United States Patent [19]

Spencer et al.

[11] **3,905,592**

[45] **Sept. 16, 1975**

[54] **FOLDING APPARATUS**

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[73] Assignee: **Kimberly-Clark Corporation**, Neenah, Wis.

[22] Filed: **Nov. 15, 1973**

[21] Appl. No.: **416,050**

Related U.S. Application Data

[62] Division of Ser. No. 177,301, Sept. 2, 1971, Pat. No. 3,782,714.

[52] **U.S. Cl.** ..... **270/61 R**

[51] **Int. Cl.²** **B65H 45/00**

[58] **Field of Search** 270/61

[56] **References Cited**

UNITED STATES PATENTS

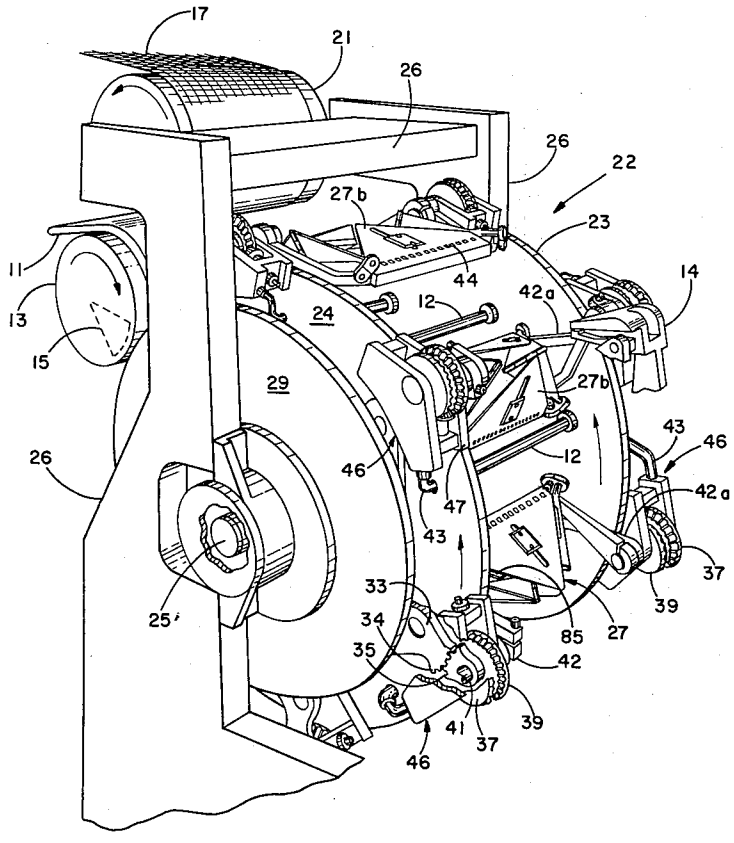
2,328,814 9/1943 Laukhuff ..... 270/61 R

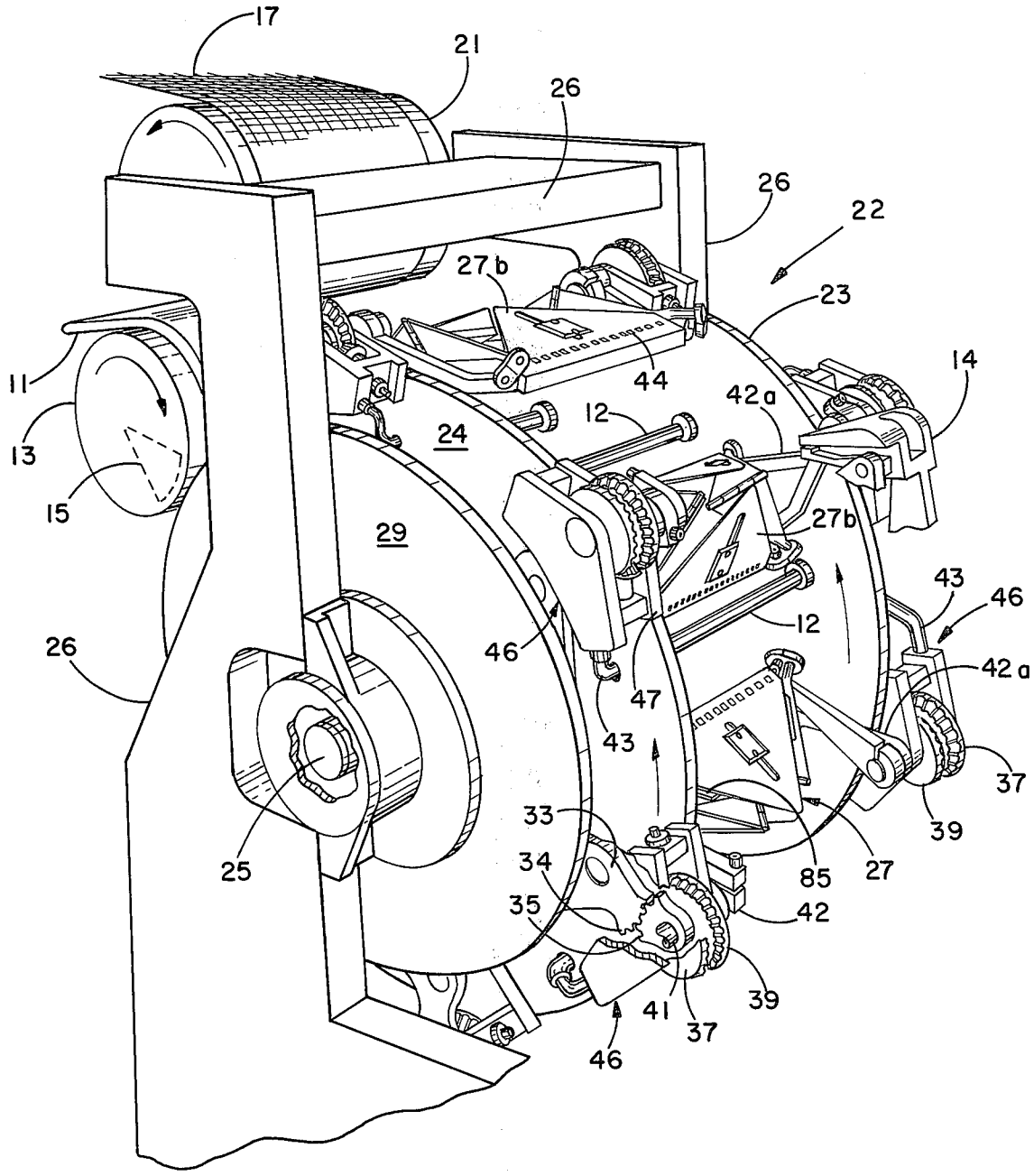
Primary Examiner—Robert W. Michell
Assistant Examiner—A. Heinz
Attorney, Agent, or Firm—Kimberly-Clark Corporation

[57] **ABSTRACT**

Apparatus for folding sheet material in which apparatus panels disposed in opposed relation form a receiving surface for the receipt of sheet material to be folded. The panels are provided with vacuum ports which the sheet material overlies and the production of suction pressure retains the sheet material securely on the forming board. The panels are pivotally mounted such that they are movable between a position in which the oppositely disposed panels lie in substantially planar relation and a position in which the panels are in substantially parallel relation. Tucking of sheet material transversely to provide fold lines in the material is accomplished by shaping the panels to appropriate configurations. A preferred form of the apparatus includes a plurality of the folding boards supported on a carrier permitting continuous operation. Additionally, mechanism mounted on the carrier provides for assisting tucking or folding operations.

1 Claim, 23 Drawing Figures

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21
26
26
22
27b
23
44
14
11
42a
12
13
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15
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27b
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46
12
26
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42a
47
43
37
39
33
25
34
85
27
35
42
39
41
37
46

