United States Patent

[11] **3,616,129**

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[54] **LONGITUDINALLY STRETCHABLE NONWOVEN MATERIAL**
7 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **161/57,** 156/175, 156/177, 156/178, 156/183, 161/129, 161/141, 161/143, 161/156, 161/157
[51] **Int. Cl.** **B32b 5/12**
[50] **Field of Search** 161/57, 58, 59, 129, 142, 156, 157, 143, 141; 156/175, 176, 177, 178, 181, 183

[56] **References Cited**

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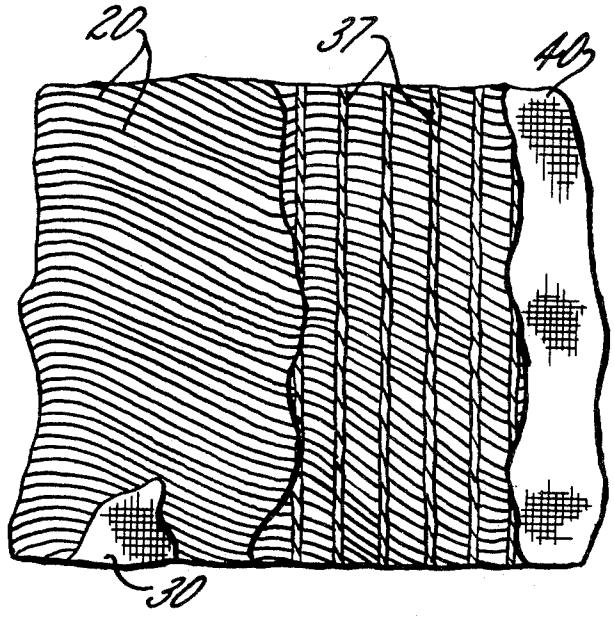
ABSTRACT: A longitudinally stretchable, nonwoven material and the method of making same are disclosed. A plurality of spaced-apart, substantially parallel warp threads are drawn from their respective supply cans and over an adhesive applicator. The warp threads are laterally oscillated and deposited on the surface of a carrier sheet moving into a thread cross-laying apparatus to produce a generally sinusoidal pattern of threads on the carrier sheet. A plurality of spaced-apart, substantially parallel cross threads are then laid generally straight across the carrier sheet in a transverse direction as it moves through the cross layer and the cross threads are adhesively bonded to the warp threads where they cross one another. Provision is also made for introducing and laminating top and bottom layers of sheet material to the longitudinally stretchable, nonwoven material.



