

[54] **DISPOSABLE DIAPER** 3,426,756 2/1969 Romanek..... 128/287
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 3,630,201 12/1971 Endres..... 128/287

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[22] Filed: **Aug. 9, 1973**

[57] **ABSTRACT**

[21] Appl. No.: **387,155**

A contoured, disposable diaper having an absorptive pad of cellulose fiber material smoothly graduated in thickness and absorptive capacity from an area of greatest thickness in the central portion to areas of lesser thickness along both the side and end edges of the diaper. The absorbent cellulose fiber pad is disposed between a fluid-pervious liner sheet of a soft, fibrous, non-woven web material and a fluid-impervious outer or backing sheet of a plastic film such as polyethylene. The liner and backing sheets are fin-sealed together along the side edges of the diaper, whereas at the end edges, the backing sheet is folded around the end of the pad, tucked between the pad and liner sheet and lap-sealed to the liner. Pressure-sensitive tapes serve to secure the diaper on an infant.

Related U.S. Application Data

[63] Continuation of Ser. No. 194,307, Nov. 1, 1971, abandoned.

[52] U.S. Cl..... **128/287; 128/284**
 [51] Int. Cl..... **A41b 13/02**
 [58] Field of Search..... 128/284, 290, 287

References Cited

UNITED STATES PATENTS

1,705,366 3/1929 Johnson..... 128/290 R
 2,890,700 6/1959 Lonberg-Holm..... 128/284
 3,059,644 10/1962 Atkinson..... 128/290 R
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8 Claims, 5 Drawing Figures