FIG. 1

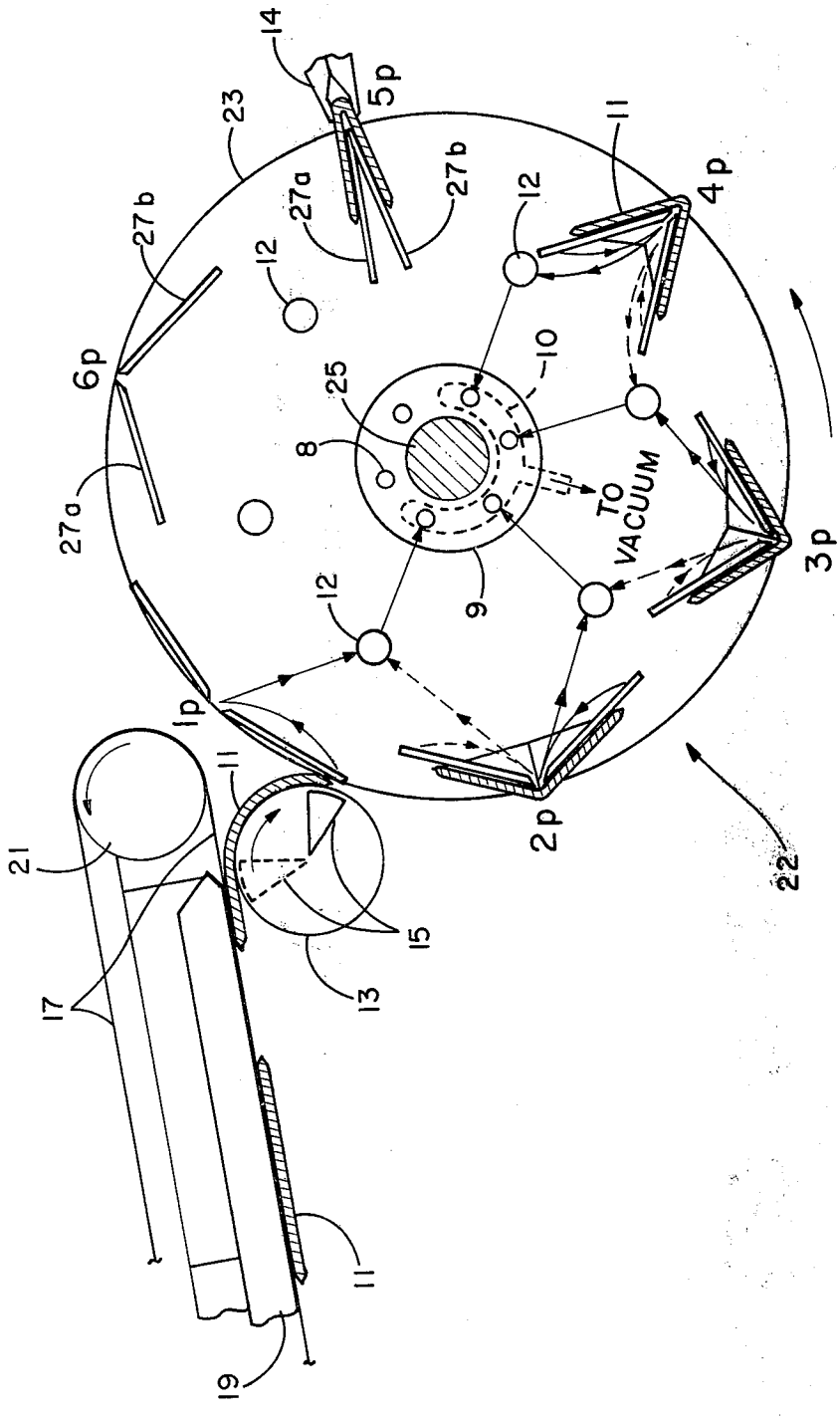
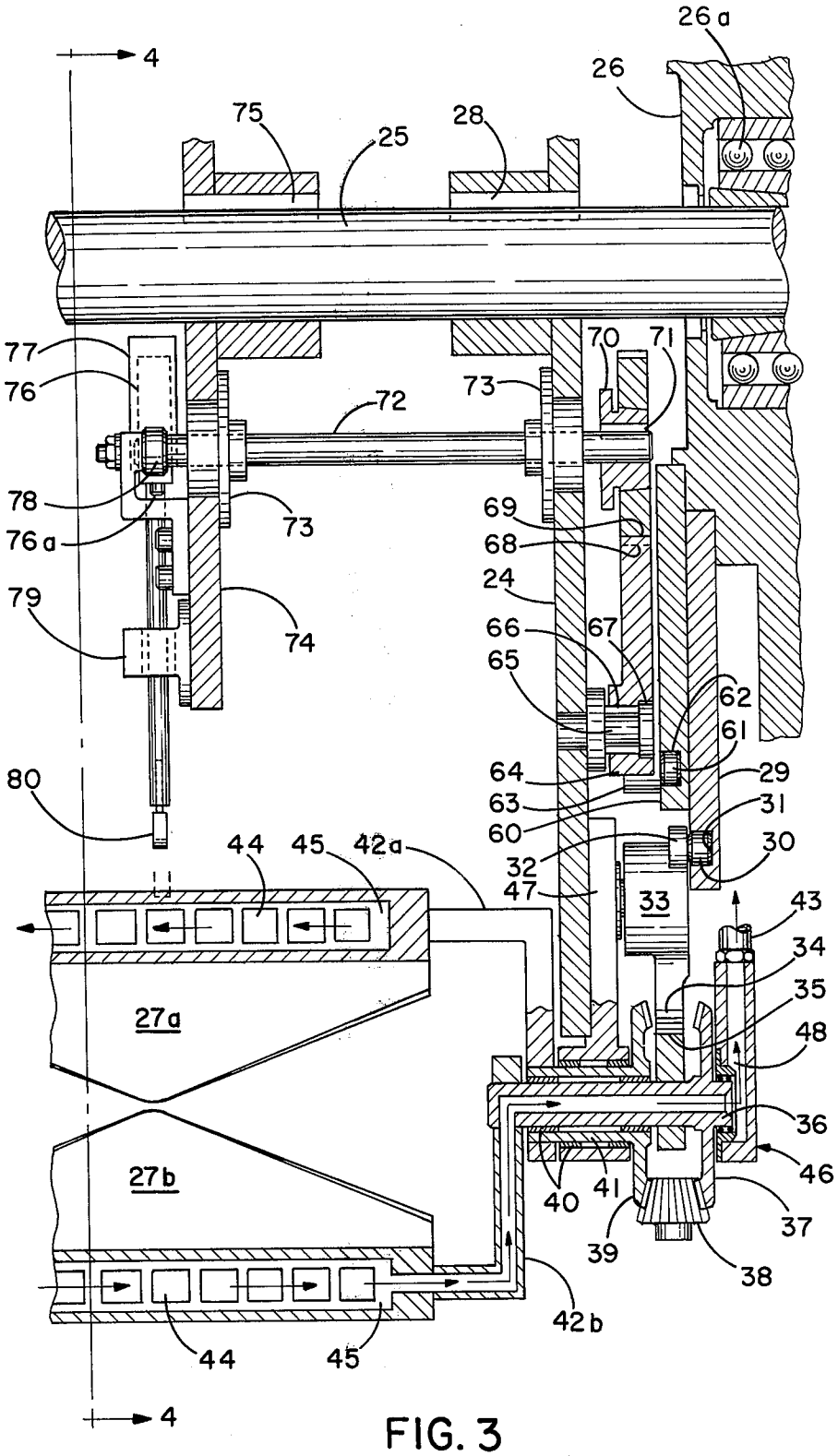

14
5p
23
11
4p
27b
27a
27b
12
12
6p
10
25
8
TO VACUUM
27a
3p
12
9
1p
2p
22
11
21
15
13
17
11
19

FIG. 2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26a
26
75
25
28
77
76
72
73
70
71
78
76a
73
69
68
24
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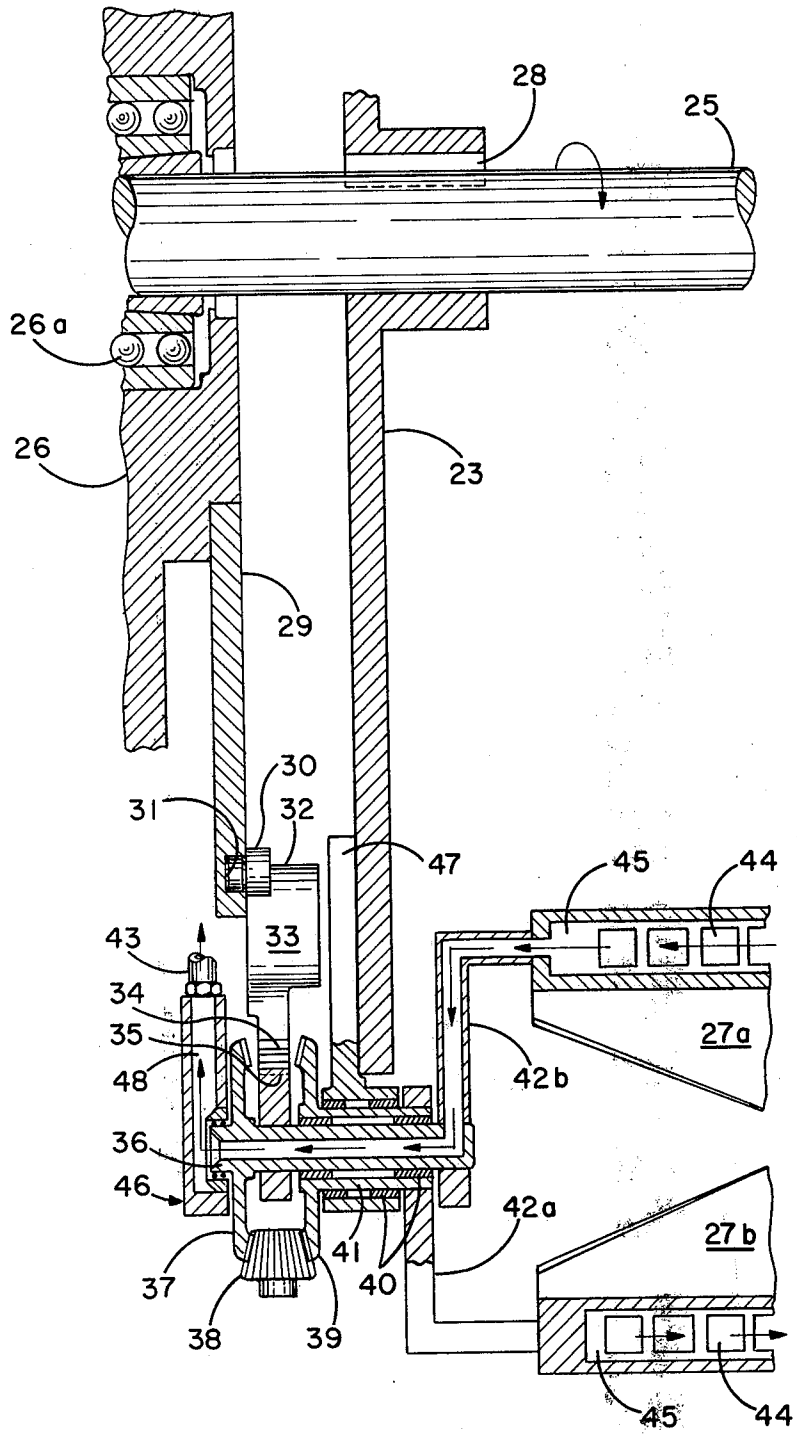
74
66
67
65
62
61
80
64
29
63
31
60
30
44
45
42a
32
47
33
43
34
27a
35
48
36
27b
46
40
41
37
39
38
42b
44
45
4

