, it is shown as a rotating swing arm 25 mounted on a shaft 26 journalled in bearings at the end of the conveyor frame. The shaft 26 is driven by a motor 27 through a suitable belt and pulley arrangement to rotate the arm 25 in the direction of the arrow shown in FIG. 1 in timed relation to movement of the diaper blanks 13 on the conveyor belts 23, 24. The arm 25 is located centrally between the belts 23, 24 and carries a short cross bar 28 at its end for lifting the diaper blank from the conveyor and flipping it over.

In accordance with the present invention, the diaper blanks 13 are placed on a substantially flat surface 30 of the folding apparatus 11. The folding surface 30 is generally rectangular and is formed of a plurality of perforated sections hinged together along lines 36—41 corresponding to the lines 16—21 along which the diaper blank 13 is folded. A vacuum is drawn on the other side of the surface to hold the diaper blank on the surface 30 and the diaper is folded by bringing the ends of the surface together to collapse the surface along the hinge lines 36—41 (FIG. 6).

In FIG. 4 the surface 30 is shown partially collapsed. As seen here, the medially located transverse hinge line 36 has a pair of alternately inwardly and outwardly folding portions 36a and 36b on either side of the center point. As the surface 30 is collapsed these portions of the transverse hinge line 36 are brought together in a tight W-shaped configuration. The other hinge lines 38—41 are symmetrically disposed on either side of the longitudinal center line of the surface 30. It will be noted that hinge lines 38 and 39 intersect at the center point 37 of the surface and extend diagonally to the edge to form an isosceles triangle. Similarly, hinge lines 40 and 41 intersect at the point separating the two alternately folding portions of the transverse line 36. These lines also extend diagonally to the edge of the surface to form another isosceles triangle having a common base with the triangle formed by hinge lines 38, 39.

At its opposite ends, the surface 30 is hinged at 42 and 43 to respective end plates 44 and 45 which are pivotally interconnected at their lower ends by a hinge pin 46. In the illustrated embodiment, one end plate 44 is mounted on a stationary frame 47 secured to the floor and the other end plate 45 is coupled to an actuator 48 also secured to the floor. While the actuator 48 may take many other forms, the one illustrated here is an air cylinder operated by compressed air. In other respects the cylinder 48 is conventional and it will be understood that suitable valves such as solenoid valves (not shown) are energized in timed relation to movement of the diaper blanks 13 on the conveyor belts 23, 24. A photocell sensor (not shown) may be used, for example to control actuation of the air cylinder.

To keep the diaper blank on the perforated folding surface 30 a vacuum is drawn on its underside. For this purpose a suitable vacuum source such as a vacuum pump 50 is provided. The vacuum is drawn from the underside of the surface 30 through conduit 51 by the pump 50. The space between the side edges of the folding surface 30 and the end plates of course is sealed, preferably by flexible side walls 52 only one of which is shown.

Upon actuation of the air cylinder 48 the folding surface 30 is collapsed along hinge lines 36—41 as the ends of the surface are brought together. Due to the proportioning of the hinged sections of the surface and by arranging for the hinge lines 38 and 39 to hinge oppositely relative to hinge lines 40 and 41, the center point 37 is forced upwardly and the diaper blank 13 is interfolded into the configuration shown in FIG. 7.

To withdraw the folded diaper from the folding surface, a pair of take-away rolls 55 and 56 are provided. The rolls 55, 56 are preferably disposed above the folding apparatus 11 with their axis parallel to the transverse center line 36 of the folding surface 30 and form a nip into which the diaper is fed as the collapsing of the surface is completed (see FIG. 6). The rolls rotate in the direction indicated by the arrows and pick the diaper 14 from the collapsed folding surface 30 and crease the diaper along fold lines 16—21.

Pursuant to another aspect of the invention the rolls 55, 56 form part of the packaging apparatus 12 and operate to place successive diapers in alternate stacks within the carton 15. To this end, the rolls 55, 56 and provided with perforated peripheries 57 and 58 respectively extending partially around their circumference and a vacuum is drawn through the rolls by a vacuum pump 60. In addition, the rolls are driven in timed relation to the operation of the folding apparatus 11 so that the perforated portion of one roll registers with an unperforated portion of the other roll. Thus successive diapers are discharged in opposite directions due to being alternately drawn by the vacuum to the respective perforated peripheries 57, 58 of the rolls 55, 56.

In order to release the diapers from the peripheries 57, 58 each roll is provided with a radially extending internal vacuum cut-off vane 61, 62. Thus as the perforated portion of the roll passes over the vane the vacuum is broken and the diaper is released. A pair of curved stacking guides 63, 64 adjacent each roll 55, 56, also intercept the leading edges of the diapers and direct them into opposite corners of the carton 15. As seen in FIGS. 1 and 3, the carton 15 is positioned over the rolls 55, 56 with its open end down and with one pair of diagonally disposed corners lying in a plane with the nip of the rolls.

With the diapers folded in the preferred form disclosed here, a square packaging carton 15 may be used. It will also be appreciated that the interfolded portion of the diaper is substantially thicker than the remaining portion of the diaper. For this reason it is desirable to overlap and interleave the trailing portions of the diapers as they are alternately stacked in the carton. This not only helps to even out and keep the stacks straight, but also makes maximum use of the space within the carton.

