April 27, 1965 W. WADE 3,179,955

METHOD FOR PRODUCING DISPOSABLE GARMENTS

Original Filed Nov. 30, 1955 2 Sheets-Sheet 1

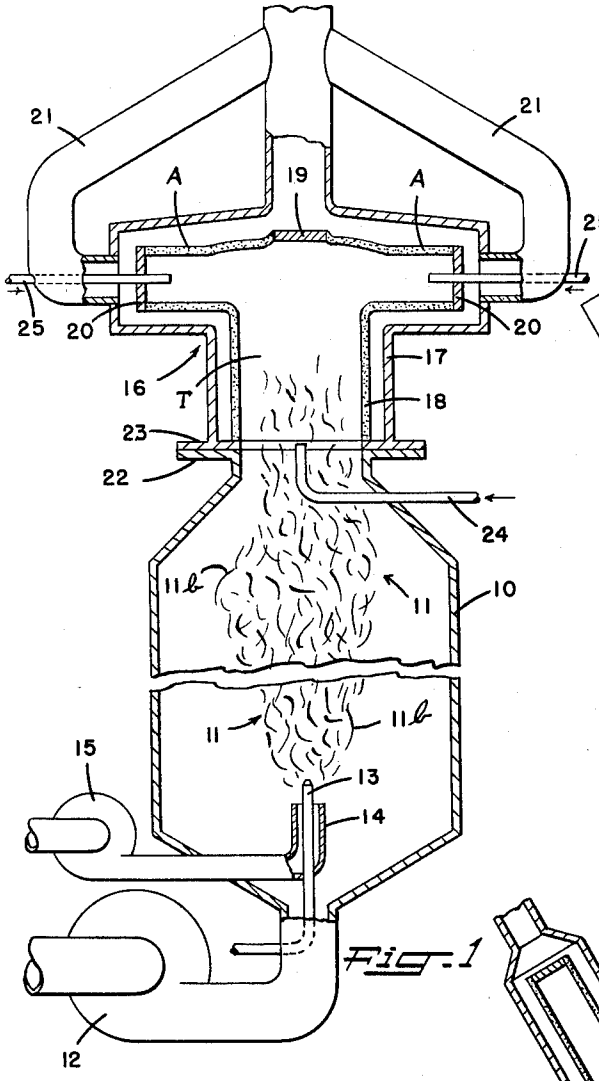


Fig. 1

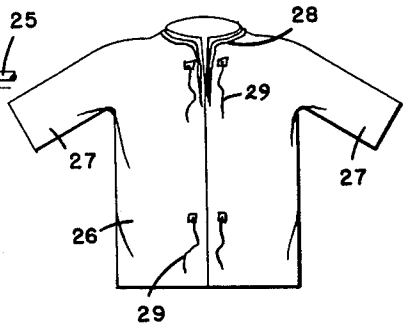


Fig. 2

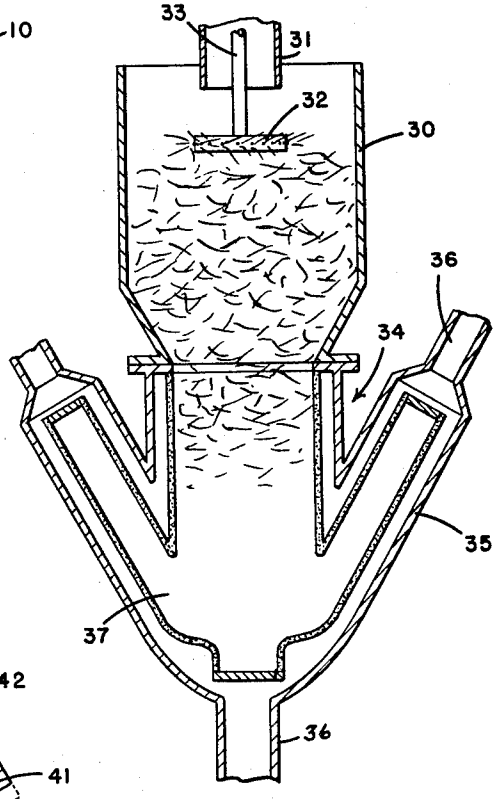


Fig. 3

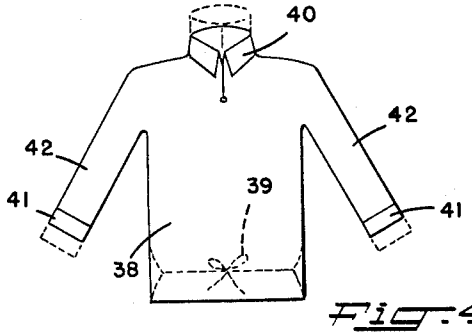


Fig. 4

METHOD FOR PRODUCING DISPOSABLE GARMENTS

Original Filed Nov. 30, 1955 2 Sheets-Sheet 2

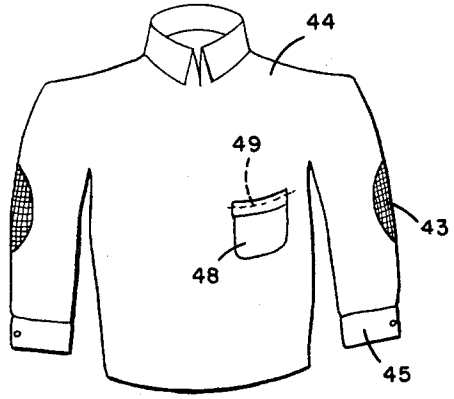


Fig. 5

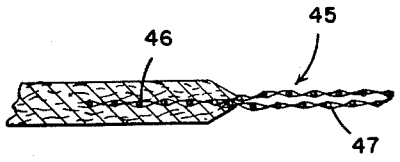


Fig. 6

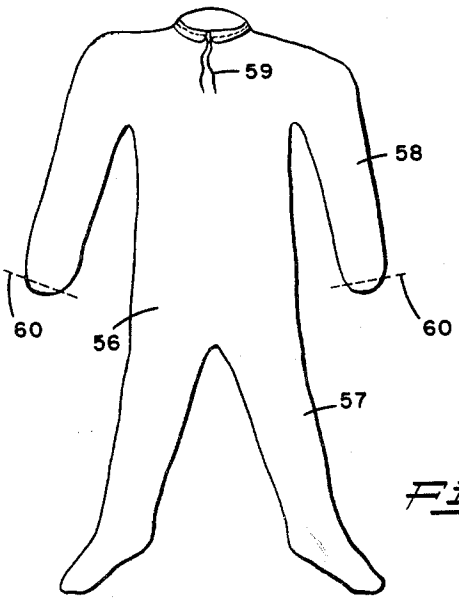


Fig. 8

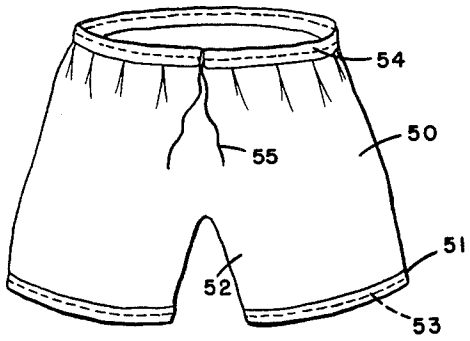


Fig. 7

United States Patent Office 3,179,955 Patented Apr. 27, 1965



# 3,179,955
# METHOD FOR PRODUCING DISPOSABLE GARMENTS

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Original application Nov. 30, 1955, Ser. No. 550,040, now Patent No. 3,032,774, dated May 8, 1962. Divided and this application July 19, 1961, Ser. No. 125,188
3 Claims. (Cl. 2—243)

This invention relates to disposable garments and to a process for producing such garments. The term "disposable garment" is used herein and in the claims to designate any garment or article of wearing apparel having a principal tubular body or torso portion and an integral tubular appendage portion and intended to be worn one or more times until it has become soiled and then disposed of without laundering.