FIG. 3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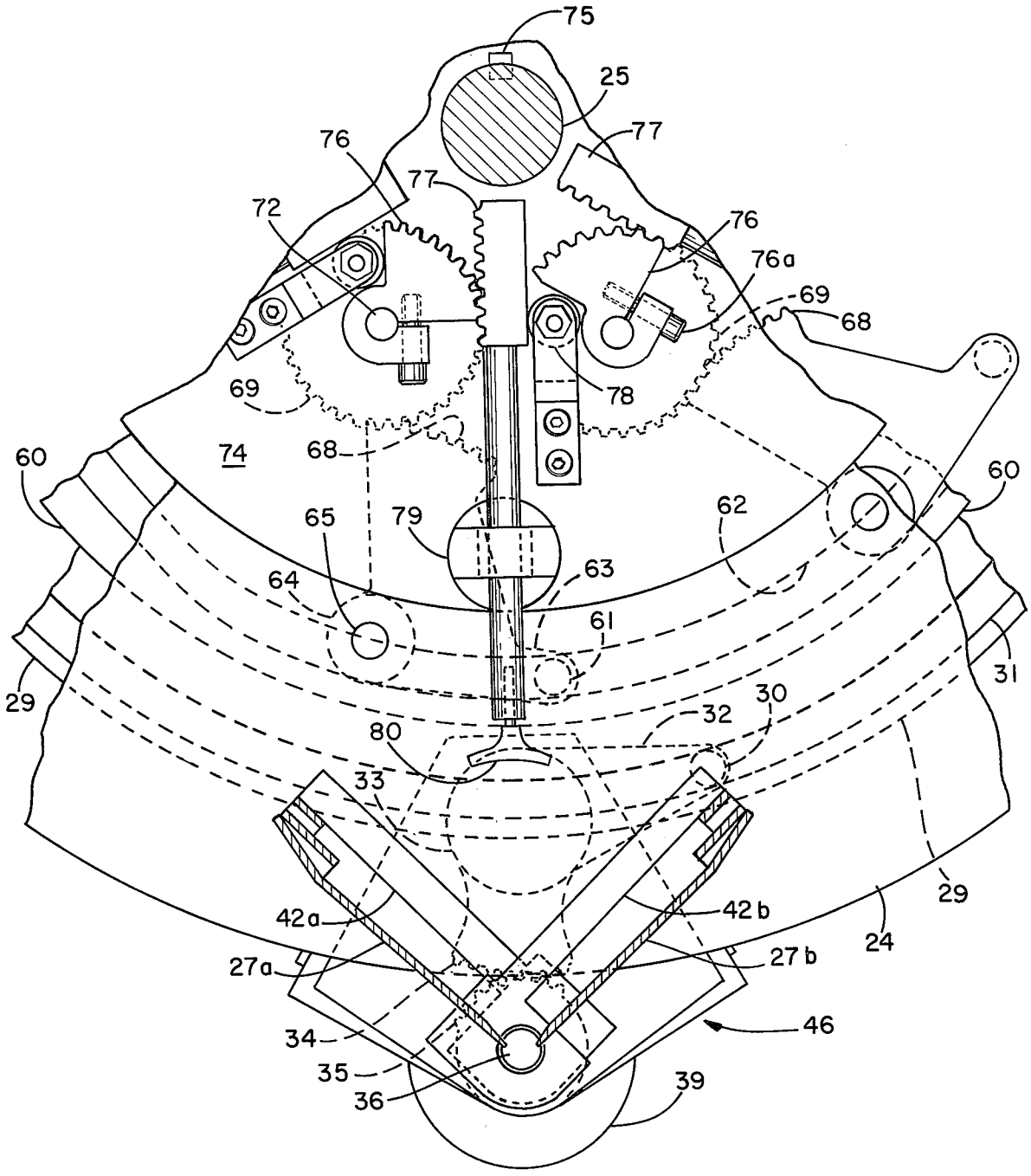
25
26a
26
23
29
30
31
32
47
45
44
43
33
34
35
48
27a
42b
36
46
42a
27b
41
37
40
38
39
45
44

FIG. 3a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25
77
76
77
72
76
76a
69
68
78
69
74
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60
62
65
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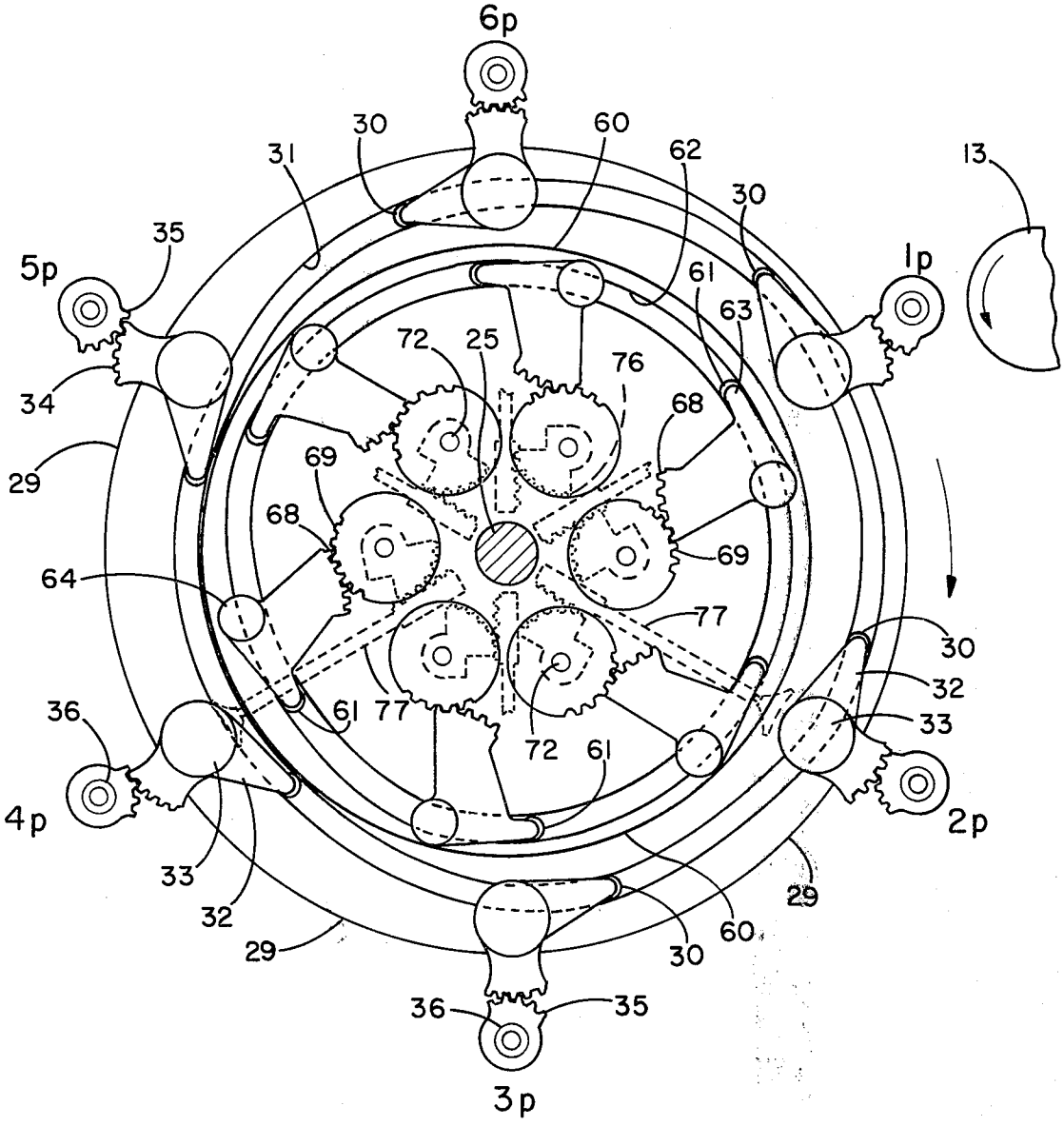
63
64
61
31
29
30
32
80
33
29
42a
42b
24
27a
27b
46
34
35
36
39

FIG. 4


6p
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60
31
62
13
30
35
5p
1p
61
63
72
25
76
34
68
29
69
68
69
64
77
30
32
36
61 77
33
72
61
4p
2p
33
29
32
60
29
30
36
35
3p