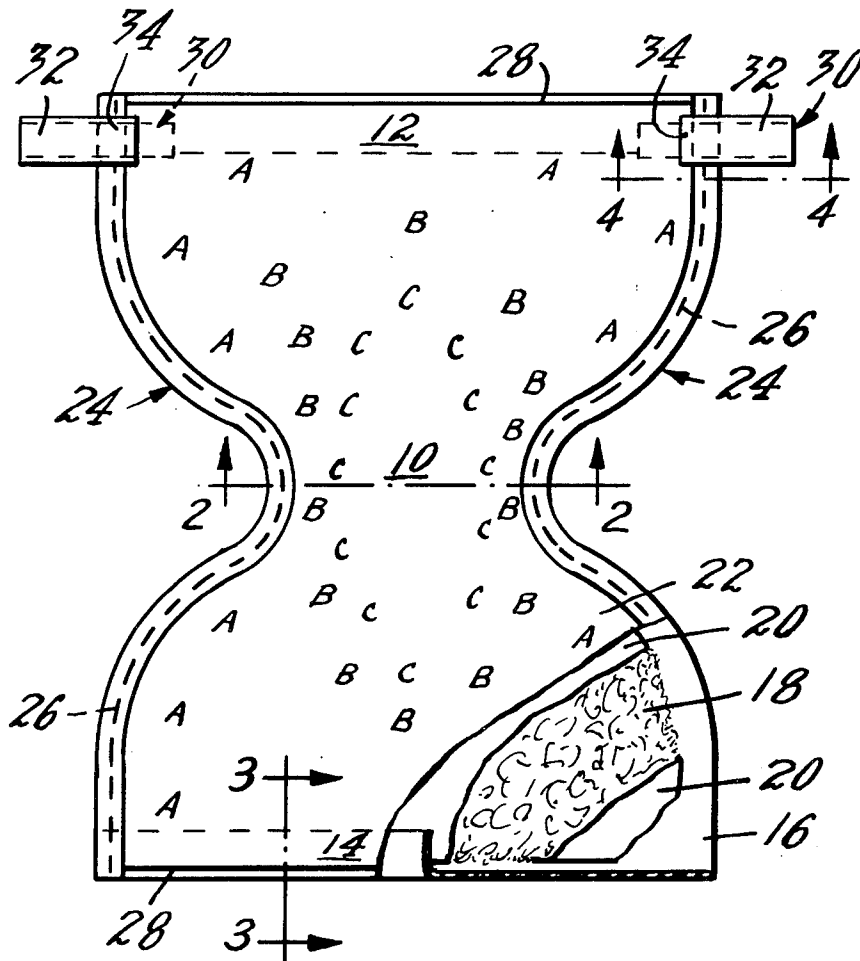


FIG. 1

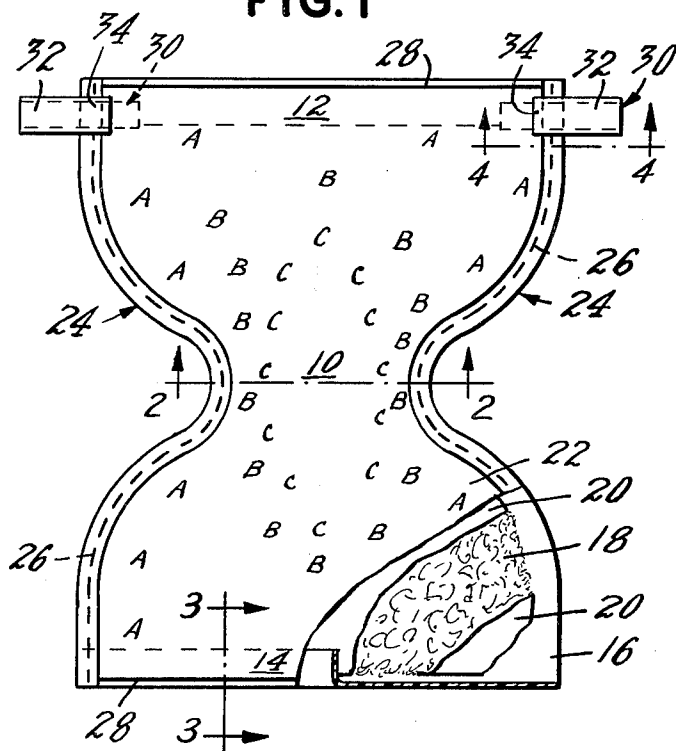


FIG. 2

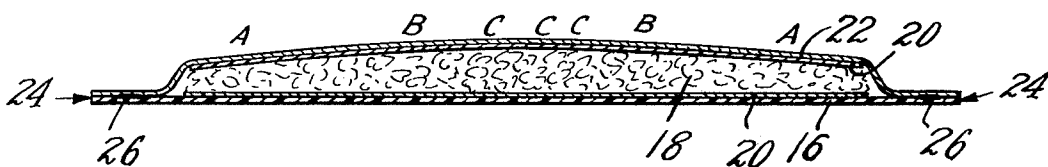


FIG. 3

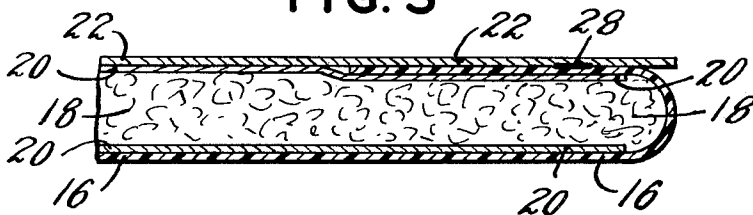
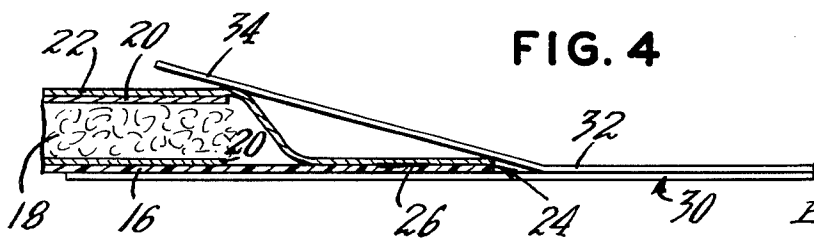