In recent years, there has been a general trend in the wearing apparel industry to such articles which may be worn after laundering without requiring ironing. There has also been a general trend by the public toward the use of disposable items such as drinking cups, dentist bibs, baby diapers, paper napkins and the like. In all of these trends, the object is to relieve the housewife of the tedious labors of ironing and laundering and to avoid the cost and troubles involved in checking the items which are sent to and received from the commercial laundry. In considering the cost of a garment such as a surgeon's operating jacket, the initial price is generally a small part of the total cost when the cost of laundering is added to the retail price. When the initial price plus the cost of laundering such items is divided by the number of times the garment can be worn before it is discarded, it will be found that disposable garments are economically feasible for many purposes. Prior to the present invention, there have been no garments which were so constructed and low enough in cost to permit the user to wear the garment once or several times until soiled and theon dispose of the garment without laundering.

The textile and garment industries cannot produce a garment which may be economically discarded after soiling because the conventional methods of manufacturing the textile garments are too costly and complicated. For example, to produce an ordinary T-shirt requires the following conventional steps: picking or carding of the fibers, drafting, yarn spinning, yarn slashing, weaving, finishing the fabric, cutting the fabric, sewing, washing and ironing or pressing. To further complicate this method, all of these steps are seldom carried out in a single establishment so that operations in different localities are required to produce the final product. In general, more than twenty machines are required to convert conventional textile fibers into a T-shirt. The costly and complicated steps of these conventional methods are eliminated by the present invention.

The general object of this invention is to provide a method for the production of disposable garments having a principal tubular torso portion and an integral tubular appendage portion in a simple and economical manner so that the garments may be disposed of without laundering after they have become soiled.

The present invention provides for the first time a seamless garment having a principal tubular body portion and an integral tubular appendage portion, the garment being formed of a layer of fibers in random distribution and with at least some of the fibers in the layer being bonded together.

The process for producing such disposable garments comprises, in general, dispersing fibers in an air stream, collecting the fibers in a random distribution and in an intermingled relationship on a form having substantially the shape of the desired garment and thereafter bonding at least some of the fibers to each other to produce a seamless non-woven garment. The apparatus, in general, comprises a chamber, means to disperse fibers in an air stream in the chamber, a collector having substantially the shape of the desired garment and means to bond the fibers together in the deposited or collected fiber layer. The collector is porous and means are provided to apply suction to one surface of the collector whereby the fibers are deposited on the other surface. In the preferred embodiment of the apparatus, the collector is so formed that the fibers are collected on the inside of a hollow porous collector and the shaped fiber layer is separated from and removed from the collector by stripping and withdrawing the article from the inside of the collector.



For a more complete understanding of the nature and objects of the invention, reference is made to the accompanying drawings wherein:

FIGURE 1 is a side elevational view, partly in section, of one form of apparatus for making disposable garments in accordance with this invention;

FIGURE 2 is an elevational view of one form of garment produced by the use of apparatus as illustrated in FIGURE 1;

FIGURE 3 is a side elevational view, partly in section, of an inverted embodiment of apparatus for forming garments in accordance with this invention;

FIGURE 4 is an elevational view of a finished garment formed with the apparatus illustrated in FIGURE 3;

FIGURE 5 is a perspective view of a further embodiment of the disposable garments of this invention having textile fabric reinforcements;

FIGURE 6 is a sectional view at an enlarged scale of a portion of the garment shown in FIGURE 5 illustrating one method of applying textile fabric inserts to the garment;

FIGURE 7 is a perspective view showing a further embodiment of disposable garments having reinforcements and having drawstring inserts; and

FIGURE 8 is a perspective view of a further embodiment of the disposable garments wherein some of the integral appendage portions or sections are provided with closed ends.

In forming the garments in accordance with the present invention, any desired fibers may be utilized. The particular fibers selected will depend largely upon the specific garment and its intended uses and the relative cost of the fiber. For example, asbestos fibers may be utilized in providing aprons, jackets, trousers and the like where the garments would be used by firefighters, metal workers and the like. For other types of wearing apparel, other natural fibers and synthetic fibers alone or in admixture may be employed.

In order to reduce costs, the garment is preferably formed of a mixture of short fibers and long fibers. The relative proportions of the short fibers and long fibers may be varied, or the garment may be formed by first depositing a thin layer of long fibers, then a layer of short fibers followed by another layer of long fibers. Alternatively, one type of fiber may first be collected or deposited to form a thin mat, then the other type of fiber introduced along with the first type and finally introducing only the second type of fiber so that the finished product has external surfaces formed of the individual types of fibers.