FIG. 4a

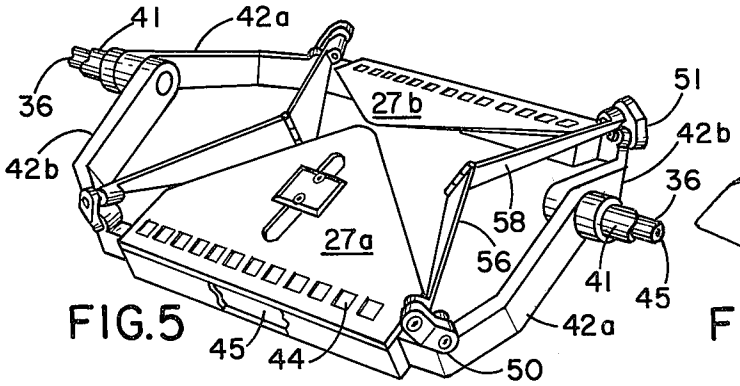


FIG. 5

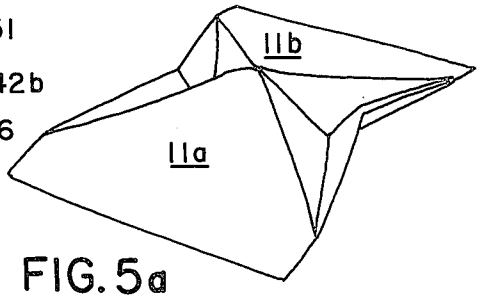


FIG. 5a

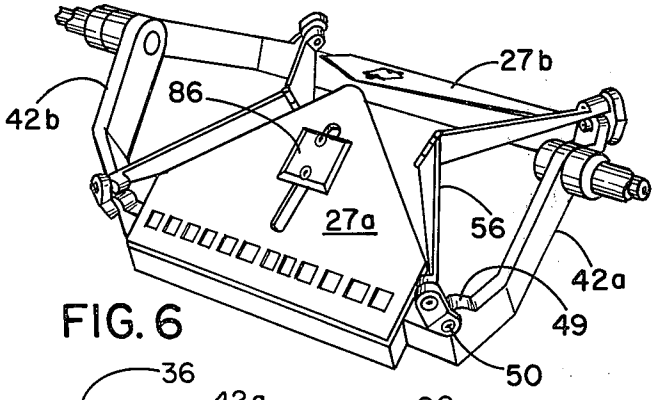


FIG. 6

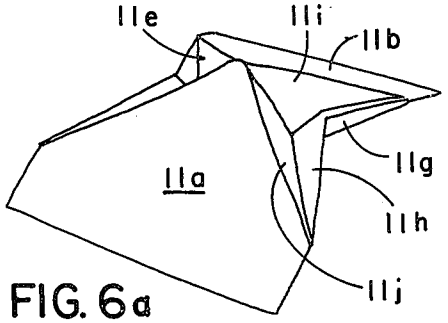


FIG. 6a

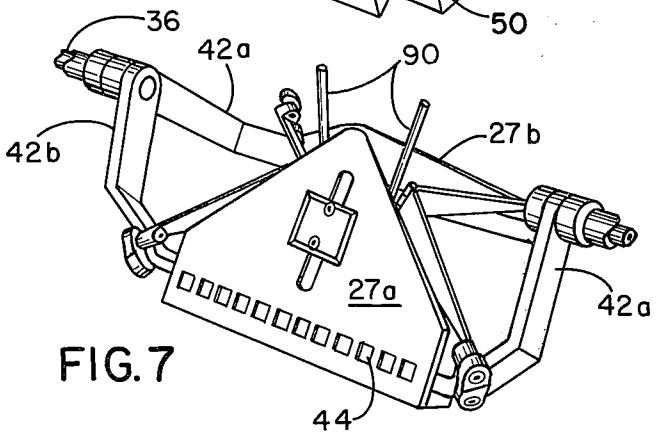


FIG. 7

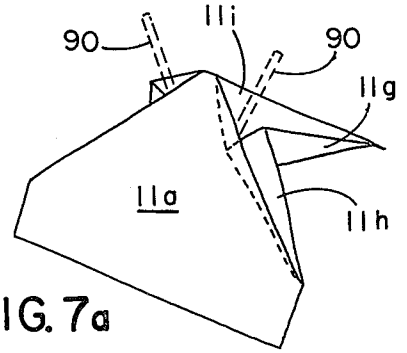


FIG. 7a

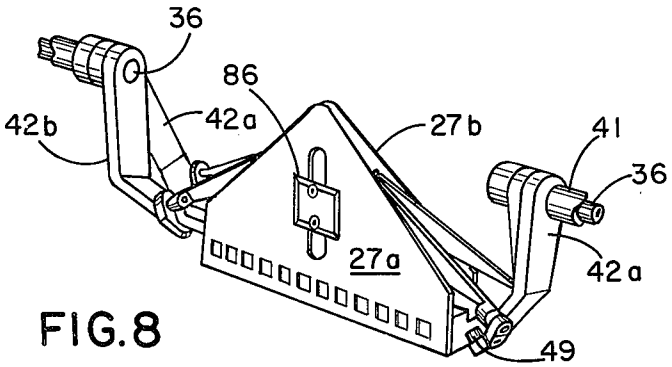


FIG. 8

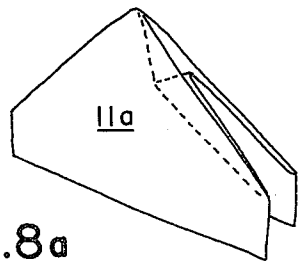


FIG. 8a

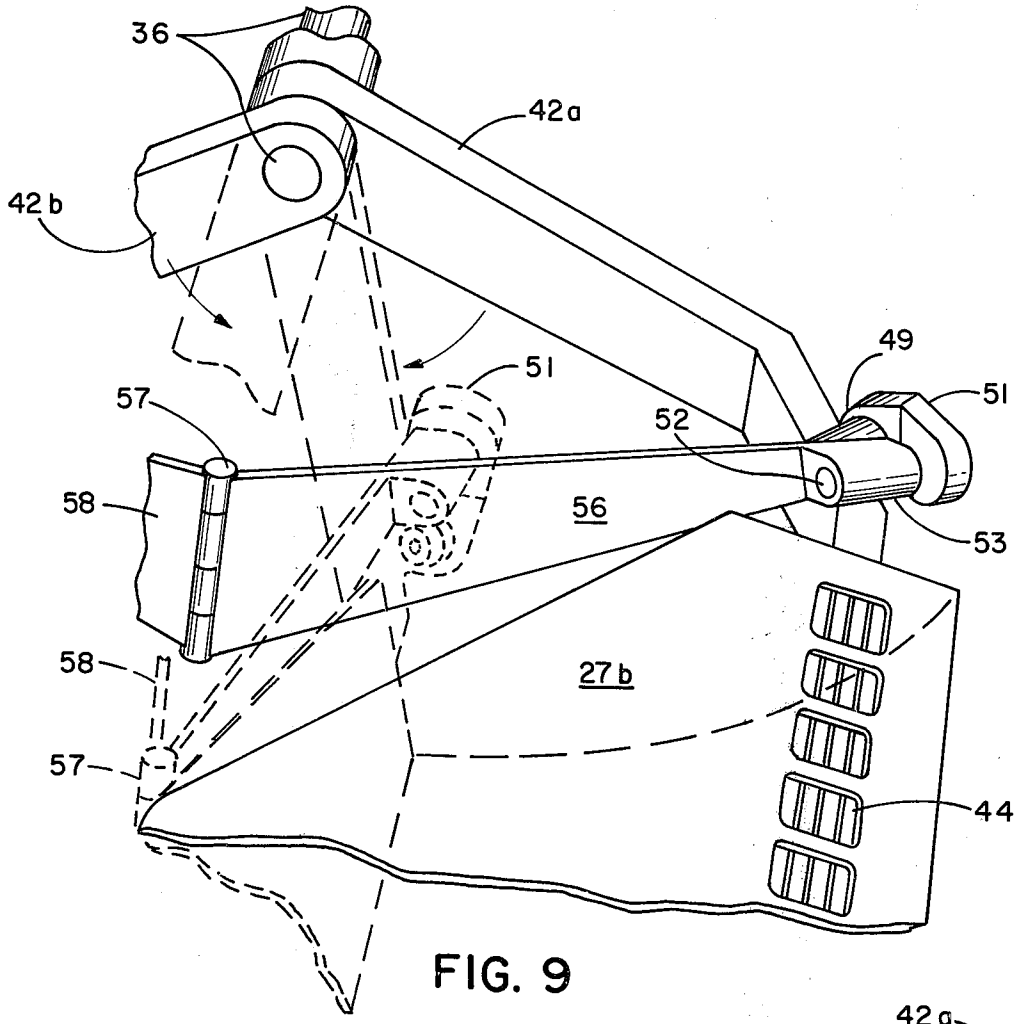
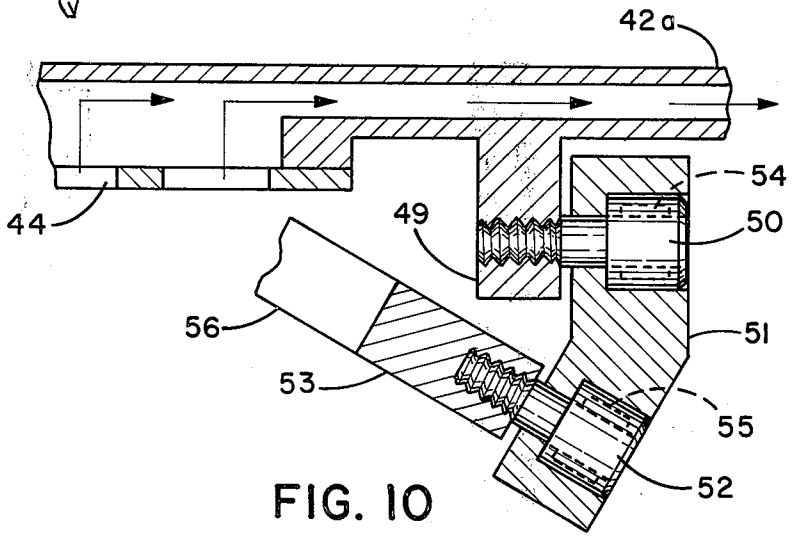