When the desired number of diapers are stacked in the inverted carton 15, it is lifted off the stacking app-
paratus 11 and turned right side up. For convenience it may be placed on a conveyor 70 which takes it to a suitable carton sealing machine (not shown). Another conveyor 71 is preferably provided to bring empty cartons 15 to the stacking apparatus 11.

While the invention has been described herein in connection with certain preferred methods and apparatus we do not intend to limit the invention to the specific procedure described or the embodiments shown. On the contrary we intend to cover such alternative and equivalent methods and apparatus as fall within the spirit and scope of the appended claims.

We claim as our invention:
1. The method of folding disposable diaper blanks into substantially infant-conforming configuration, comprising the steps of: placing one of the diaper blanks on one side of a substantially flat perforated surface, said flat surface formed by a plurality of sections hingedly connected together so that all sections can be simultaneously collapsed together, said sections formed by two diagonal hinge lines extending from opposite sides of said flat surface and intersecting at the center of said flat surface to form four sections comprising a pair of opposite end sections and a pair of opposite side sections, a central hinge line bisecting said side sections and intersecting said diagonal hinge lines at said center of said flat surface, drawing a vacuum from the other side of the surface to hold the diaper blank on the surface; simultaneously collapsing said flat surface along said hinge lines to fold the diaper blank by bringing said end sections of the surface together with said side sections interfolded therewith; and withdrawing the folded diaper from said collapsed surface.

2. The method defined in claim 1 wherein said surface before being collapsed is substantially rectangular in shape.

3. The method defined in claim 2 wherein said hinge lines interconnect portions which when said surface is collapsed are brought substantially together in a tight W-shaped configuration.

4. The method defined in claim 3 wherein said hinge lines are symmetrically disposed on either side of the longitudinal center line of the surface and include lines on each side of said longitudinal center line which, together with said diagonal hinge lines and a line forming a substantial portion of the longitudinal edge of the surface as a common base, form a pair of nested isoceles triangles whose apices are located on said central hinge line, one at the center thereof and the other at a point between the center and the longitudinal edge on that side of the center line.

5. The method defined in claim 1 wherein said end sections are brought together to collapse said surface with the diaper blank on the outside thereof.

6. The method defined in claim 5 wherein said folded diaper is withdrawn by a pair of counter-rotating rolls forming a nip and said diaper is fed into said nip as the collapsing of said surface is completed.

7. The method defined in claim 6 wherein each of said rolls is perforated around substantially half of its circumference and said rolls are timed so that the perforated portion of each roll registers with the unperforated portion of the other roll and a vacuum is drawn through said rolls so that successive diapers fed through said nip are discharged in opposite directions.

8. The method defined in claim 7 wherein said rolls are arranged to discharge and position the diapers in alternately interleaved stacks.

9. Apparatus for folding disposable diaper blanks into substantially infant-conforming configuration comprising in combination,

a substantially rectangular folding surface having a plurality of perforated sections hinged together along lines dividing said surface into a plurality of triangular areas symmetrically disposed with respect to both the longitudinal and transverse center lines of said surface;
one of said hinge lines lying on said transverse center line and;
said other hinge lines being disposed symmetrically on either side of said longitudinal center line and including on each side thereof two pairs of lines which, together with a line forming a substantial portion of the longitudinal edge of the surface as a common base, form a pair of nested isoceles triangles whose apices are located on said transverse hinge line, one at the center thereof and the other at a point between the center and the longitudinal edge on that side of the center; and,
means for collapsing said surface along said hinge lines to fold a diaper placed on said surface into a W-shaped cross sectional configuration as viewed in the plane containing said transverse hinge line.

10. Apparatus as defined in claim 9 including means for drawing a vacuum from the other side of the surface to hold the diaper blank thereon.

11. Apparatus for folding disposable diaper blanks into substantially infant-conforming configuration comprising, in combination: a substantially flat perforated surface, said flat surface formed by a plurality of sections hingedly connected together so that all sections can be simultaneously collapsed together, said sections formed by two diagonal hinge lines extending from opposite sides of said flat surface and intersecting at the center of said flat surface to form four sections comprising a pair of opposite end sections and a pair of opposite side sections, a central hinge line bisecting said side sections and intersecting said diagonal hinge lines at said center of said flat surface, means for drawing a vacuum through said perforated surface; and means for simultaneously collapsing said surface along said hinge lines to fold the diaper blank by bringing said end sections of the surface together with said side sections interfolded therewith.

12. Apparatus as defined in claim 11 including a pair of counter-rotating discharge rolls forming a nip into which the diaper blank is fed as the collapsing of said surface is completed.

13. Apparatus as defined in claim 12 wherein each of said rolls is perforated around substantially half of its circumference and said rolls are timed so that the perforated portion of each roll registers with the unperforated portion of the other roll and a vacuum is drawn through said rolls so that successive diapers fed through said nip are discharged in opposite directions.

14. Apparatus as defined in claim 13 wherein each of said rolls includes a radially directed internal vane adapted to break the vacuum and release the diaper as the perforated peripheral portion of the roll passes by.

15. Apparatus as defined in claim 13 including a pair of curved stacking guides disposed in straddling rela-
tion to the rolls to intercept the leading edge of the successive diapers as they are alternately discharged by said rolls.

16. Apparatus as defined in claim 13 wherein said rolls are arranged to discharge and position the diapers in alternately interleaved stacks.