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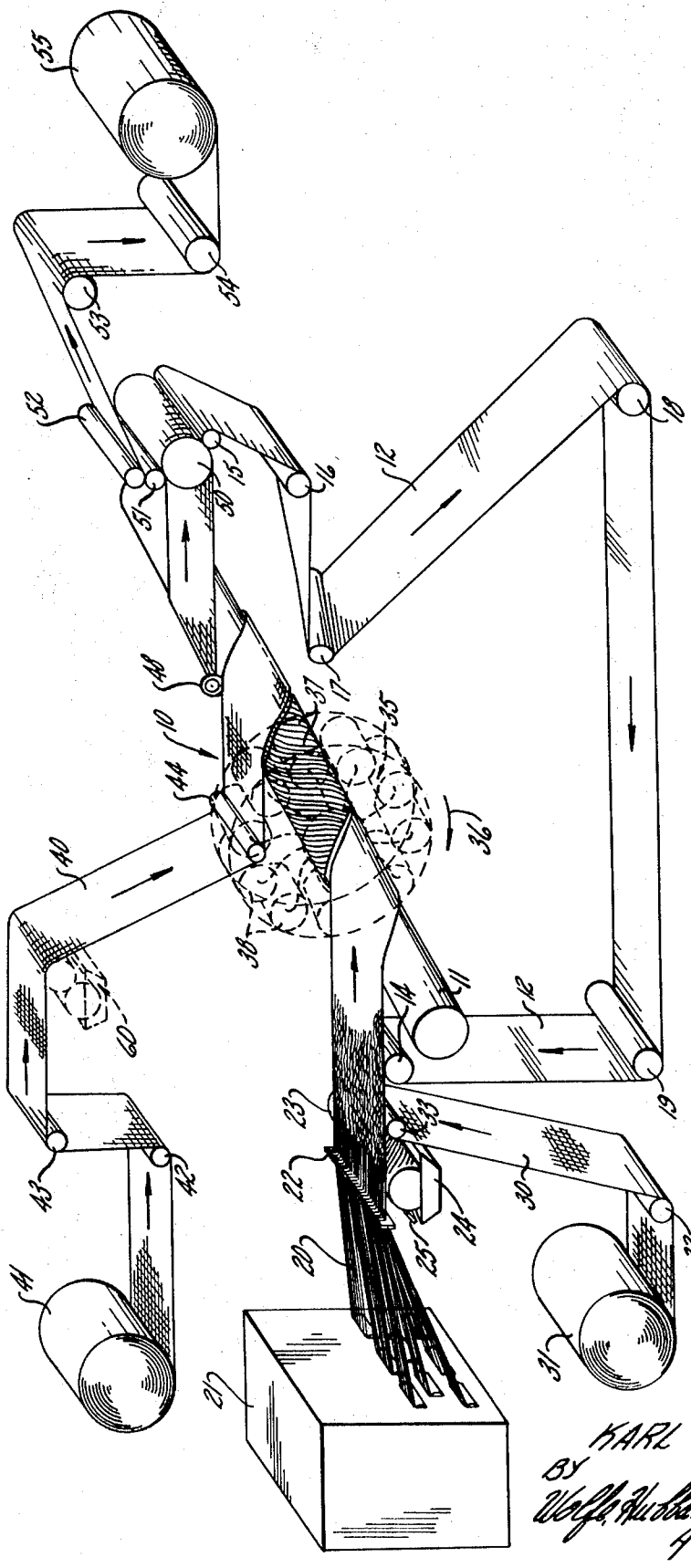

Fig. 1.

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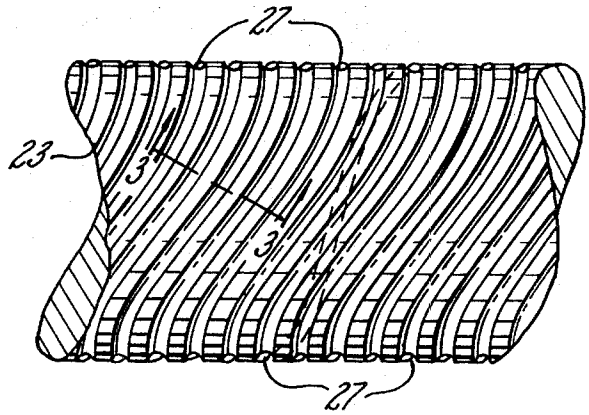
Fig. 2.



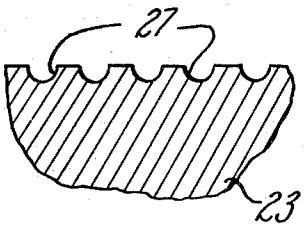


Fig. 3.

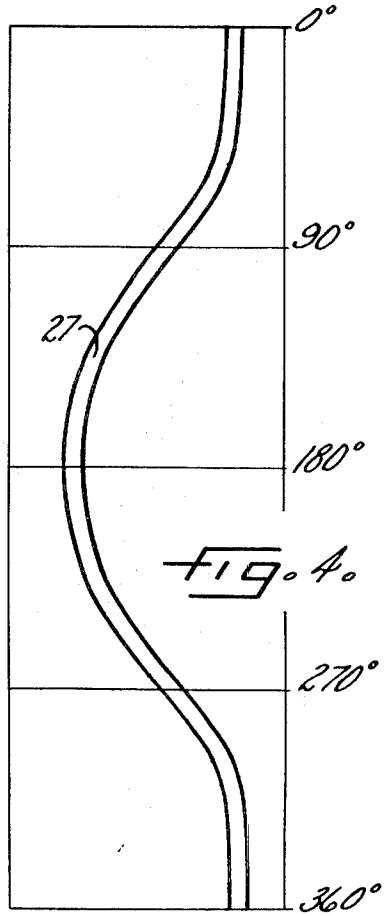


Fig. 4.