The term "long fibers" as used herein and in the claims designates textile making fibers capable of being carded and the term "short fibers" designates non-textile making fibers having a length less than about one-half inch and

including papermaking fibers. For example, the short fibers can be wood fibers, before or after beating, kapok, asbestos, glass fibers and organic plastic fibers of less than one-half inch in length, wool waste and noils and the like, all of which are normally not useful for making conventional woven or knitted garments.

The fibers in the product are preferably bonded together at least where the fibers cross each other. The garment fibers may be adhesive bonded or fiber bonded. This bonding may be effected by spraying a suitable adhesive onto the web after the garment has been formed or an adhesive may be sprayed into the stream of airborne fibers as they pass toward the collector. Preferably, however, the garment is made of a mixture of non-binder fibers and binder fibers, that is, at least some of the fibers are potentially adhesive. The binder fibers may be adhesively tacky when they are deposited on the collector or they may be rendered tacky or adhesive by a suitable treatment with a solvent or heat with or without pressure. Such fibers are termed "potentially adhesive."

The binder or potentially adhesive fibers may be formed of any fiber-forming substance which may be rendered adhesive, that is, sticky, cementitious, agglutinous or tacky by heating to temperatures elevated with respect to normal or atmospheric temperatures or by treatment with a solvent or both. Fiber-forming substances satisfactory for the purposes of this invention are substances such as polymers which may be formed into fibers from a flowable condition, that is, from a plastic or molten state or from a solution such as cellulose derivatives, resins or elastomers. The cellulose derivatives include organic solvent soluble cellulose esters such as cellulose acetate, cellulose acetate-butyrate and the like and organic solvent soluble cellulose ethers and the like. Resins which are satisfactory for forming the potentially adhesive fibers include inexpensive natural resins such as shellac, dammar and the like, and synthetic resins formed by the polymerization of various organic compounds such as coumarone, indene, vinyl, styrene, sterol aldehyde, furfural, ketones urea, thiourea, phenol-aldehyde resins, either alone or modified with oils, urea-aldehyde resins, polyhydric alcohol-polybasic acid resins (Dacron), drying oil-modified alkyd resins, resins formed from acrylic acid, its homologues and their derivatives, resins formed from dicarboxylic acids and diamines (nylon type); natural and synthetic rubber or rubber substitutes such as polymerized butadiene, olefine polysulfides, isobutylene polymers, chloroprene polymers; copolymers such as copolymers of a vinyl halide and vinyl acetate, or a vinyl halide and an acrylic acide derivative, for example, a copolymer of vinyl chloride and vinyl acetate (Vinyon), a copolymer of vinyl chloride and acrylonitrile (Dynel), copolymers of acrylonitrile containing a predominant proportion of acrylonitrile (Acrilan, Orlon) and mixtures of the various substances.

The non-binder or non-adhesive fibers may be natural fibers and fibers formed of synthetic resins which are not rendered adhesive when the potentially adhesive fibers are rendered adhesive and include asbestos, wood fibers, cotton, flax, jute, sisal, kapok, wool, hair, silk and the like, cellulosic fibers such as formed from cellulose hydrate, cellulose esters, cellulose ester-ethers, mixed cellulose ethers, cellulose hydroxyalkyl ethers, cellulose carboxyalkyl ethers, cellulose ether-xanthates, cellulose xantho-fatty acids, cellulose thiourethanes, fibers formed from alginic acid, gelatine, casein, and the like, and also fibers and filaments made by slitting, cutting or shredding non-fibrous films such as waste cellophane.

The character and quality of the non-woven fabric forming the garment may be varied by varying the nature of the short fibers and the long fibers. By utilizing short fibers which are non-binder or non-adhesive in admixture with long fibers which are potentially adhesive, a non-boardy soft pliable garment results. By utilizing short fibers of a binder or adhesive nature and long fibers which are non-adhesive, the fabric is relatively stiff although it is still flexible. By confining the short fibers to an inner layer between two outside layers of long fibers of a binder material, a relatively stiff fabric results which may be of extremely low cost. By the use of large proportions of relatively long fibers of a binder or adhesive material on the outer surface of the fabric, the wear-resistance of the fabric may be increased.