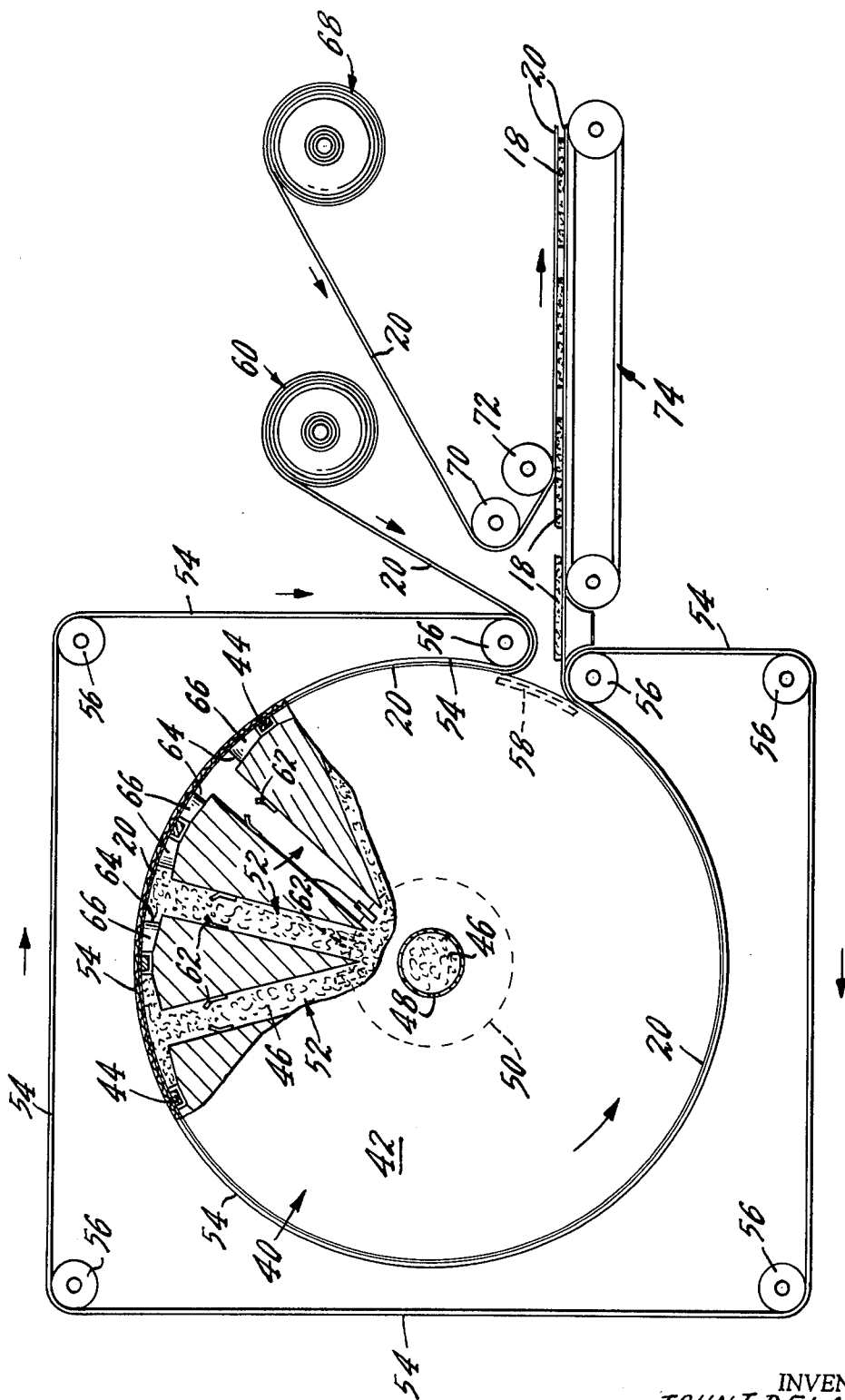
FIG. 4



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FIG. 5



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DISPOSABLE DIAPER

This is a continuation of application Ser. No. 194,307, filed Nov. 1, 1971, and now abandoned.

BACKGROUND OF THE INVENTION

In the manufacture of a disposable product such as a diaper for the absorptive retention of infant waste material, it is highly desirable that the product be contoured to fit the infant snugly and comfortably, have a high fluid absorbency without undue bulk, be of substantially leak-proof construction, must fit the child closely to prevent leakage and be capable of production at relatively low cost. The achievement of a satisfactorily high level of fluid absorbency in the critical crotch area without making that area of the diaper so bulky that it is uncomfortable for the infant to wear has presented a substantial degree of difficulty.

