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Grieves et al.

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[54] **NON-WOVEN PAPERMAKERS FELT**

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Related U.S. Application Data

[62] Division of Ser. No. 205,009, Dec. 6, 1971, abandoned.

[52] **U.S. Cl.** ..... **162/348;** 28/72.2 R

[51] **Int. Cl.** **B32b 5/06;** D04h 18/00

[58] **Field of Search** ..... 161/57, 58, 60, 69, 80, 161/81, 154, 227, 231, 247; 28/4 R, 72.2 R

[56] **References Cited**

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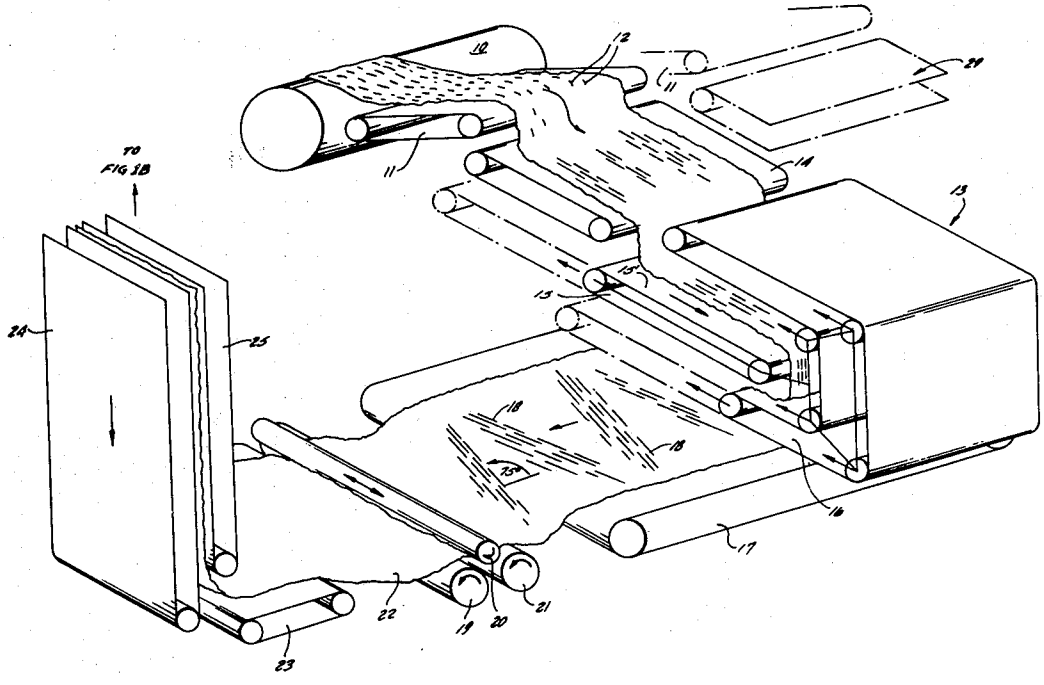
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Primary Examiner—George F. Lesmes
Assistant Examiner—Alan T. McDonald

[57] **ABSTRACT**

An improved non-woven papermakers felt and economical method of manufacturing the same in which a base fabric is formed of a plurality of layers of webs formed of fibers oriented substantially longitudinally consolidated into a homogeneous mass and a web of fibers is needled thereinto.