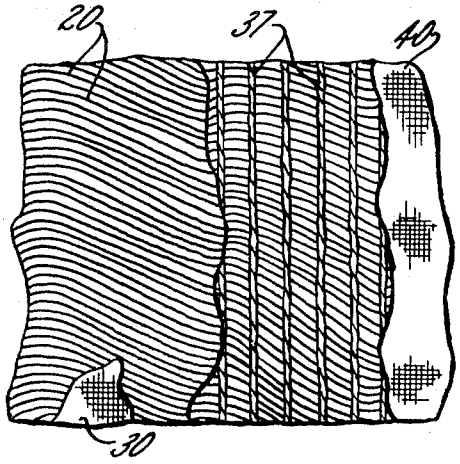


Fig. 5.

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LONGITUDINALLY STRETCHABLE NONWOVEN MATERIAL

BACKGROUND OF THE INVENTION

The present invention relates generally to nonwoven material and more particularly concerns longitudinally stretchable nonwoven materials and methods of making same.

It has previously been proposed, for example in Hirschy U.S. Pat. No. 2,841,202 and in Burger U.S. Pat. No. 3,025,196 to provide thread cross-laying apparatus for making a cross thread reinforced nonwoven material in which both the longitudinally extending warp threads and the generally transversely extending cross threads are adhesively bonded together at their crossings in spaced-apart, parallel and substantially straight condition. Such a nonwoven scrim, of course, has utility of its own, but more often it is used to longitudinally and transversely reinforce one or more layers of sheet material which otherwise have relatively low strength characteristics. One very practical application of such scrim-reinforced materials employing outer layers of creped cellulosic wadding is in the fabrication of disposable garments, sheets, coverings, toweling and the like. Normally, however, such creped wadding has considerably higher stretch and strength properties in the longitudinal direction than in the cross direction and this makes it difficult to match the creped wadding with a reinforcing scrim having the desired properties of stretch and strength in both the longitudinal and transverse directions.

Accordingly, it is the primary aim of the present invention to provide a method of making a cross-reinforced nonwoven material which has a controlled and predetermined amount of longitudinal stretch built into it.

It is a further object to provide such a longitudinally stretchable nonwoven reinforcing material which can be easily matched with the stretch requirements of various surfacing webs.

A more particular object is to provide a longitudinally stretchable nonwoven reinforcing scrim in which the warp threads are disposed in a generally sinusoidal pattern.

SUMMARY OF THE INVENTION

The longitudinally stretchable, nonwoven material of the present invention includes a plurality of spaced-apart, substantially parallel warp threads which extend generally longitudinally in a sinusoidal pattern and a plurality of spaced-apart, substantially parallel cross threads which extend generally straight across the warp threads with the warp threads and cross threads bonded together where they cross one another. The warp threads are first drawn from their respective supply cans and aligned in spaced-apart, substantially parallel relation and, after application of adhesive, are laterally oscillated and deposited on the surface of a carrier sheet moving into a cross-laying apparatus where the cross threads are laid straight across the sinusoidally disposed warp threads.