One possible means for alleviating this difficulty is by reducing the width of the central section of the diaper as in U.S. Pat. Nos. 2,649,858, issued to J. M. LeBolt, and 2,890,700, issued to E. C. Lonberg-Holm, so that the overall diaper outline generally resembles an "hourglass" in shape, the narrowed portion being designed to fit between the legs of the infant in the crotch area. Contouring of the diaper into an hourglass shape thus obviates the necessity of bunching up of the diaper in the crotch and thus reduces the possibility of discomfort. Additionally, the hourglass contour of the diaper promotes a snugger fit around the buttocks of the infant with attendant improvement in comfort and reduction in the possibility of leakage. Coincident with the narrowing of the crotch area, however, is the resultant loss of some of the absorptive capacity in the very area where maximum fluid retaining capacity is a prime requisite, and efforts have been made to correct this deficiency by laying on extra thicknesses of absorbent material in the crotch area, as exemplified by the above-mentioned U.S. Pat. No. 2,890,700 and U.S. Pat. No. 3,386,442, issued to R. Sabec. In these and similar prior art constructions, however, the thicker portions of the absorbent material were not smoothly contoured and integral with the remainder of the absorbent pad, but were built up as a series of separate layers superposed on one another, the material thickness changing sharply from one level to another as the edge of the diaper was approached. Thus, the inner surface of the diaper in the area of multiple absorptive material thickness is interrupted by the discontinuous transitions between the various thicknesses of absorbent material which serve as sources of possible discomfort and irritation to the skin of the infant. It is thus apparent that the prior art diaper constructions have failed, in one respect or another, to provide for both the comfort of the infant and the desired high absorptive capacity in the critical central area of the diaper. It is to be understood that, although the following discussion of diapers is couched in terms of infant use, it applies also to diapers for use by incontinent adults.

SUMMARY OF THE INVENTION

The present invention provides a diaper combining a high absorptive capacity in the central area with a maximum degree of comfort for the infant. The article of this invention is, then, a disposable sanitary article of wearing apparel for infants and children, comprising a generally hourglass-shaped, fluid-absorbent pad of fibrous cellulose fluff preferably restrained between two

webs formed of cellulose wadding, the restrained pad being backed on one side by an outer waterproof layer of polyethylene film and on the other side by an inner liner layer of a fluid permeable non-woven fabric. The integral absorbent fluff pad is smoothly contoured to have greater thickness and absorptive capacity in the central areas. At the side edges of the diaper, the waterproof outer layer and the inner liner layer extend beyond the limits of the absorbent pad and are fin-sealed together in these areas. On the ends of the diaper, the waterproof outer layer extends around the edge of the absorbent pad and is tucked underneath and lap-sealed to the inner liner layer. Tapes having a pressure-sensitive adhesive coating are attached to, and extend from, the side edges of the diaper at one end thereof for securing the diaper on an infant.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The novel structure of the diaper of this invention will be apparent from the following description of a preferred embodiment thereof, illustrated with reference to the accompanying drawings, wherein:

FIG. 1 is a top plan view of the diaper with parts thereof broken away,

FIG. 2 is an enlarged transverse cross-sectional view along line 2—2 of FIG. 1,

FIG. 3 is an enlarged longitudinal cross-sectional view of an end portion of the diaper along line 3—3 of FIG. 1,

FIG. 4 is an enlarged transverse cross-sectional view of a portion of the diaper along line 4—4 of FIG. 1 and

FIG. 5 is a schematic view, partially broken away, of an apparatus suitable for forming the diaper pad.

Referring to the drawings, the diaper as shown in FIG. 1 has an overall contour, in verticle plan view, reminiscent of an hourglass, the central, or crotch-containing area 10, being of substantially reduced width in comparison to the width of the two end sections 12 and 14 which, when the diaper is placed on an infant, form the waist-encircling portion thereof.