36
42a
42b
49
51
57
52
58
56
53
58
27b
57
44

FIG. 9


42a
54
44
49
50
56
51
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55
52

FIG. 10

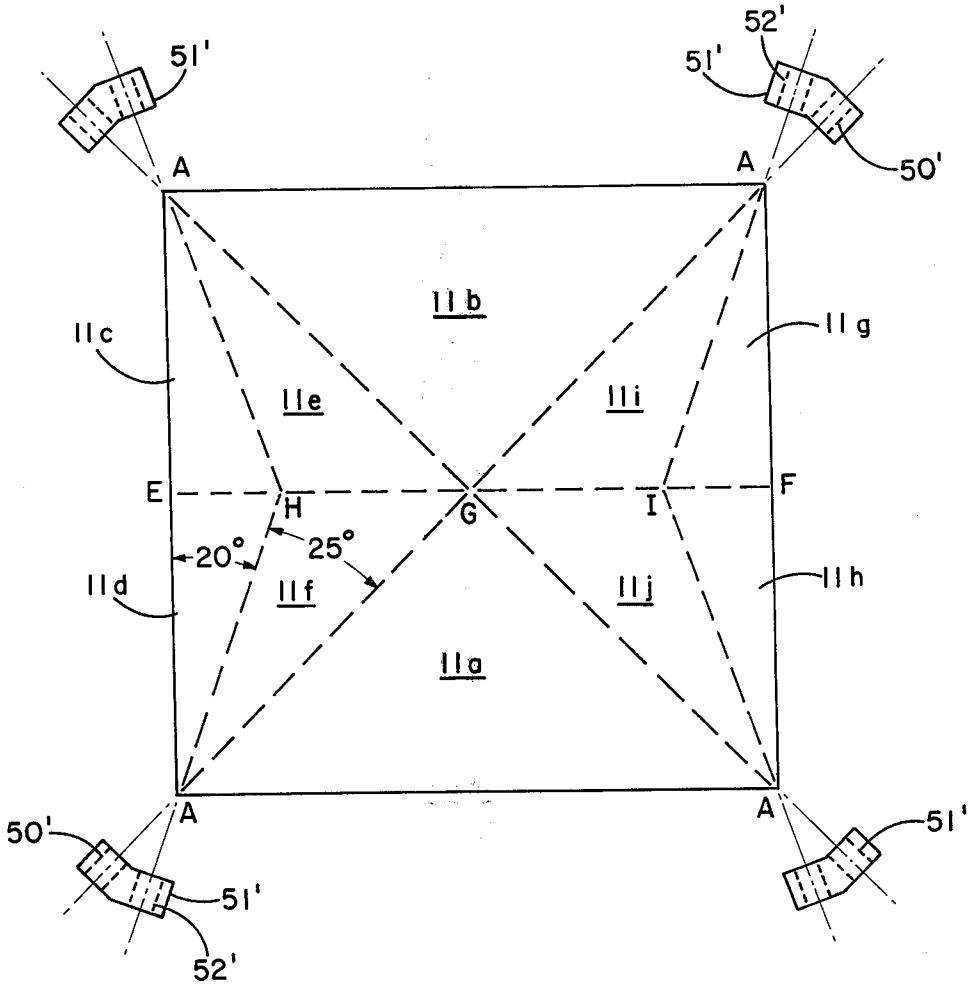

51'
52'
51'
50'
A
A
11b
11c
11g
11e
11i
E
H
G
I
F
20°
25°
11d
11f
11j
11h
11a
A
A
50'
51'
51'
52'

FIG. 11

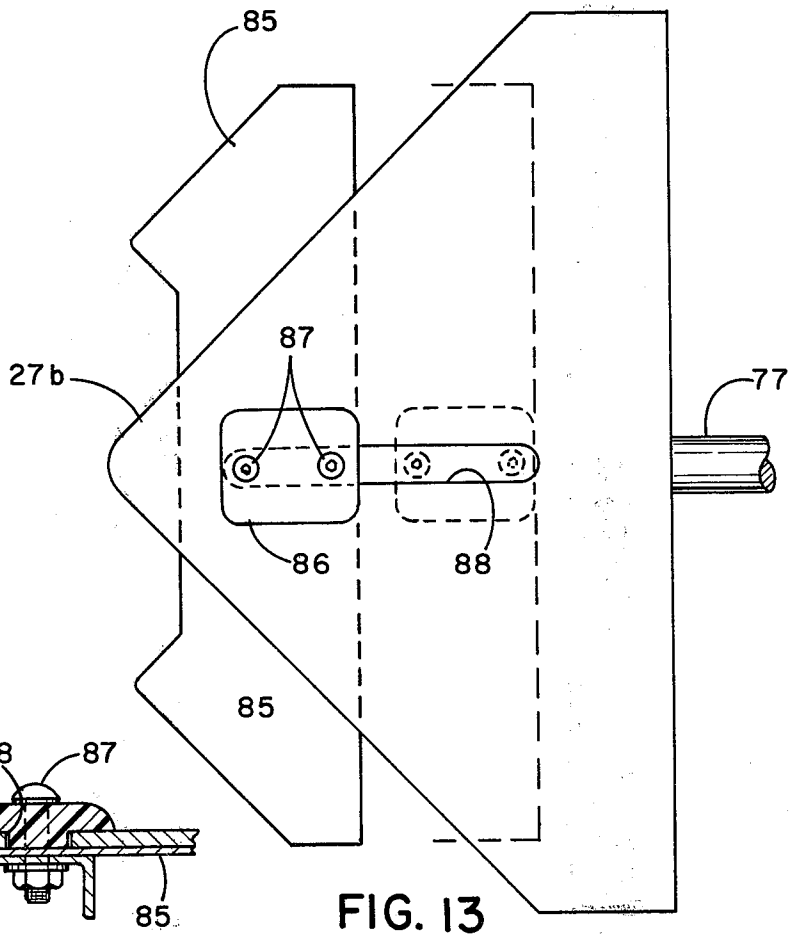


FIG. 13

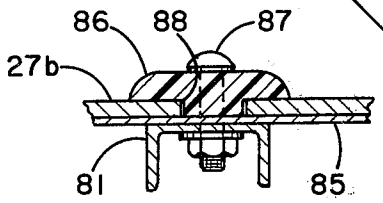


FIG. 14

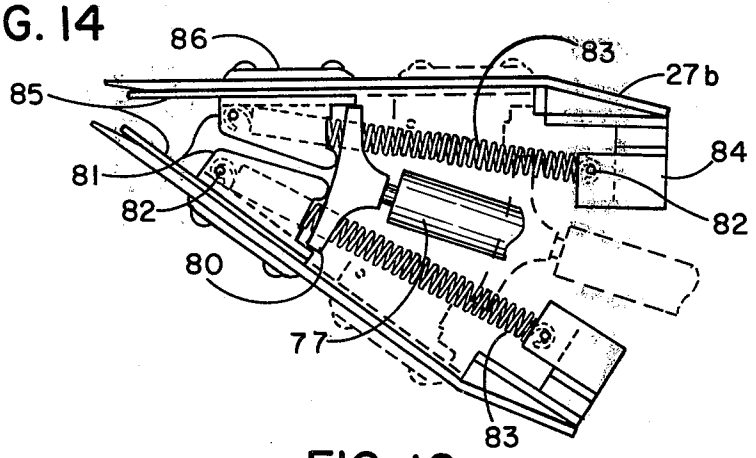
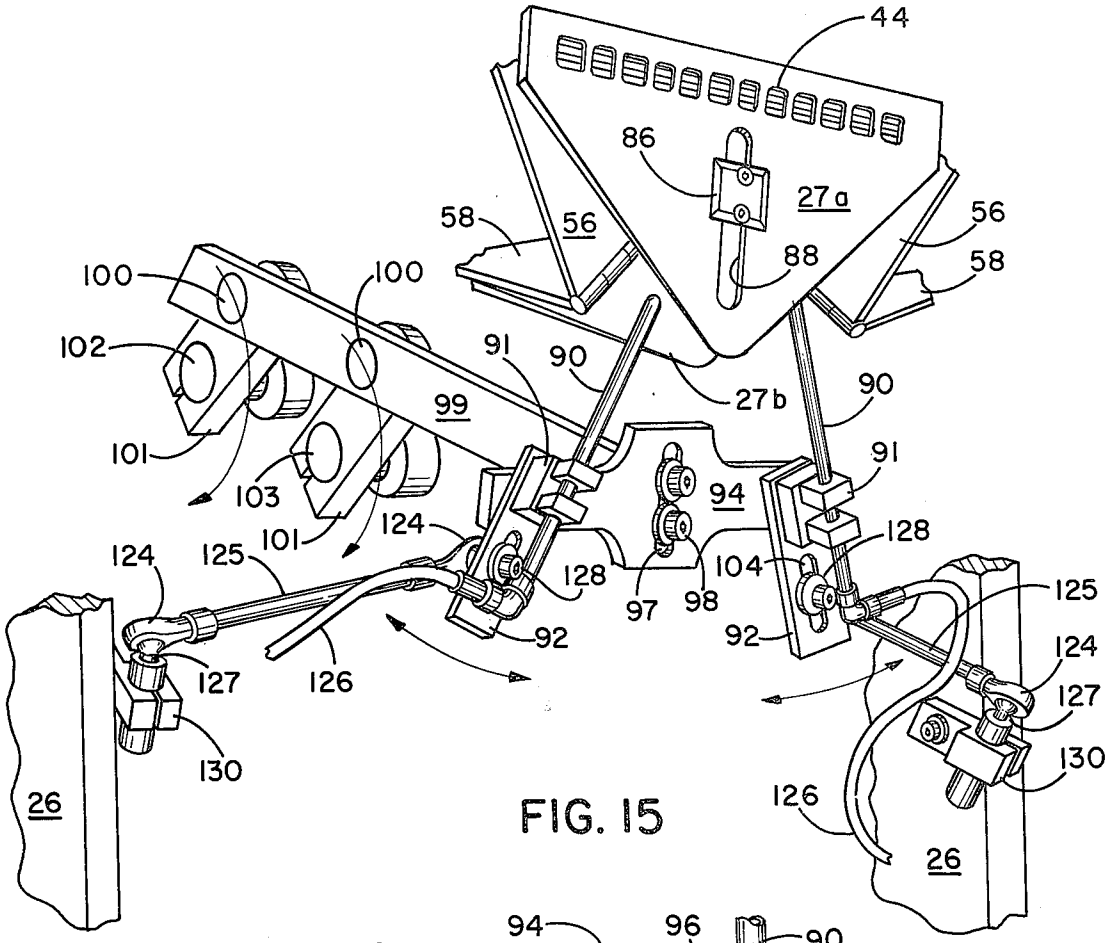