1 Claim, 6 Drawing Figures



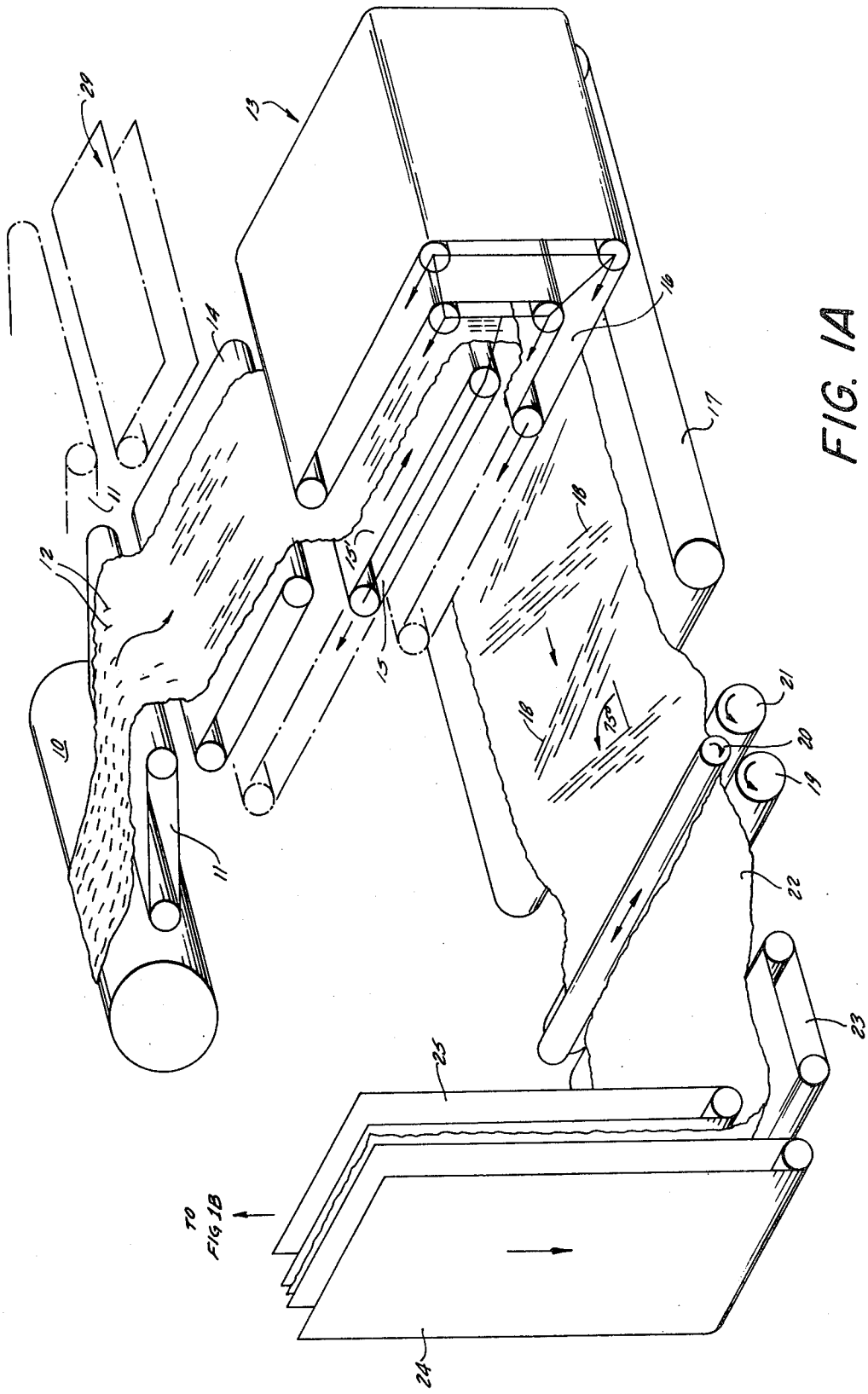


FIG. 1A

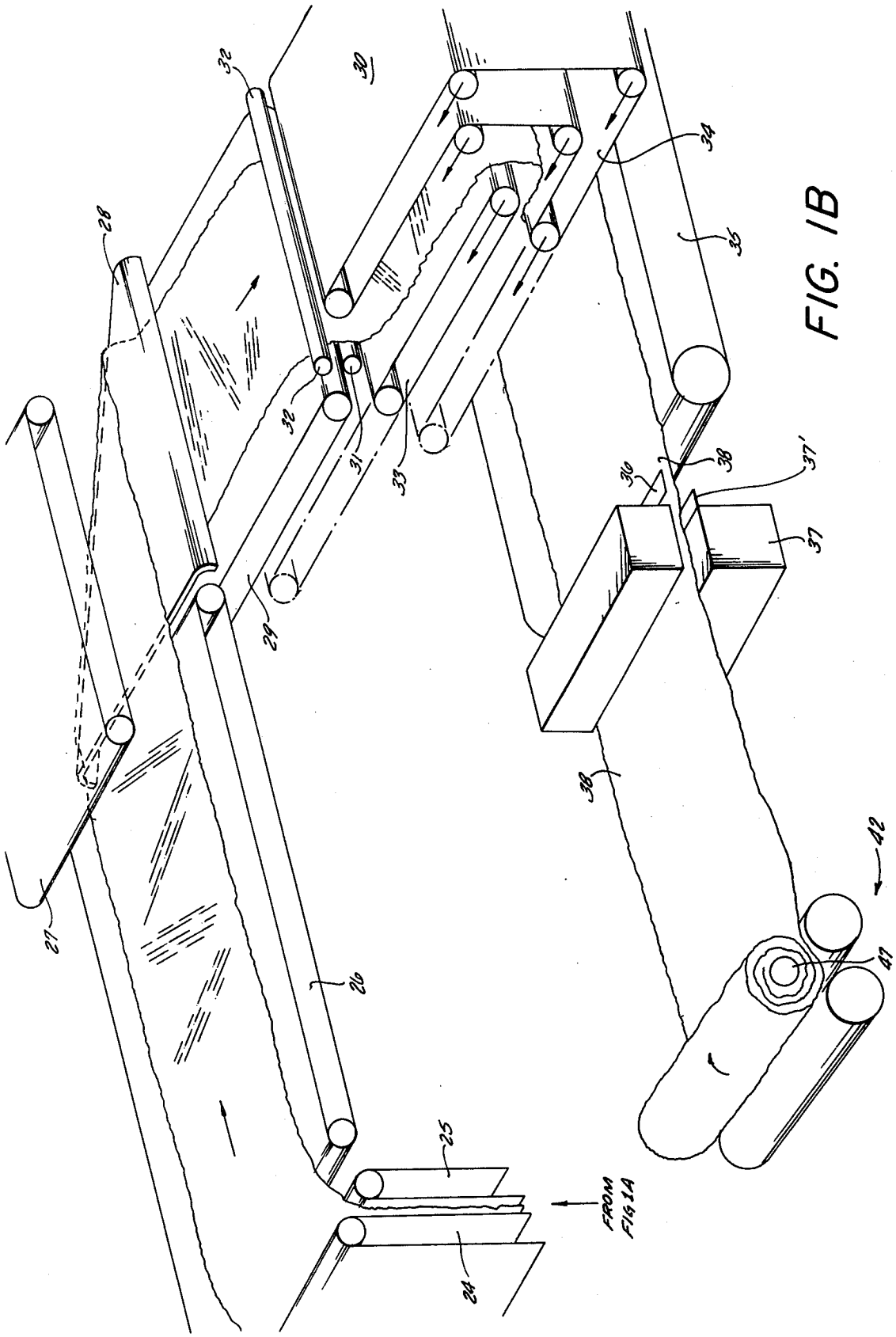


FIG. 1B

FIG. 2A

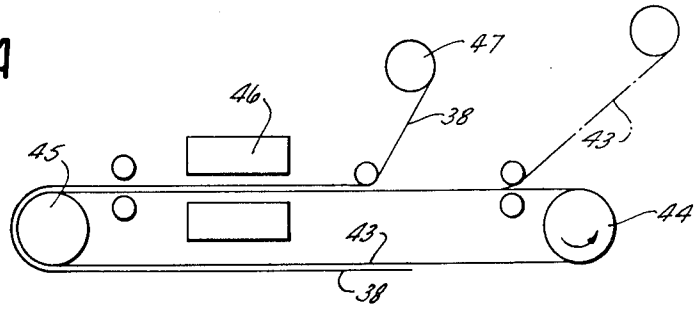


FIG. 2B

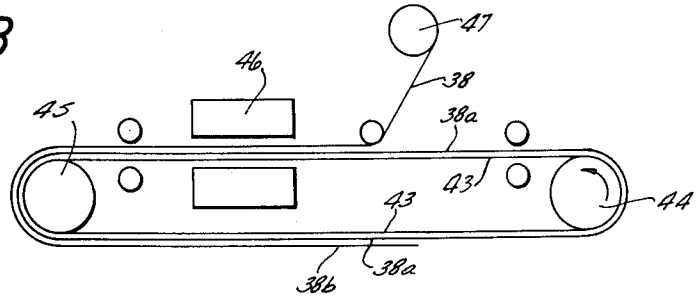


FIG. 2C

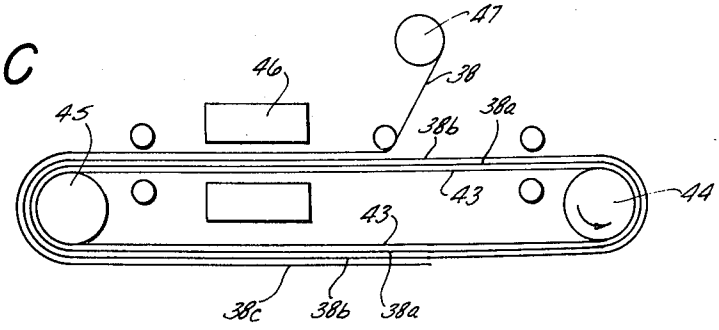
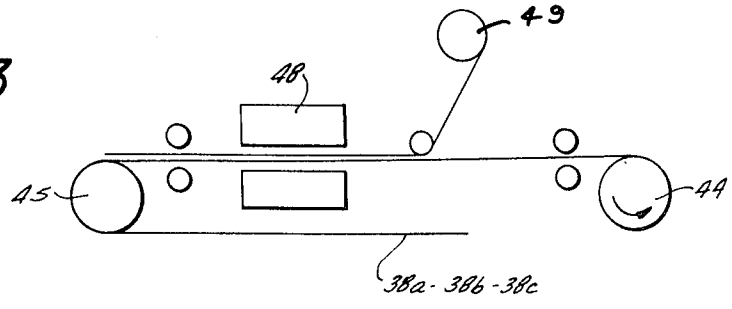


FIG. 3



NON-WOVEN PAPERMAKERS FELT

This is a division of application Ser. No. 205,009, filed Dec. 6, 1971, now abandoned.

BACKGROUND OF THE INVENTION

Felts for use in papermaking machines are of many varieties and have undergone changes through the years. The woven version is the traditional type, developed by weaving the wool or wool-synthetic yarns, and then shrinking or felting the fabric to provide the appropriate desired finish characteristics and the stable running size for the particular paper machine position. Although conventional felts are still used to a great extent, needled felts are becoming increasingly popular. The standard needled construction consists of needle punching a web of fibers into a previously woven base fabric. Although the needled felt has generally been more costly to