In the preferred form of low cost, disposable garment, a mixture of fibers is employed consisting of a major proportion of short fibers, e.g., from about 50% to about 95% by weight, and a minor proportion of long fibers, e.g., from about 5% to about 50%, the long fibers preferably being potentially adhesive and serving to bond the fibers in the garment.

The apparatus shown in FIGURE 1 includes a chamber **10** wherein the fibers **11** are dispersed in an air stream moving axially of the chamber. The air stream may be provided by a suitable blower **12** and the fibers may be dispersed in the air stream by introducing them into the blower or through a separate conduit. If desired, some of the fibers may be formed within the chamber. For example, a suitable fiber-forming device may be of the form shown in the copending application of Paul C. Watson, Serial No. 400,304, filed December 24, 1953 now abandoned. A fiber-forming liquid is extruded through a tube **13** positioned coaxially within a high velocity gas stream supplied through nozzle **14** by means of a suitable blower **15**. The liquid is dispersed into a multiplicity of fine tacky fibers **11***b* which float up and mix with the blown fibers **11**.

At the opposite end of chamber **10**, there is positioned a removable mold **16**. The mold comprises an outer impermeable shell **17** and an internal foraminous or porous collector shell **18** spaced from the outer shell **17** and having substantially the desired configuration of the garment. For example, the collector for a T-shirt would have a principal tubular body or torso-receiving portion T and integral tubular appendages or arm-receiving portions A. At what corresponds to the neck portion of the T-shirt, the collector may have an impervious portion **19** and likewise at the ends **20** of the arm portions the collector may be formed of an impermeable material. The collector is positioned in spaced relationship within the impervious outer casing **17**, the casing being preferably provided with a plurality of ducts **21** through which the gas may be exhausted from the chamber. In order to provide a ready assembly and disassembly of the mold from the chamber, both the mold and the chamber may be provided with mating flanges **22** and **23**. Since the sprayed fibers **11***b* are tacky at the time when the fiber mixture is deposited on the mold, they bond the other fibers and enable the garment to be removed from the mold in one piece.

Where the fibers are all preformed fibers such as rayon staple fibers introduced into the chamber as through blower **12**, they are carried from the point of introduction to the collector by the air stream and become intermingled and are deposited on the collector in a random distribution. After a layer of the desired thickness is collected on the collector surface, a suitable binding or adhesive material may be introduced as through atomizers **24** and **25**, the air flow through the chamber and through the collector surface being maintained during the atomizing period. Where the fibers which are collected include thermoplastic fibers either introduced as preformed thermoplastic fibers or formed by the spraying unit, the collected fibrous layer may be bonded into a unitary structure by introducing hot gas or by introducing steam through atomizers **24** and **25** to raise the temperature sufficiently high to cause the thermoplastic fibers to become tacky and then introducing cooler air to set the thermoplastic fibers. Where the fibers may be rendered adhesive by a solvent, vapors of the solvent may be supplied through the atomizers **24** and **25** followed by flushing with air

to deactivate and reset the adhesive fibers. Thereafter, the mold **16** may be separated from the chamber **10** and the fibrous article or garment is stripped from the collector **18** internally of the mold.

The garment as produced by this apparatus and utilizing any of the bonding methods is shown in FIGURE 2. The garment comprises a main hollow or tubular body or torso-receiving portion **26** and integral hollow or tubular appendage or sleeve or arm-receiving sections **27**. The torso-receiving portion has at one end a neck portion adapted to encompass the wearer's neck and the arm-receiving sections or sleeves extend in a generally downward direction along the torso-receiving portion from a position adjacent the neck portion, the axes of the arm-receiving sections forming acute angles with the axis of the torso-receiving portion. Obviously, the length of the torso portion and the lengths of the sleeve portions may be of any desired size. A cord **28** may be laid around the neck portion or may be secured adjacent the neck portion and the neck portion turned down upon itself to enclose the cord and therby provide a drawstring. The cord may be adhered by adhesive or by thermally bonding the layers of garment. The back portion may be slit and tie cords **29** secured along the slit to provide a jacket or gown for use by surgeons, nurses, waitresses, etc.