FIG. 12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86
27a
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91
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27b
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101
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126
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FIG. 15

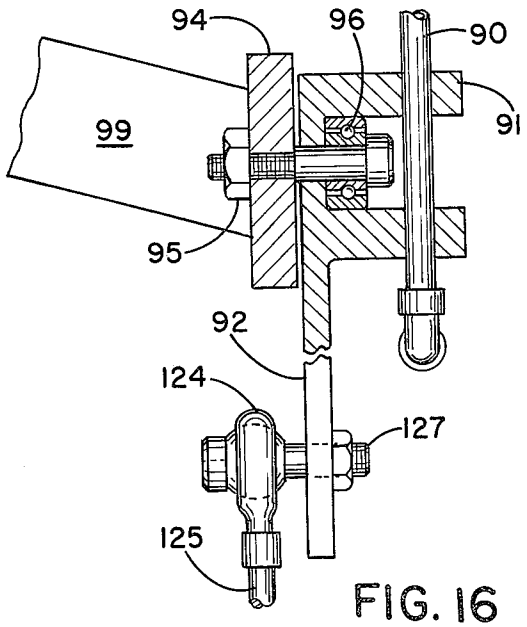
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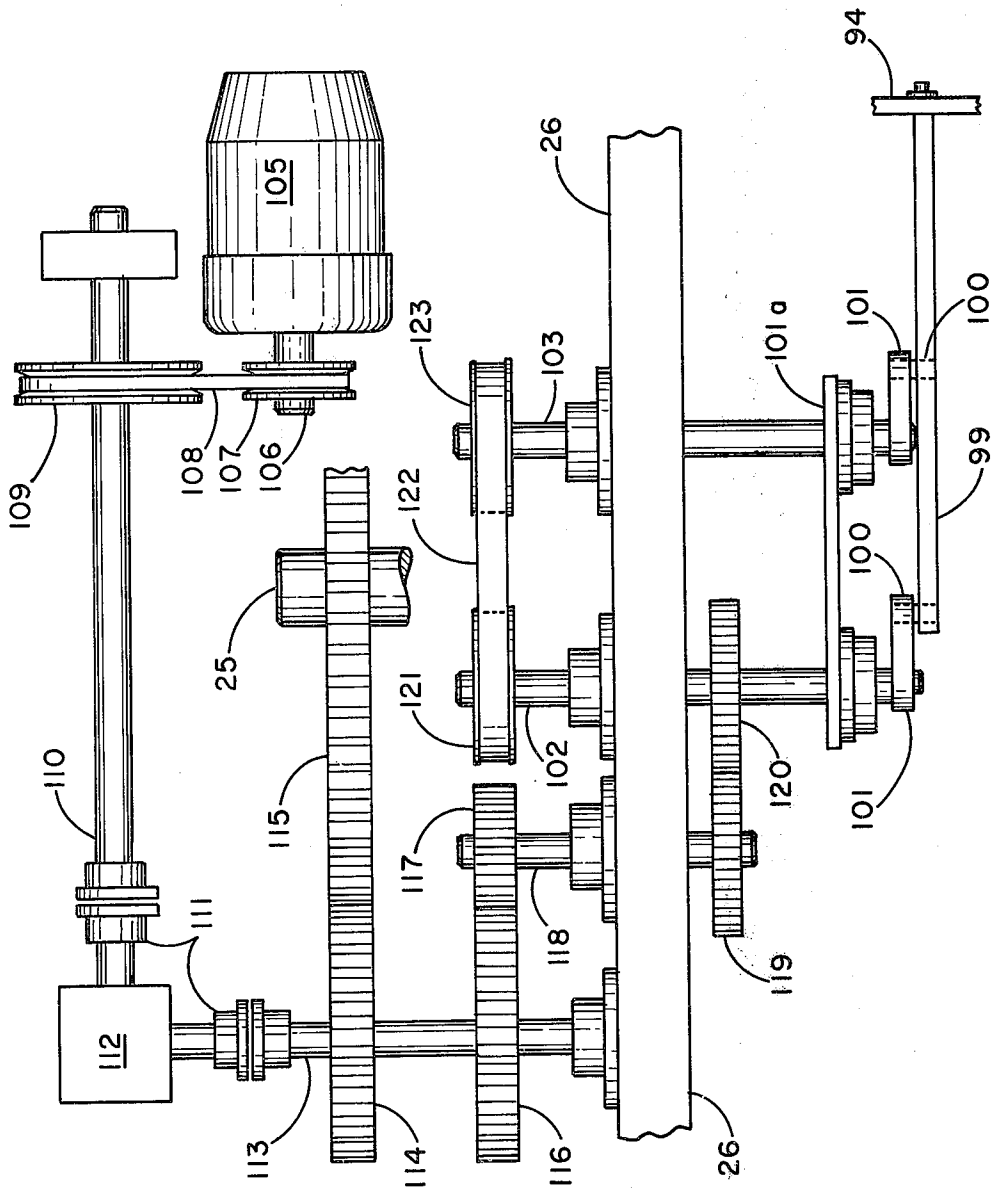
FIG. 16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114
116
26

FIG. 17

FOLDING APPARATUS

This application is a division of copending application Ser. No. 177,301 filed Sept. 2, 1971, now U.S. Pat. No. 3,782,714 issued Jan. 1, 1974.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to sheet folding apparatus and more particularly concerns apparatus for the folding of disposable absorbent articles such as diapers into contoured configurations so that the article conforms readily to a wearer.

2. The Invention With Relation to the Prior Art

The folding of flexible materials, and specifically materials having a somewhat non-uniform structure, is of increasing important as disposable materials become more prominent in commerce. The folding is required to be uniform from article to article to accommodate modern packaging techniques and to insure commercial acceptability. Exemplary of articles demanding accuracy and reproducibility in folding while yet necessarily being folded on a production basis are disposable diapers, particularly those which are contoured to accommodate themselves to the shape of wearers, such as young children. A diaper of the kind under consideration is disclosed in Hrubecky U.S. Pat. No. 3,196,874.

Additionally, sheet materials of the paper tissue kind and those which combine tissue with nonwoven materials in the toweling, bib, napkin and like fields are articles which require folding to desired shapes at a substantial production rate.

It is, accordingly, a primary object of this invention to provide apparatus for the folding of sheet material which is widely applicable in the paper and similar producing industries.

An important object of the invention is to provide a novel folding board arrangement which has particular utility as a component of apparatus which automatically folds sheet material at a substantial production rate. The board provides for the folding of material lengthwise of itself and may substantially simultaneously provide for the making of transverse folds or folds angularly disposed to the length and width of the sheet material as desired.

A further and more specific object of the invention is to provide apparatus for folding a disposable diaper along a medially located line lengthwise of itself and to tuck edge portions of the diaper inwardly centrally of the diaper length to provie a generally triangular fold in the diaper with a centrally disposed pocket.

Other objects and advantages of the invention will be more readily apparent by reference to the following detailed description and accompanying drawings wherein:

FIG. 1 is a perspective view of a diaper folding apparatus incorporating a plurality of folding boards in accordance with a preferred embodiment of the invention;

FIG. 2 is an essentially schematic view in side elevation illustrating fold positions of a diaper folding board as the board progresses in the operation of the apparatus of FIG. 1 from the machine inlet to the machine outlet positions;

FIGS. 3 and 3*a* are fragmentary and sectional views which, taken together, illustrate the mechanism for effecting folding board operations, the views being taken in the direction of the position of machine outlet;

FIG. 4 is a somewhat enlarged and fragmentary sectional view taken on line 4—4 of FIG. 3;

FIG. 4*a* is a view like that of FIG. 4 to a somewhat smaller scale illustrating particularly the camming mechanism for actuation of the folding boards and associated equipment;

FIGS. 5 and 5*a* through FIGS. 8 and 8*a* illustrate corresponding positions of the diaper folding mechanism and the fold in the diaper itself at specific stages of the operation;

FIGS. 9 and 10 are detail views of the diaper folding mechanism;

FIG. 11 is a schematic view illustrating a mode of determining relative shaft positions for operation of the specific folding mechanism;

FIG. 12, 13 and 14 are detail views of a pusher mechanism for effecting diaper removal from the folding mechanism;

FIGS. 15 and 16 are detail views illustrating an arrangement of assist fingers for effecting diaper folding with a deep centrally positioned diaper pocket; and

FIG. 17 is a view in plan of a power source arrangement for the equipment operation described.

In broad aspect the mechanism in accordance with the invention includes a folding board which moves in a predetermined path and intercepts an article to be folded, such as the mentioned disposable diaper. It is apparent that other sheet material may be folded to predetermined configurations in accordance with the principles of the invention and that the diaper structure in its passage through the mechanism fully illustrates these principles. The diapers in the preferred practice of the invention move to the folding board in essentially planar condition.

The folding board includes a pair of oppositely disposed panels arranged to be pivoted from a position in which the panels form essentially a plane to receive the planar disposed diaper, to a position in which the panels lie in substantially parallel relation with the diaper folded lengthwise about a medial transverse fold line of the diaper. The panels, for the purpose of securely retaining the diaper as it is folded, each include rearwardly disposed on the panel a housing communicating with vacuum ports. Accordingly, as a diaper is transferred to the folding board, a leading edge of the diaper lies across the leading end of the first panel and the application of vacuum holds it in fixed position relative to the panel. As the folding board moves, the diaper is further drawn onto the second and trailing panel, and the trailing edge of the diaper lies across and is retained by the vacuum condition existing at the ports of the trailing end of the second panel.