In the preferred embodiment, the warp threads and cross threads are of multifilament low twist construction having an overall denier in the range of between about 15 and 150 and a twist ratio of not more than 6 turns per inch and are spaced apart between about 2 and 12 threads per inch. However, the invention also contemplates the use of monofilament threads which, preferably, have a denier in the range of 15 and 20 for certain applications. A preferred laminated longitudinally stretchable nonwoven material includes a longitudinally sinusoidal scrim as described above adhesively bonded to one or more layers of sheet material having appreciably more longitudinal than transverse stretch characteristics such as creped cellulosic wadding. The creped wadding layers are each preferably formed of at least one ply having a basis weight before creping of between about 4 and 12 pounds per 2,880-square-foot ream and have a residual stretch ratio of between about 1.2 and 1.5 after stretching and ironing.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a schematic side elevation of a cross-laying apparatus which may be utilized to practice the method of the present invention;

FIG. 2 is an enlarged fragmentary front elevation view of the adhesive application roll;

FIG. 3 is an enlarged fragmentary section taken substantially along line 3—3 in FIG. 2;

FIG. 4 is a projection of one of the grooves in the cylindrical surface of the adhesive application roll shown in FIG. 2; and,

FIG. 5 is an enlarged fragmentary plan view of one form of longitudinally stretchable, nonwoven material made on the apparatus shown in FIG. 1 with the various layers broken away to show the internal details of the multicomponent construction.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to the drawings, there is shown schematically in FIG. 1 an apparatus 10 for making longitudinally stretchable, nonwoven material according to the present invention. The illustrated apparatus 10 includes a generally cylindrical mandrel 11 around which an endless belt 12 is helically wound through a plurality of turns. The mandrel 11 is preferably in the form of a hollow cylindrical shell having a plurality of air discharge openings therein and the interior of the mandrel is supplied with air under pressure in order to floatingly support the belt 12 on the surface of the mandrel. In the present instance, the belt 12 makes three turns or wraps on the mandrel 11 and the belt is further supported by a plurality of guide rollers and turning bars 14–19 mounted in a suitable frame (not shown).

It will be understood that the location and disposition of the roller 14 relative to the mandrell 11 determines the approach angle of the best 12 to the mandrel and thus the angle of the helical turns. In the illustrated embodiment, roller 15 not only guides and supports the belt 12 as it moves off the mandrel, but also drives the belt around the helical turns through suitable means (not shown). The belt is also guided by roller 16 and 19 and turning bars 17 and 18, which are preferably of the air-floating type, as it returns from drive roll 15 to guide roll 14.

Pursuant to the present invention, a plurality of threads 20 are drawn from their respective supply spools which are located, for example, in a creel room 21. The threads 20 pass through a comb 22 to align them in spaced-apart, substantially parallel relation. The threads 20 are then drawn over a grooved adhesive applicator roll 23 which coats the threads with a thin layer of flexible adhesive. The applicator roll is partially submerged in liquid adhesive contained in a supply trough 24 and excess adhesive is removed from the surface of the roll by a suitable doctor blade 25.

As shown in greater detail in FIGS. 2 and 3, the surface of the applicator roll 23 is provided with a plurality of axially spaced, self returning grooves 27, each of which, in cylindrical projection, define a sinusoidal pattern (see FIG. 4). Suitable means (not shown) are provided for rotating the applicator roll 23 and, as it rotates, the grooves 27 impart a laterally oscillating sinusoidal movement to the threads 20. The applicator roll 23 is preferably rotated with a differential surface speed relative to the movement of the threads 20 to help avoid wrap-up of the threads on the roll and to enhance the lateral force imparted to the threads by the grooves 27.

From the adhesive applicator roll 23, the threads are deposited on the upper surface of a carrier sheet 30 moving into the cross-laying apparatus 10. In the illustrated embodiment the carrier sheet comprises a web of creped wadding drawn from a supply roll 31 and around guide rollers 32 and 33 onto the upper surface of the belt 12. Desirably the roller 33 is positioned such that the web 30 of creped wadding intersects the threads 20 at a slight angle and the adhesive on the threads is sufficiently tacky to hold the threads on the web surface in the predetermined sinusoidal pattern imparted by the adhesive applicator

A serving ring **35** is rotated about the mandrel **11** in the direction of the arrow **36** in timed relation to the helical movement of the belt **12** around the mandrel. As the serving ring rotates, a plurality of reinforcing threads **37** are drawn from respective supply cones **38** are helically wound about the mandrel **11** and belt **12**, with the threads **37** disposed in spaced-apart, substantially parallel relation and extending generally straight across the web **30** in a transverse direction. The precise spacing of the threads **37** and their angular orientation relative to the web **30**, of course, depend upon the number of threads served by the ring **35**, the rotational speed of the ring relative to the belt as well as the helical angle of the belt. The reinforcing threads **37** are partially embedded and held in their parallel, spaced-apart relation by the adhesive on the threads **20** where the threads **37** and **20** cross one another.