The diaper construction includes a thin, flexible, waterproof outer layer 16 of a thermoplastic material, preferably polyethylene which, for aesthetic reasons, is generally pigmented to present an opaque appearance and may, if desired, be embossed and/or printed to further increase its attractiveness. The central, moisture-absorbing core comprises a soft pad 18 of wood cellulose fibers in fluff form generally restrained between two thin layers 20 of cellulose wadding or tissue. Covering the restrained absorbent pad is an inner liner sheet 22 of a fluid permeable sheet of high wet strength non-woven material. If desired, the pad may be lightly dusted with scented or antiseptic treated talc, the liner sheet being sufficiently porous to permit migration of the powder into contact with an infant's skin.

Along the side edges 24 of the diaper, both the polyethylene backing sheet 16 and the non-woven liner sheet 22 extend beyond the transverse boundaries of the fluff pad 18 and its restraining sheets of cellulose wadding 20 and the inner surfaces of the liner 22 and backing sheet 16 are adhered together in face-to-face relationship in a "fin" seal, as indicated by the numeral 26. Conveniently, this seal is formed by heat fusion of the thermoplastic backing sheet 16 to the non-woven liner 22, although it is to be understood that, if desired, the sheets may be adhered in any desired manner as,

for example, by a suitable adhesive which is water-insensitive.

At the ends of the diaper, the edge of the liner sheet 22 is substantially coincident with that of the absorbent pad 18 and the restraining sheets 20. The backing sheet 16, however, is of greater length than the liner sheet 22 and is brought up over the end edge of the absorbent pad 18, tucked under the end edge portion of the liner sheet 22 and the outer face of the backing sheet is then heat-sealed or otherwise adhered to the inner face of the liner sheet, as indicated at 28 in FIG. 3. This tucked and sealed construction prevents fluid from leaking from the end of the absorbent pad to dampen the clothing on the upper body of the infant.

It is to be noted that the above-described relationships between the liner sheet and backing sheet at the side and end edges of the diaper ensure that the absorbent filler is completely sealed within the envelope formed of these two sheets and the only surface which contacts the skin of the infant is that of the soft, moisture-permeable inner liner sheet 22. Skin contact with the impermeable polyethylene, which tends to trap moisture when in contact with the skin, is carefully avoided. The fin-sealed side edge area of the diaper is adapted to fit the infant's upper leg snugly to prevent leakage of waste material from the diaper in this area.

In order to facilitate fastening of the diaper on an infant, tapes 30 bearing a pressure-sensitive adhesive coating are attached to, and extend from, the areas adjacent the side edges of the diaper near one end thereof, as shown in FIG. 1. The adhesive coating on the extending portions of the tapes 30 is covered by release tab 32 of paper bearing an easy release coating such as silicone resin. An extending free portion 34 of the release tab serves as a grasping or pull tab section for easy removal of the release tab from the pressure-sensitive adhesive surface. When the diaper is applied to the infant, the adhesive-coated tabs 30 serve to connect the two ends of the diaper about the waist of the infant.

Of primary importance to the diaper construction of this invention is the fact that the absorbent pad of cellulose fiber fluff 18 is unitary in its construction rather than being formed of a number of separate superposed layers of varying area. The thickness of the unitary pad, however, varies very substantially in different sections of the overall diaper according to a predetermined pattern for obtaining maximum holding capacity for body wastes with a minimum bulk of absorbent material, with consequent maximum comfort for the child and minimum inconvenience and nuisance for the mother caring for the child. In this connection, it is emphasized that the pad thickness is smoothly contoured or tapered in both directions from the thicker areas in the central portion of the diaper toward both the side edges and the end edges of the diaper. Furthermore, the absorbent cellulose fiber fluff pad, while completely enclosed within the outer envelope formed of the liner sheet and the backing sheet, is devoid of attachment to the outer envelope and therefore has the potential of limited regional shifting movement within the outer envelope to adjust in thickness and contour to conform with the body contours of the infant. With the diaper of the instant construction, it has been found that the natural leg and body movement of the infant tends to further concentrate the fibrous fluff in the central area, particularly in the crotch, thus further enhancing the

absorptive capacity in the critical portion of the diaper.