In that embodiment of the apparatus as shown in FIGURE 3, there is provided a chamber **30** and a conduit **31** through which gas may be passed which gas may carry preformed fibers. The fiber-forming device **32** includes a hollow disc secured to a tubular shaft **33** and having a series of spaced orifices in its outer peripheral surface and means (not shown) for rotating the disc at a high velocity. A fiber-forming plastic in liquid state is supplied to the hollow disc through the tubular shaft and the plastic is thrown through the orifices by centrifugal force to form fibers which are carried downwardly in the tower by a gas stream. At the opposite end of the tower, there is mounted a mold **34** which comprises an outer impervious shell **35** provided with gas exhaust conduits **36** and an internal foraminous or porous collector shell **37**. The collector shell, in this instance, may be in the form of a turtle-neck sweater and may be shaped as illustrated. After the fiber layer deposited on the collector shell is of a desired thickness, the fibers in the layer are bonded together as described hereinabove. The mold is thereafter separated from the chamber and the garment is stripped from the collector surface. This apparatus may be inverted if desired.

The lower marginal portion of the torso section **38** may be folded upwardly and a cord placed within the fold before the edge is bonded to the torso portion to form a drawstring **39**. The neck portion may, if desired, be slit and a portion folded downwardly as shown to form a collar **40**. The marginal portions **41** of the sleeves **42** may be turned upwardly to reinforce the open ends of the sleeve. Because of the non-woven structure, the fibrous sheet has limited stretchability. It is necessary to form the seamless body or torso portion of sufficient width to allow the garment to be slipped over the shoulders of the wearer. The drawstring at the lower portion or, if desired, a drawstring attached higher up on the torso section may be provided to gather in the fullness at the wearer's waist.

The garment as illustrated in FIGURE 5 includes woven fabric reinforcement sections such for example as collar and cuff members, and knee, elbow or foot portions. Portions of the garment may be reinforced by applying textile portions, which may be of relatively open mesh, to the web during formation of the garment on the collector so that the open mesh textile is embedded in the web layer. Where the open mesh fabric is embedded in the web layer, it becomes an integral part of the web and the fibers on each surface of the fabric become bonded to the fabric and bonded to each other through the openings in the fabric.

Alternatively, the area adjacent the elbow portion **43** of the shirt **44** may be provided with a woven textile reinforcement. The textile may be secured to the garment by means of a suitable adhesive, or, where the garment includes thermoplastic fibers, the textile may be secured to the garment by a hot pressing operation whereby the thermoplastic fibers become tacky and upon cooling bind the textile to the fibrous web. For better grades of garments, the textile reinforcement may be sewn to the garment.

The cuff portions **45** may be secured to the sleeve in the same manner. Alternatively, the cuff and collar portions may be formed of a loosely woven or woven mesh section **46** and a closely woven portion **47**. The open mesh portion **46** may be embedded in the fibrous web as shown in FIGURE 6 and bonded to the fibrous web by the use of an adhesive or by the use of adhesive fibers in the non-woven garment. Application of heat and pressure activates the adhesive material or adhesive fibers and joins the cuff portion to the garment to form a unitary assembly. A pocket **48** may be secured to the garment by adhesively mounting the pocket on the garment along the sides and bottom of the pocket section. The pocket section may be formed of a woven fabric if desired. The upper marginal portion of the pocket section is preferably turned downwardly over a cord **49**, the ends of which are adhesively or thermally bonded to the garment as a reinforcing means.

In forming this type of garment, the reinforcing fabric may be applied to the initially collected fibers. For example, after the thickness of the collected fibrous web is about one-half that of the desired thickness, the introduction of the fibers into the chamber may be arrested and the reinforcing woven fabric applied at the desired areas. The fibers are then introduced into the chamber and collected over the reinforcing fabric portions until the desired thickness of fiber layer has been collected. After removal of the garment from the mold, it may be subjected to a suitable heating and pressing operation to bind the fibers to the reinforcing fabric. In this embodiment of the garments of this invention, the garment is provided with reinforcements at the ends of the sleeves and at the neck portion which are most likely to obtain strains which might tear the garment. Simultaneously, the appearance is enhanced by the tailored cuffs and collar.