Following the helical wrapping of the threads **37** over the sinusoidal threads **20** on the web **30**, another web **40** is preferably introduced in registry with the belt **12** and web **30** is wound about a subsequent helical turn on the mandrel **11**. In the illustrated apparatus **10**, the web **40** is drawn from a supply roll **41** and is trained around guide rolls **42**, **43** and **44** which guide the web **40** to the mandrel in registry with the belt **12** and web **30** as they travel around the mandrel. The web **40** thus overlies the threads **37** and imprisons them against the sinusoidal threads **20** and the lower web **30**. The top web **40** preferably makes at least one complete helical turn on the mandrel **11** and a slitter **48** is disposed along the edges of the web **40** and belt **12** to cut the cross threads **37** into transverse segments after they are imprisoned between the webs **30** and **40**.

After the slitting operation, the belt **12** and composite web comprising the bottom wadding layer **30**, sinusoidal threads **20**, cross threads **37** and top web **40** travel off the mandrel **11** in the direction of the belt drive and support roller **15**. The composite web is then separated from the belt **12** and, in the illustrated apparatus **10**, is wound around the surface of a preheat drum **50** before being directed into the nip of a pair of calender rolls **51** and **52**.

The preheat drum serves to at least partially cure or dry the adhesive in the composite web and brings the adhesive to the desired condition for final bonding of the assembled components. The required surface temperature will depend on the type of adhesive employed as well as the length of time the web remains in contact with the heated drum surface. While various adhesives may be employed, advantages reside in the use of plastisols which, as is well known, are colloidal dispersions of synthetic resins in a suitable organic ester plasticizer. While many adhesives of this nature are known, those found particularly useful for incorporation in the product of this invention include vinyl chloride polymers, and copolymers of vinyl chloride with other vinyl resins, plasticized by organic phthalates, sebacates, or adipates. These combinations provide a fast-curing plastisol adhesive characterized by relatively low viscosity, low migration tendencies, and minimum volatility. Such adhesives remain soft and flexible after curing, can be reactivated by the application of heat and pressure, such as by hot-calendering, and insure that the resultant laminated product retains the desired softness, and proper hand and feel. Although plastisols are preferred, polyvinyl resins per se, plasticized or unplasticized, such as polyvinyl acetate, and copolymers may also be used. Other flexible adhesive may also be used, including acrylic resins such as the alkyl acrylates, and butadiene resins such as butadiene-styrene and butadiene acrylonitriles.

When using the preferred plastisol adhesives described above, the steel drum **50** is heated to a temperature of about 250° to 350° F., to advance the curing or drying of the adhesive. Hot calender rolls **51** and **52** operate at temperatures of 300°–375° F. and serve to complete the curing or drying of the adhesive while firmly bonding the cross threads **37** and sinusoidal threads **20** to the bottom web **50** and top web **40**. The composite web then passes over a series of cooling drums **53** and **54** prior to being wound on a take-up roll **55**.

In the preferred embodiment, the top web **40** is formed of creped cellulose wadding similar to the bottom web **30**. Such a material is shown, in somewhat exaggerated form, in FIG. **5**. The creped wadding layers are each preferably formed of at least one ply having a basis weight before creping of between about 4 and 12 pounds per 2,880-square-foot ream and have a residual stretch ratio of between about 1.2 and 1.5 after stretching and ironing. If desired, the under surface of the top web can also be printed with adhesive and for this purpose, an offset adhesive printer, indicated generally at **60**, is provided.