The letters A, B and C in FIG. 1 represent areas of different fiber density (in terms of weight of cellulose fiber fluff per unit area) in the absorbent pad, the following specific values of fiber weight being exemplary of a diaper proven to be highly acceptable for ordinary wear by an average infant. Diapers for new-born infants would be somewhat smaller, whereas nighttime diapers and diapers for incontinent adults would contain larger amounts of absorbent fibers. The letter A in FIG. 1 represents a fiber weight of about 0.04–0.10 gm./sq. in., B represents a fiber weight of about 0.10–0.15 gm./sq. in., and C represents a fiber weight of about 0.15–0.25 gm./sq. in. In general, it is desired that the areas marked C should have a fiber weight per square inch of about three to five times as great as that in the areas marked A. In a preferred version of an infant diaper having outside dimensions of about 13 in. by 17 in. and narrowed in the crotch area to about 6½–7 in. in width, the area of heaviest fiber concentration, corresponding to the letter C in FIG. 1, is generally elliptical in shape and, as measured along the longitudinal axis of the diaper, extends for a distance of about 4–6 inches in each direction from the geometrical center of the diaper. Along the transverse axis, the area of high fiber density extends about 1½–2 inches in each direction from the geometrical center. The area of heaviest fiber concentration thus occupies from about 15 to about 30 percent of the total absorbent pad area.

In forming a cellulose fiber fluff pad of unitary construction and varying in fiber concentration in the various areas of the pad in the manner described above, provision is made for conveying the individual cellulose fibers suspended in an air stream to a fiber-collection and pad-forming area where the fibers are screened from the air stream and accumulated into a pad. Varying thickness of the pad areas is achieved by baffles inserted in the fiber-bearing air stream which direct a greater volume of flow, and hence a higher concentration of fibers, to selected areas of the fiber collecting screen. The following is a description of a preferred method and apparatus for achieving the desired, smoothly contoured pad.

Referring to FIG. 5 of the drawings, papermaking pulp in dried roll form, commonly referred to in the trade as roll fluffing pulp, is fed to a fiber separating device such as a hammermill (not shown) which tears, shreds and disintegrates the roll pulp web structure into its individual, constituent cellulose pulp fibers or to loosely bonded small groups of such fibers. These resulting individual pulp fibers, or fluff, are suspended in an air stream and the fiber-bearing air stream is conveyed to a fiber collecting drum 40, which includes a pair of drum heads or ends 42 mounted in spaced relation and so maintained by spacer bars 44, and adapted for rotation about an axis passing through the respective drum head centers. The airborne fluff 46 is fed into the area between the drum heads through axially located inlet tubes 48 where the air stream impinges on a deflector disk 50, which directs the flow outward toward the periphery of the drum.

Extending radially outward from the central area of the drum adjacent the deflector disk are a series of diverging fluff conveying chutes 52 which end at the periphery of the drum, the ends of the chutes being covered by an endless screen belt 54 which forms the side wall of the drum. The screen belt is supported on a se-

ries of rolls 56 so that it enwraps the drum throughout practically its entire circumference as the drum revolves about its axis, the remaining portion of the drum periphery being closed with a barrier plate 58 to prevent the escape of air and fluff fibers from this area. Each of the chutes 52 flares out sharply adjacent the drum periphery and the flared area which is covered by a portion of the screen belt 54 constitutes the fiber collection and pad forming area for the pad of a single diaper. Provision is made for supporting a feed roll 60 of a fiber-collecting air pervious web material 20 such as a cellulose wadding web which is threaded to lie on the inner surface of the screen belt 54 as it contacts the drum periphery, so that the air stream, in passing out of the drum, passes through the fiber-collecting web 20 and the screen web 54 which overlies it, whereby the fluff fibers are filtered from the air stream and accumulate on the collecting web 20 to form the desired pad 18. Deflector tabs 62 are placed within the chute 52, attached either to the chute side walls or the deflector disk 50, or both, to direct the flow of airborne fluff so that it concentrates to the desired degree in each of the areas designated A, B or C in FIG. 1.

By varying the placement, size and shape of the deflector tabs 62 on the deflector disk and/or within the individual drum segments or chutes, the specific areas of high fluff deposition may be varied so that the thickest portion, designated C in FIG. 1, may be substantially elliptical, as shown in the drawing, or may be substantially T-shaped, rectangular or hourglass shaped, for example. The generally elliptical shape of this thickened area represents the preferred condition, however.