The panels are suitably shaped to provide for fold lines in the diaper additionally to the medial transverse fold line. In specific application the panels are of a generally triangular configuration and of the same dimensions so that, upon folding the flexible material, the product shape is substantially symmetrical about the medial fold line. The attainment of the additional fold lines is with the aid of tucking elements which suitably function simultaneously with the pivotal movement of the panels and may be actuated from machine components common to the panels or from components independently actuated.

For production operations a plurality of the folding boards are provided on a carrier which traverses a closed path from a diaper inlet zone to a diaper outlet zone, returning to the inlet zone for the reception of a continuing supply of diapers to be folded. The folding board panels are suitably each controlled in their movement from the planar open position to a parallel or closed folded position and return to the open position by cam means moving in a fixed track and supported by the carrier. Additionally, a cam actuated device is provided to assist diaper removal from the folded or collapsed folding board.

In the specific embodiment disclosed, the carrier includes an arrangement to assist folding and provide a relatively deep pocket centrally of the diaper. This arrangement acts in conjunction with each forming board as it approaches the diaper outlet zone and is synchronized with the movements of the carrier and folding boards to permit entry to and withdrawal from the partially folded diapers in a reciprocating action.

The diapers in their folded condition, with the folding board panels lying in generally parallel relation to each other, are relatively fixed in position even after removal of the vacuum conditions. To aid removal, each folding board includes means, suitably cam actuated, for urging the diapers from the boards while the panels are in their folded position.

Referring to the drawings more in detail, the numeral **11** in FIGS. **1** and **2** indicates a diaper moving in planar arrangement in the direction of the arrows toward a transfer roll **13** which carries a fixed vacuum box **15.** The diaper **11** may be of any construction suitable to be folded in the manner such as is, for example, generally indicated in FIG. **8***a*. The diapers commonly are formed of a composite of flexible materials including a liquid impermeable ply as of polyethylene, an absorbent ply as of wood pulp fibers, and a soft body-contacting ply of reinforced tissue as is well-known in the art. Further details of construction are not essential to the practice of this invention but a useful diaper construction is more specifically shown in U.S. Pat. No. 3,196,874 previously mentioned herein.

A plurality of the diapers as particularly indicated in FIG. **2** move in succession in spaced apart relation to the roll **13** and are carried to the roll on a wire screen **17** under the influence of vacuum applied from a fixed vacuum box **19.** The screen **17** is conveniently supported on rollers in well-known manner, one roll being indicated at **21** in FIG. **2.**

The folding apparatus is generally designated by the numeral **22** (FIGS. **1** and **2**). It includes a pair of oppositely disposed carrying plates **23, 24** retained in spaced relation by a plurality of horizontally extending spacers **12** which are also hollow and serve as conduits for air flow in a vacuum system later to be described. The plates **23, 24** are fixedly retained on a main shaft **25** (FIGS. **1, 2** and **3**) for rotation therewith by conventional keys as at **28.** Framing **26,** which includes a transverse member and a pair of uprights, support the shaft **25** rotatably on bearings as indicated at **26***a* (FIG. **3**). As shown most clearly in FIGS. **1** and **2,** a plurality of folding boards generally indicated at **27** are provided and carried in rotation between the plates **23, 24** for the purpose of acting on a corresponding plurality of diapers simultaneously to fold them from the flat position of FIG. **1** to the position generally indicated in FIG. **8***a*. The sequence of folding steps is illustrated in FIGS. **5***a* through **8***a*, and the corresponding folding board positions are shown in FIGS. **5** through **8.**

Referring now to the movement of the folding boards **27,** in the present instance the general type of mechanism is a cam actuated one. For this purpose the frame **26** fixedly carries a pair of cam plates **29,** one on each side of the apparatus (FIGS. **3** and **3***a*). Two plates **29** are employed in practice for smooth operation. For convenience one cam plate and its associated equipment for rotation of the panels of a folding board, as illustrated particularly in FIG. **3,** will be described in detail but it is to be understood that the operations on each side of the machine for actuation of the panel folding mechanism will be similar. Each of the folding boards **27** is actuated in the same way by separate cam means, as may be clearly seen from FIGS. **4** and **4***a*. Corresponding parts, where convenient, are designated by corresponding numerals. Also in FIGS. **3** and **3***a* for sake of clarity in illustration, the panels are at 90° to their normal position.

The panels **27***a*, 27*b* of a folding board are actuated through a single cam on each cam plate **29.** Thus, cam plate **29** receives a cam follower **30** which moves in a cam track **31.** The follower **30** is carried by a bell crank **32** which has a hub **33** of rotation and carries at one end gear teeth **34** arranged as a sector of a gear. The teeth **34** mesh with a toothed gear **35** fixedly retained (FIG. **3**) on an inner hollow tubular shaft **36** (FIG. **5**). The shaft **36** is integral with bevelled gear **37** which meshes with pinion **38,** the latter meshing with bevelled gear **39** for rotation with respect to shaft **36.** Gear **39** is integral with outer shaft **41.** Bearings indicated at **40** support the gear **39** and outer shaft **41** for rotation with respect to the inner shaft **36,** the concentric shafts **36** and **41** having opposite rotational directions. Panel support arms designated at **42***a* and **42***b* are respectively secured to outer shafts **41** and **36.**

The panels **27***a*, 27*b* at their oppositely disposed rearward ends, as shown in FIG. **5,** have housings **45** and vacuum ports **44** which communicate the housing interiors with the atmosphere. Conduits **43** (FIGS. **3** and **3***a*) connect to vacuum pump means (not shown) and air flow may take place from the housing interiors through the second and hollow tubular arms **42***b* and hollow shafts **36.** Each housing is closed off interiorly at one end as most clearly shown in FIG. **3** to provide for air passage from the folding board surface to the housing interior and vacuum application to material resting over the ports **44.** A second support arm **42***b*, and a first support **42***a* (which is suitably solid and blocked off from the interior of housing **45** to provide for the vacuum effect) are connected with each panel for driving it in rotation as illustrated in FIGS. **5** through **8.** For this purpose the radial distance of the arms **42***a*, 42*b* are equal from the axial center of the hollow shaft **36** so that each arm cooperates smoothly in providing for the movement.

The numeral **46** (FIGS. **1** and **3**) generally designates a bracket for retention of the gear cluster **37, 39** to which reference has already been made. Each bracket includes a mounting plate **47** secured fixedly to a circular carrying plate for traveling in rotation with the plate. As indicated in FIG. **3,** shaft **41** is rotatably mounted with respect to and supported by this plate **47.** This permits free rotation of the outer shaft **41** relative to the plate **47.** The other outer oppositely disposed plate **48** of each bracket **46** is hollow, providing for air

flow to the conduits **43** from the arms as already noted (FIGS. **3** and **3***a*).

The movement of the arms to effect panel movements is permitted by the gimbal joint arrangement, more specifically described in connection with FIGS. **9** and **10.** As shown, each arm **42***a* and **42***b* fixedly carries a mount **49.** The mount **49** threadedly receives a bearing screw **50** (FIG. **10**) which is itself pivotally retained on block **51** by roller bearing **54.** The pivot block **51** also includes a second bearing screw **52** which is theadedly received in a mount **53** carried on the extremity of a wing or fold member **56.** Provision for rotation of the bearing screw **52** is made by the roller bearing **55** similar to bearing **54.** Member **56,** as indicated at **57,** is hingedly connected to a second and similar wing **58.** The wings **56, 58** in their movement, as indicated in FIGS. **5** through **8,** effect folding of the diaper as indicated in the views shown in FIGS. **5***a* through **8***a*. More specifically, shafts **36** and **41,** driven as already indicated and which are associated with the arms **42***a*, 42*b*, cause the arms **42***a*, 42*b* to move through the positions indicated in FIGS. **5** to **8.** As such movement takes place, the wings **56, 58** are caused to collapse on themselves and also inwardly against the diaper, urging the diaper into a fold condition such as is indicated, for example, at **11***h* and **11***g* in FIG. **6***a*.

The wings **56, 58** themselves collapse inwardly upon movement of the arms **42** due to the gimbal joint arrangement illustrated in FIGS. **9** and **10** and previously described. The lines of fold are determined by selection of the relative axial alignment of the axes of bearing screws **50, 52** as indicated at **50'** and **52'** in the schematic illustration FIG. **11.** (In FIG. **11,** for convenience, the schematically illustrated gimbal joint components have the same numerals in other figures but are primed.) More specifically, the line GA, for example, extending from the simulated diaper center to a diaper corner and beyond provides one axis while a line HA projected from the point H provides a second axis **52'**. These axes lie along the intended lines of fold of the diaper and augularly to the medial transverse fold line EF. When oriented, as shown in FIG. **11,** the diaper, upon movement of the wings **56, 58** as indicated, results in primary diaper sections **11***a*, 11*b* and outer side folds **11***c*, 11*d*, **11***g*, and **11***h* as well as inwardly disposed folds **11***e*, 11*f*, 11*i*, and **11***j*.