manufacture than the conventional wholly woven felt, it has many advantages—not the least of which is the ability to provide in the felt a base having a specific construction and materials selected for a particular purpose (generally dimensional stability) and combine it with a surface of needled web of fibers formed of different material and having its own structure free of the base and selected to provide the desired surface characteristics in the product being formed.

In conventional needled felt construction the base fabric is woven on the usual papermakers felt loom. The web is formed by carding fibers and is laid on the base just prior to passing it through the needling machine. Several layers of web may be used, the felt going through the needling machine after each layer is added.

In the needled construction based on paper machine requirements, more or less web can be used on either or both sides of the base fabric. The needles are fashioned with tiny barbs. As the needles descend, these barbs grasp fibers from the web and force them into the base fabric.

Needled felts are generally stronger. The web contributes strength in accordance with the orientation of the fibers. As a result of available manufacturing procedures, substantially all of the fibers in the web of conventional needled felts are oriented transversely to the path of travel of the felt.

Because of the finish problems with regular felts, it is frequently not possible to add large amounts of synthetics to resist wear. The needled felts being stronger maintain their bulk, water removal and finish characteristics for a longer time than conventional felts.

Another desirable feature of needled felts is improved sheet finish. The twisted yarns are hidden in the base and a better and smoother cushion meets the sheet. The fleecy web needled in provides innumerable very minute fiber contacts with the sheet, in contrast to the coarser yarn contacts of the wholly woven felt. This smooth surface imparts superior finish to one side of the sheet and often improves finish on the other side, as well by reducing strike-through. Yarns in woven fabrics and in woven bases of conventional needled fabrics are often objectionable because of strike-through or marking of the sheet of paper being formed.