In order to form and maintain the pad in the hourglass contoured shape as described and illustrated in FIG. 1, the flared ends 64 of the chutes are equipped with impervious baffle plates 66, the edges of which are shaped in conformity with the desired shape of the pad side edge and which are held by the tension of the screen belt in firm contact with the inside surface of the screen belt and its overlying collecting web when the screen belt is being carried around the drum periphery. Since the baffle plates 66 do not permit the passage of air through the collecting web and screen in the area which the plates cover, no fluff fibers are deposited in such areas and the desired hourglass shape of the pad is thus obtained.

The pad is completely formed in one revolution of the drum and is removed, together with the supporting wadding web as the endless screen belt is removed from contact with the drum. If desired, a second, upper web of an air and water pervious material such as cellulose wadding 20 may be brought into overlying contact with the top surface of the pad at this point. Such web may be fed from stock roll 68 and is superposed on the pad after passage around idler roll 70 and nip or lay down roll 72. The fluff pad, now restrained between the two webs of cellulose wadding or similar material, is then passed on a conveyor 74 to a trimming operation which trims the restraining web to match the pad area and the liner and backing sheets are subsequently applied and sealed together in the conformation hereinbefore described. Finally, the tapes are applied to give a completely finished diaper.

Thus, in the diaper of this invention, a high concentration of absorptive material is achieved in the critical central area without undue bulk in the waist band area of the diaper and without the crowding or folding of ex-

cess width of diaper material in the crotch area which causes discomfort to the infant. The hourglass contoured construction fits the child snugly and comfortably in all areas and, due to the snug fit, the diaper is far less prone to leakage around the edges than is the case when excess material is folded and crowded in the crotch area.

It is to be understood that the above description is merely illustrative of the preferred embodiment of the invention, which is not intended to be limited as to details of construction other than as defined in the appended claims.

We claim:

1. A disposable diaper of substantially hourglass outline having an intermediate portion of less width than the two end portions, comprising a moisture-impermeable outer backing sheet, an integral fluid absorbant pad of unbonded cellulose fiber fluff disposed on said backing sheet and a fluid-permeable, high wet strength inner liner sheet of non-woven material disposed on said absorbant pad, said backing and liner sheets extending beyond the side edges of said pad and having their inside faces in superimposed face-to-face adhered relationship in the area of such extension, the end portions of said backing sheet extending around and covering the end edges of said absorbant pad and being back-folded and lap-sealed to said inner liner sheet, said absorbant pad being formed of a single, integral layer of varying thickness and smoothly contoured for even transition from relatively thin sections near the diaper side and end edges to a relatively thick section, said relatively thick section being generally elliptical in plan view with the major axis of said ellipse disposed longitudinally of said diaper and the minor axis of said ellipse disposed transversely of said diaper and generally aligned with the minimum width portion of said diaper, said elliptically shaped relatively thick section constituting a central area of between approximately 15 to 30 percent of the total absorbative pad area.

2. The disposable diaper of claim 1 wherein the end edges of said backing sheet are lap-sealed to the interior side of said liner sheet.

3. A diaper according to claim 1 wherein the fiber weight per unit area in said thick section of predetermined shape is between three and five times as great as the fiber weight per unit area in said relatively thinner sections near the diaper periphery.

4. A diaper according to claim 3 wherein said relatively thick section of predetermined shape extends in each direction along the longitudinal axis of the diaper a distance of from $6\frac{1}{2}$ -7 inches and in each direction along the transverse axis of the diaper a distance of from $1\frac{1}{2}$ -2 inches as measured from the geometric center of the diaper.

5. A diaper according to claim 4 wherein said relatively thick section is substantially elliptical in shape.

6. A diaper according to claim 3 wherein said absorbant cellulose fiber pad is restrained between two thin webs of cellulose wadding.

7. A diaper according to claim 3 wherein a tape coated with a pressure-sensitive adhesive extends from each side edge of the diaper adjacent one end thereof.

8. A diaper according to claim 3 wherein said absorbant cellulose fiber pad is free of attachment to either the fluid-impermeable backing sheet or the fluid-permeable liner sheet.

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