It will, accordingly, be understood from the foregoing that in the rotation of plates **23, 24** the brackets **46** and their associated plates **47** rotatably secured to the hubs **33** move the followers **30** in their respective tracks **31** and through the mechanism previously described, causing the panels **27***a*, 27*b* of the folding boards to move through the steps indicated in FIGS. **5** through **8.** Specifically, the panels which are spaced apart lengthwise in end-to-end relation to define a gap for forming a transverse fold line in the diaper are oscillated or rotated to a back-to-back position with the gap maintained. In the course of this action a diaper which has been delivered in lengthwise planar disposition to a folding board as in FIG. **2** is completely folded in the course of its passage from the transfer roll **13** to the removal jaws **14.** Also, in the course of this action, the diaper is subjected to vacuum conditions as indicated in FIG. **2.** Thus, at the first station **1**p vacuum is applied to the forward end of panel **27***a* by drawing air through the vacuum ports **44** which are positioned forwardly on the folding board **27.** The air flow is to the shaft **36,** conduit **43** (FIG. **3**) and through spacer-conduit **12** to the rotary valve **9** and port **10** of the valve, the exhaust to vacuum being by legend indicated in FIG. **2.** The rotary valve **9** is of a conventional type in which openings **8** in circular plate **23** (FIG. **2**) and also plate **24** are covered and uncovered sequentially in known manner in plate rotation relative to the valve to provide respectively for stopping and starting of air flow.

In the drawing the solid lines indicate air flow from the vacuum ports to the hollow shafting. The solid lines indicate air flow or the presence of vacuum conditions at the leading end of the folding board; the dash lines indicate the presence of vacuum conditions at the rearward end of the board, and the absence of solid or dash lines indicates that vacuum conditions are not present.

Accordingly, as shown at positions **2***p* through **4***p* (FIGS. **2** and **4***a*), the diaper is retained in positions as the panels in their movements cause folding of the diaper longitudinally about the median transverse fold line. As the folding board traverses its path from position **4***p* to **5***p*, the vacuum condition is removed and the diaper is free to move from the ports and to be withdrawn by suitable mechanism at station **5***p*. In the travel to the position **6***p* under the influence of the cam means **30,** the folding board opens toward a substantially planar condition.

To assist the removal of the diaper at the station **5***p* (FIG. **2**) the mechanism as is particularly illustrated in FIG. **3** and more in detail in FIGS. **12** to **14** is provided in association with each folding board. As illustrated in FIGS. **3** and **4,** the frame **26** carries a cam plate **60** for receiving a plurality of cam followers **61** in the track **62.** Each follower **61** is retained by a bell crank **63** (FIG. **4**). Each bell crank is provided with a hub **64** which is received on a shaft **65.** Each shaft **65** through bearing **66** rotatably supports the bell crank from the rotatable carrier plate **24.** A bearing retainer nut **67** provides for retention of a shaft **65** on a bell crank **63.** Each bell crank **63** carries teeth **68** which mesh with the teeth of a gear **69** supported by a bushing **70** which itself receives a key **71** (FIG. **3**). A key **71** is received by each shaft **72** so that a gear **69** drives a shaft **72.** Each shaft **72** is suitably supported by bearings **73** as indicated particularly in FIG. **3.** As is apparent in the rotation of the carrier plate **24,** the shafts **72** are driven through the followers **61** of bell crank **63.**

A circular plate **74** (FIG. **4**) suitably termed a pusher support plate is secured for rotation with shaft **25** through key **75** (FIG. **3**). The pusher support plate **74** rotatably supports each shaft **72** of the diaper pusher assembly. Each shaft **72** carries a sector gear **76** which is retained on the shaft by a clamp screw **76***a*. Each sector gear **76** meshes with and drives a rack **77.** A fixedly positioned backing roller **78** (FIG. **4**) associated with each pusher assembly guides each rack in its rectilinear movement as does a guide block **79.** Each rack **77** on its extremity is provided with a suitably shaped pusher **80** (FIGS. **4,** and **12–14**).

Referring now to FIGS. **12–14** inclusive, a pusher **80** of each folding board acts against brackets **81** which form part of the mechanism for assisting diaper removal from the diaper folding boards. Only one pusher assembly will now be described in detail. Pins **82** carried on opposite ends of a spring **83** are retained by the forward bracket **81** and rearward bracket **84.** Further, bracket **81** is fixedly retained on a movable slide **85** on the under side of each of the panels **27***a*, 27*b* of the

folding board. Each slide **85** carries a block **86** of nylon, the slide and block being retained together by nut and bolt assemblies **87.**

The nylon block **86** moves in a slot **88** extending in each of the panels of the folding boards as indicated most clearly at **27***b* in FIG. **12.** Accordingly, when a pusher **80** is actuated by the movement of the shaft **72** under control of a cam follower **61,** a diaper on the folding board will be urged outwardly of the board and the board and the board assumes the position of FIG. **13.** As most clearly seen from FIG. **3,** the actuation of the diaper removal device is governed by the relationship of a cam follower **61** to that of the cam follower **30,** and these are so synchronized that the diaper is urged from the plate at the proper station as indicated in FIG. **4***a*.

It has been found desirable to assist the action of the wings or folding members **56, 58** in the folding of the diapers and to achieve a relatively deep central pocket. For this purpose there is provided the mechanism illustrated in FIGS. **15** and **16.** Referring first to FIG. **15,** there is indicated at **90** a pair of fold assist tubular rods **90** through which an air flow may be directed. These rods are received on pivot blocks **91** which include a base **92** and, since each rod arrangement is similar, only one will be described in detail. The base **92** receives therethrough a screw **93** (FIG. **16**). A cross-arm **94** receives the screw **93** in threaded engagement and nut **95** abuts the cross-arm retaining the screw and cross-arm in fixed relation. One extremity of the screw **93** (FIG. **16**) rotatably receives block **91**; for this purpose the bearing **96** is provided to effect the rotational support. Each of rods **90** is thus pivotally mounted with respect to cross-arm **94.**

The cross-arm **94** is slotted at **97** and receives cap screws **98** which are threadedly secured in an extremity of bar **99.** The bar **99** is provided with stud shafts **100** (FIG. **17**) which rotate within the bar, the stud shafts being carried on extremities of the cranks **101.** A first crank **101** receives shaft **102** while the second crank **101** receives shaft **103** (FIGS. **15** and **17**). The bar **99** describes an essentially orbital or generally circular motion with the centers of shafts **100** moving in an arcuate fashion about the centers of shafts **102, 103.**

Shafts **102** and **103** are driven in a manner more clearly seen from FIG. **17.** In FIG. **17** the numeral **105** designates an electric motor source of power. Motor shaft **106** carries pulley **107** which, through belt **108,** drives pulley **109** and shaft **110.** A suitable right angle drive arrangement **112** connected by couplings **111** from shaft **110** to shaft **113** provides for actuation of gear **114.** Gear **114** drives main gear **115** carried on main shaft **25** to which reference has already been made. Second gear **116** on shaft **113** drives gear **117** and hence shaft **118** and gear **119.** The latter gear cooperates with gear **120** to drive shaft **102.** Shaft **102** carries pulley **121** which drives timing belt **122** and pulley **123** on the shaft **103.** Thus, shafts **102** and **103** are rotatably supported by frame **26** and are arranged to rotate in timed relation. The rotation of shafts **102, 103** cause movement of the cranks **101** and hence movement of the arm **99** and cross-arm **94.**

Cross-arm **99** provides for the movement of the fold assist rods **90** in an arcuate motion so that the rods **90** may enter the diaper in an arcuate motion as the diaper is being folded and as the diaper and the folding board carrying it itself move in a closed path.

For the purpose of guiding the inward and outward movement of the rods **90** freely of other parts of the mechanism and the diaper itself, a linkage system controls motion of the rods **90** in a generally oscillating manner. More specifically, from each fixed frame support **26** a bracket **130** is provided. A pair of ball joints **124** carrying a rigid link **125** (FIG. **16**) are respectively secured to brackets **130** and to the base **92** of the block **91** for free pivotal movement. Retaining means **127** of conventional nature such as a threaded bolt and screw effect securing to the brackets **130** and with rigid arms **125** tend to limit the movements of each of the bases **92** carrying the rods **90.**

The retaining means **128** serve to retain rigid arms **125** to base **92** and base **92** is slotted to provide for adjustability and to permit accurate location of the retaining means.

The rods **90** are hollow for the purpose of directing air through them against the diaper to assist folding and also to aid release from the diaper. For this purpose air lines **126** communicate with the rods as indicated in FIG. **15.**

The diapers passing from the folding boards to the jaws **14** are ready for packaging and may be directed to suitable cartons in known manner.

Mechanism as described is capable of handling diapers of a size of about 12½ inches by 17½ inches at a rate of up to 200 diapers per minute, and more. The folding boards, panels having their edges which taper from the relatively wide rearward end to a narrow forward terminating at the gap between panels, are as described suitably on **24** inch centers about the carrier periphery, and the carrier plates **23, 24** rotate at a speed of about 40 rpm.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that I do not limit myself to the specific embodiments thereof except as defined in the appended claims.

We claim:

1. In apparatus for folding lengths of flexible sheet material having end portions and lateral edge portions, means for feeding a succession of the lengths of sheet material endwise in open substantially planar condition in spaced relation along a path, a frame, a rotatable carrier on the frame having an axis of rotation and comprised of a pair of plates spaced apart along the said axis of rotation, a plurality of folding boards in circumferentially spaced apart relation supported between the plates of the carrier and each comprising a pair of panels forming a surface for the receipt of a length of sheet material to be folded, the panels of a folding board being spaced apart longitudinally of the board to define a gap in the folding board for providing a transverse fold in sheet material on said folding board, support means including rotatable shaft means supporting each of the panels of each folding board for rotation between a position in which the panels are in end-to-end substantially planar relation to a position in which the panels are in back-to-back substantially parallel relation, means for rotating said shaft means, tucking means for infolding the edge portions of sheet material at the gap between said panels, finger means to assist folding of the sheet material and means for actuating the finger means in timed sequence with the rotation of the panels to the back-to-back position to provide for entry of the finger means between the panels

to urge said sheet material to the folded condition, said frame having guide means projecting therefrom and the guide means being connected with said finger means for guiding movement of the finger means, and means supporting said finger means for movement in an orbital path so that the finger means move inwardly and outwardly between the panels in the rotated back-to-back condition of the panels.

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