It has been realized for some time that if a completely non-woven felt (not even a woven base) could be produced without excessive cost and one which would have sufficient strength for satisfactory operation, an even superior felt would thus be made available.

SUMMARY OF THE INVENTION

A non-woven papermakers felt comprising a base formed of a plurality of lapped layers of webs of fibers oriented substantially in the direction of felt travel and which have been consolidated into a homogeneous mass by consecutive compressing and needling operations, and a web of fibers needled into the base. The fibers can be synthetic, natural or a blend of synthetic and natural.

A method for producing a non-woven papermakers felt comprising the steps of: carding a first web of fibers onto a conveyor with the fibers substantially parallel and oriented in the direction of movement of the conveyor, delivering the web to a primary lapper and depositing the web on the moving top cart apron with the fibers oriented in the direction of movement of the apron and thence to the lower cart apron, lapping layers of web from the lower cart apron onto a floor apron with the speed of the lower cart apron and floor apron adjusted to produce four fiber layers with the angle of fibers deposited within the range of 85° to 45° to the direction of travel of the floor apron, consolidating the fibers into a homogeneous sheet by compressive rub rolls, producing a tapered feathered edge on each edge of the sheet by the use of edge comb rolls, delivering the sheet to a secondary lapper and depositing the sheet on the moving top cart apron and thence to the lower cart apron, lapping four layers of sheet from the lower secondary cart apron onto the floor apron with the speed of the lower cart apron and floor apron adjusted to produce four sheet layers with the fibers therein forming an angle with the direction of travel of the floor apron in the range of 10° to 40°, consolidating the sheet into a homogeneous substrate by pre-needling, providing an endless scrim netting and feeding the substrate onto the scrim and consolidating by passing through a needle loom to form a base fabric, peeling the scrim off the base fabric, and adding web to the base fabric by a needling operation.

An apparatus for producing the non-woven papermakers felt by the said economical method.

The method and apparatus disclosed herein provides the ability to produce a wide, continuous length of web with individual fibers oriented substantially in the lengthwise direction. The width of web produced is limited only by the width of available lapping equipment. Felts made in accordance with this invention do not contain lengthwise or crosswise yarns, therefore, there will be no yarn marks imparted on the sheet of paper. Due to the absence of a woven base fabric, the felt will drain water better than a conventional felt because of this homogeneity in the felt; and the absence of a woven base fabric results in a felt which will be easier to clean using conventional methods employed on the paper machine.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1A** and FIG. **1B** which is a continuation thereof disclose in perspective view the novel method and apparatus for producing the non-woven base for the felt which is the subject of this invention;

FIG. **2A**, **2B** and **2C** are side diagrammatic views of the non-woven base for the felt which is the subject of this invention at various stages of its formation; and

FIG. **3** is a side diagrammatic view of the needling in of fibers to complete the felt after formation of the base.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The terms substrate, base and felt are used herein to designate the product at various stages of completion as will appear.

Also the terms "pre-needling" and "needling" are used as commonly understood in the art. The term pre-needling designates a needling operation in which fibers are very lightly consolidated to facilitate handling such as rolling and unrolling. Needling is the operation in which fibers are firmly consolidated to produce the product involved.

In the method disclosed herein and illustrated in the Figs. a blend of synthetic fibers is first carded in a conventional manner on a woolen system card. The type of blend used has a bearing on the end product. Consideration as to type of polymers, blend percentage, fiber denier and staple length is pertinent. In one embodiment of the invention the substrate is formed of **60** percent, **15** denier, 4½ inch polyamid fibers to give strength plus elasticity, **25** percent, **6** denier, 4½ inch polyester fibers to resist stretching and **15** percent, **6** denier, 3 inch polypropylene fibers which is a fusible material and useful to heat set the end product.