The warp threads **20** and cross threads **37** are preferably of multifilament low twist construction having an overall denier in the range of between about 15 and 150 and a twist ratio of not more than 6 turns per inch and preferably not more than 2 turns per inch. Both the warp threads and cross threads are disposed in spaced-apart parallel relation between about 2 and 12 threads per inch. It will be understood, of course, that the sinusoidal disposition of the warp threads **20** is selected to afford a longitduinal stretch characteristic within the range of and preferably identical to the residual stretch ratio of the creped wadding layers **30** and **40**.

The present invention also contemplates the method of producing cross-thread-reinforced fiber webs which does not require the addition of a top layer of cellulose wadding. However, in practicing this method it is desirable to introduce holddown threads on each side of the slitter as disclosed, for example, in U.S. Pat. No. 3,025,196. If such holddown threads are employed, the edges of the composite material are subsequently trimmed off to remove the holddown threads so as not to impair the longitudinal stretch characteristics of the material

The bottom wadding layer **30** may also be initially eliminated, if desired, to produce a longitudinally stretchable, cross-thread-reinforced nonwoven material. To produce a nonwoven material of this character, the adhesively coated threads **20** are discharged in a sinusoidal pattern directly on the release-coated surface of the carrier belt **12**. After the cross threads **37** are wound around the helically traveling threads **20**, holddown threads such as disclosed in the above mentioned U.S. Pat. No. 3,025,196 are preferably introduced on each side of the slitter **48**. In this instance the belt **12** may also be heated by means (not shown) to partially cure or dry the adhesive to the point where the threads **20** release cleanly from the belt. One or more wadding layers may subsequently be applied to the previously formed nonwoven scrim as, for example just prior to wrapping it around the preheat drum **50**.

While the invention has been described and illustrated in connection with certain preferred embodiments and procedures, it is not intended to limit the invention to those specific embodiments and procedures. Rather, it is intended to cover such other alternative and equivalent embodiments and procedures as fall within the spirit and scope of the present invention.

I claim as my invention:

1. A longitudinally stretchable, nonwoven material comprising, in combination:

a plurality of spaced-apart, substantially parallel warp thrdads extendimg generakly n he longhtudim[l diqebsion $01of the material and in a generally sinusoidal pattern;

a plurality of spaced-apart, substantially parallel cross threads extending generally straight across the material in ə transverse direction;

said warp and cross threads being of multifilament low twist construction;

top and bottom layers of sheet material having appreciably more longitudinal than transverse stretch characteristics;

said cross threads being adhesively bonded to said warp threads where they cross one another, and said top and bottom layers being adhesively bonded to at least said warp threads.

2. A nonwoven material as defined in claim **1** wherein said warp threads have an overall denier in the range of between about 15 and 150 and a twist ratio of not more than 6 turns per inch.

3. A nonwoven material as defined in claim 1 wherein said cross threads have an overall denier in the range of between about 30 and 100 and a twist ratio of not more than 2 turns per inch.

4. A nonwoven material as defined in claim 1 wherein said top and bottom layers are each formed of at least one ply of creped cellulosic wadding having a residual stretch ratio of between about 1.2 and 1.5.

5. A nonwoven material as defined in claim 4 wherein said

plies of wadding each have a basis weight before creping of between about 4 and 12 pounds per 2,880-square-foot ream.

6. A nonwoven material as defined in claim 1 wherein said warp threads are spaced apart between 2 and 12 threads per inch.

7. A nonwoven material as defined in claim 1 wherein said cross threads are spaced apart between 2 and 12 threads per inch.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,616,129 Dated October 26, 1971

Inventor(s) Karl E. Sager

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Specification:

Col. 2, l. 34 change "mandrell" to --mandrel--;

l. 75 after "applicator" add --roll 23.--;

Col. 3, l. 18 after "web 30" add --and--.

In the Claims:

Claim 1, ll. 4 and 5, change "thrdads extendimg generakly n he longhtudim[l diqebsion $01" to -- threads extending generally in the longitudinal direction--.

Signed and sealed this 28th day of November 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

M PO-1050 (10-69)

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