In FIGURE 7, there is illustrated an undergarment, such as drawers, panties or the like. The marginal portions **51** of the leg members **52** of the drawers **50** are preferably folded back upon themselves to form a hem and a cord or layer **53** is positioned under the fold or within the hem. The marginal portions are then adhesively or thermally bonded to the leg members. Such structure is well suited to reinforce these leg openings which might be subjected to sufficient strains to cause the garment to tear. Alternatively, the folded marginal portions may be secured to the leg members and the openings reinformed by sewing. The upper end of the drawers should be of sufficient size to pass the wearer's hips. The upper marginal portion **54** is folded downwardly upon the torso portion of the garment and a drawstring **55** is positioned under the fold before the marginal portion is adhesively secured to the torso portion. The seat section of the garment and where the garment is formed with leg portions which extend to the wearer's ankles, the knee portion, or the entire garment may be surfaced with or reinforced with a woven fabric or with a continuous film of plastic material, such as a vinylite resin sheet.

In FIGURE 8, there is illustrated a further form of garment which may be formed in accordance with the present invention, namely, a child's sleeping garment. The garment is formed with a torso portion **56** and integral leg appendages **57** and arm appendages **58**. The neck portion is preferably provided with a drawstring **59** of the same type as described hereinbefore. If desired,

the ends of the arm appendages may be cut adjacent the ends as shown by the dotted lines 60. Portions of the garment may be reinforced with woven fabric or a continuous film of plastic material as described hereinabove.

This application is a division of my copending application Serial No. 550,040, filed November 30, 1955, now Patent No. 3,032,774 dated May 8, 1962, entitled Seamless Garment.

While preferred embodiments of the invention have been disclosed, the description is intended to be illustrative and it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. The method of forming a seamless, non-woven garment having a tubular body portion formed with one end open and an open terminal portion, and tubular appendages integral with the tubular body portion, each of said appendages having an open terminal portion remote from said body portion, said method comprising dispersing fibers in an air stream, passing the air stream containing the dispersed fibers into a porous tubular mold having an opening at one end, a non-porous closure at the other end and porous tubular appendages projecting angularly from the tubular mold adjacent to said other end, each of the appendages having non-porous closures at their ends remote from the tubular mold, collecting a layer of the fibers in random distribution on the interior surfaces of the porous tubular mold and appendages while permitting the air stream to pass therethrough, said collected fibers together providing a configuration of the garment, bonding to each other at least some of the fibers in the deposited layer to retain the configuration and to form the garment and removing the garment from the interior surfaces of the mold and appendages.

2. The method of forming a seamless, non-woven garment as defined in claim 1 wherein the marginal edges of the garment are folded back upon the layer of fibrous material to form a hem and securing the fold to the layer of fibers.

3. The method of forming a seamless, non-woven garment as defined in claim 1 wherein the air stream containing the dispersed fibers is arrested when the thickness of the layer of collected fibers is about one-half the desired thickness, a reinforcing woven fabric is applied to the layer of collected fibers at desired areas and the air stream containing the dispersed fibers is then passed into the porous tubular mold and appendages until the desired thickness of the layer of collected fibers is effected.

**References Cited by the Examiner**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 1,967,704 | 7/34 | Bunn | 2—167 |
| 2,347,578 | 4/44 | Roher | 2—243 |
| 2,479,609 | 8/49 | Fouch et al. | 2—243 |
| 2,491,766 | 12/49 | Richardson | 18—2.5 |
| 2,511,247 | 6/50 | Champlin | 112—262 |
| 2,609,539 | 9/52 | Shearer | 2—243 X |
| 2,814,162 | 11/57 | Toulmin | 18—2.5 |
| 2,903,387 | 9/59 | Wade | 2—243 |
| 2,994,091 | 8/61 | Aftergood | 2—243 |
| 3,032,774 | 5/62 | Wade | 2—243 |

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