The carded fibers are doffed from the cylinder doffer **10** in a conventional manner onto inclined conveying apron **11.** The weight of the web doffed in the preferred embodiment is approximately 20 grains per square foot and the fibers are laid on apron **11** in an essentially parallel orientation running in the length direction of the web or in the direction of movement of the conveyor. The orientation of the fibers on apron **11** is illustrated by exaggerating certain of the fibers and designating them by the numeral **12.** The carded web is conveyed into primary lapper **13.** In order to accomplish this the inclined apron **11** deposits the web on top apron **14** which deposits the web onto top cart apron **15** of the lapper and thence to lower cart apron **16.** The web as deposited on the moving top cart **15,** has the fibers thereof oriented in the direction of movement of the apron as illustrated in FIG. **1A** by the arrow **15'**. The web is lapped by layers in lapper **13** from the lower cart apron **16** onto floor apron **17** with the speed of the lower cart apron and floor apron adjusted to produce four fiber layers with the angle of fibers deposited within the range of 85° to 45° to the direction of travel of the floor apron. Again in FIG. **1A,** the orientation of the fibers on the floor apron is illustrated by exaggerating the fibers and designating them by the numeral **18.** In the apparatus, the lower cart **16** travels from left to right and then right to left—or to-and-fro—depositing the layers of web on the moving floor apron. The width of the web lapped onto the floor apron is approximately 80.5 inches in one example and consists of four layers of the web and the angle of fibers deposited being approximately 75° to the direction of travel of the floor apron. The four layers of web thus deposited are then consolidated into a homogeneous sheet of fibers by means of compressive rub rolls **19, 20** and **21.** By this means the four layers of web are prevented from ply separating in subsequent processing. The sheet so produced is designated in the Figs. by the numeral **22.** This sheet is then taken up by the first intermediate apron **23** and fed between vertical aprons **24** and **25.**

During the process of conveying the four layers of web from the floor apron to the first intermediate apron **23,** the web is drafted approximately 1.74 times or 74% by varying in speed of the rub rolls and aprons. This results in the angle of fibers being reduced to approximately 66° to the direction of travel.

The sheet is transported between the vertical aprons **24** and **25** to the second intermediate apron **26** which is shown in FIG. **1B.**

From the second intermediate apron **26** the sheet is conveyed by means of top apron **27** to a stationary **90°** turning device **28.** The surface of this stationary turning device **28** should be slippery and the device can be made of highly polished stainless steel, teflon, or any other material which would provide such slippery surface. The sheet, after turning, is deposited upon feed-through apron **29** and transported to secondary lapper **30.**

An intermediate step in the process is to remove the folded-over edges of the sheet by means of edge combing devices **31** and **32.** The fiber removed by these edge combing devices on each edge are conveyed by blowers and a pipe system, not shown, back to the card-feeders. With the folded-over edges removed by the edge comb rolls, a tapered-feathered edge remains on the sheet.

The secondary lapper **30** operates in a similar manner to the primary lapper **13** except that very wide widths can be developed in the secondary lapper. In one example, lap widths up to 400 inches were made. There is no limit to the width that can be made provided a sufficiently wide lapper is available.

In the secondary lapper, the sheet is deposited on the secondary top cart apron **33** and thence to the secondary lower cart apron **34** and then onto the secondary floor apron **35.**

Four layers of web had been lapped in the primary lapper to produce a sheet. Now four sheets are lapped in the secondary lapper to produce a substrate on secondary floor apron **35** consisting of a total of sixteen original fiber layers.

The sheets are laid onto the floor apron with the speed of the lower cart apron and the floor apron adjusted to produce the four sheet layers with the fibers therein forming an angle with the direction of travel of the floor apron in the range of 10° to 40°. The width of the laps formed is infinitely variable within the ranges available in the machine and in the specific example disclosed herein the width of the laps thus formed is variable within the ranges of 100 inches minimum and 400 inches maximum. For the 100 inch width the fibers are aligned at approximately 13.5° and 34.5° to the direction of travel and for the 400 inch width the fibers are aligned at approximately 21.5° and 26.5° to the direction of travel.

In order to consolidate into a homogeneous substrate, the sheet is compressed and passed through pre-needling machine **37.** The compression prior to pre-needling can be accomplished by any suitable means. In the present application the bed plate **37'** of the pre-needler is extended toward apron **35** and a plate **36** which is a compacting sheet of metal is mounted over the bed plate **37'** on the top side of the sheet. As the substrate passes between plates **36** and **37'**, it is compressed. The substrate so formed and indicated by the numeral **38** in the Figs. is passed to wind up mechanism **42** where rolls of the substrate are produced for subsequent use in further processing. The example of the embodiment disclosed herein allows for the production of long lengths of substrate up to 200 feet in length on the rolls. This is not a limit but rather an example.

These rolls of substrate have the fibers oriented essentially in the length direction giving the substrate more resistance to stretch lengthwise than crosswise. Weight of the substrate produced varies from 180 grains per square foot to 225 grains per square foot. Lighter or heavier substrates could also be made but would depend upon the anticipated end use. In the present stage of the art heavier substrates may not be useful for papermakers felts, however, they may be desirable for other types of non-woven industrial textiles such as corrugator belts or conveyor belting.

In the next step in the process, which is illustrated in FIGS. **2A, 2B** and **2C,** an endless scrim **43** is installed between rollers **44** and **45** and lightly tensioned. In one example the scrim is formed of light weight polypropylene netting in endless form and of proper length and width to produce a wet felt. Another type of scrim can be used if desired to hold the substrate together during the needling operation which is accomplished in the needle loom designated by the numeral **46** in FIGS. **2A, 2B** and **2C.**

The lengthwise oriented substrate **38** is then unwound from roll **47** onto the scrim netting and consolidated by passing through the needle loom **46.** Three layers are shown being needled in in FIGS. **2A, 2B** and **2C.** The first layer after passage through the needle loom **46** is a needled in layer indicated by the numeral **38***a*. The next step illustrates the scrim **43** with layers **38***a* and **38***b* and the third or final step illustrates the scrim **43** with layers **38***a*, **38***b* and **38***c* needled thereinto.

Once these three layers have been sufficiently consolidated by needling so that they become self-supporting, the initial scrim **43** is peeled away from the inside to provide the base fabric. This base fabric is an endless loop of the proper length, width and strength for subsequent processing. Onto this base are applied further layers of fibers which are lapped in a conventional manner as a web with fiber orientation essentially crosswise to the length direction of the felt and there is provided subsequent consolidation by needling as illustrated in FIG. **3** wherein the base **38***a*-**38***b*-**38***c* is shown passing through needling machine **48** after multiple layers of conventional web from roll **49** have been placed thereon. In FIG. **3** the needling machine designated by the numeral **48** could also be the machine previously designated in FIGS. **2A, 2B** and **2C** by the numeral **46.**

After completion of needling the felt is washed in a conventional manner and then stretched to its proper operating tension and length on a conventional felt dryer. During the lengthwise stretching the fibers in the base which had been at angles to the lengthwise direction as a result of the first and second lapping operations are oriented substantially lengthwise. In one example, after stretching the resulting length of the felt is 108% of the length prior to stretching. The felt is dried by means of heated cylinders (such as steam heated, gas heated or otherwise) as is well known in the art.

In certain embodiments, after drying, the felt is subjected to a heat treatment in the neighborhood of 380°F which tends to fuse the polypropylene fibers previously referred to. This fusing tends to further stabilize the fabric. Another alternative for further bonding and stabilization dimensionally is to use resin treatments but these tend to make the finished products stiff and impede easy installation in certain positions on the paper machine.

In FIG. **1A** feed-through apron **29** is shown in phantom. Conveying apron **11** is also shown in phantom in a shifted position. The apparatus is so constructed with apron **11** shiftable between two positions so that when it is desired to make a conventional web with fibers oriented crosswise, it is necessary only to shift apron **11** from the position shown in solid lines to the position shown in phantom in FIG. **1A** where it can feed the fibers received thereon directly onto feed-through apron **29** thereby by-passing the first lapping operation.

We claim:

1. A non-woven papermakers felt which comprises a substrate formed of a plurality of lapped layers of webs of fibers oriented substantially in the direction of felt travel and which have been consolidated into a homogeneous mass in the absence of bonding and stitching by consecutive needling operations wherein the weight of the substrate is within the range of 180 grains per square foot to 225 grains per square foot; and a web of fibers needled into said substrate substantially crosswise of said felt travel.

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