Dec. 3, 1968 H. HERGERT 3,413,695

METHOD FOR ELECTRIFYING AND SHEARING OF PILE FABRICS

Filed Oct. 31, 1966 2 Sheets-Sheet 1

FIG. 1

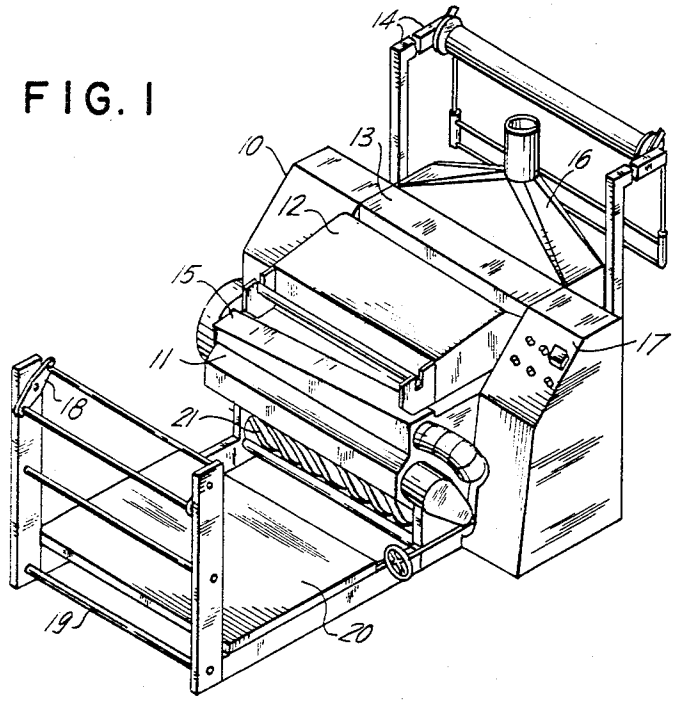

FIG. 2

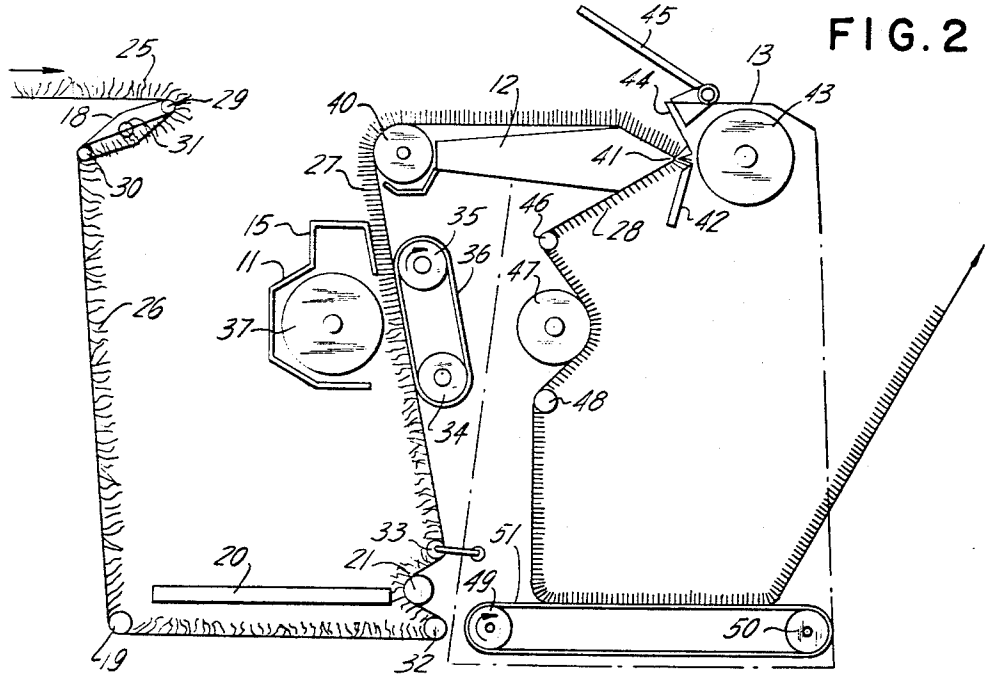

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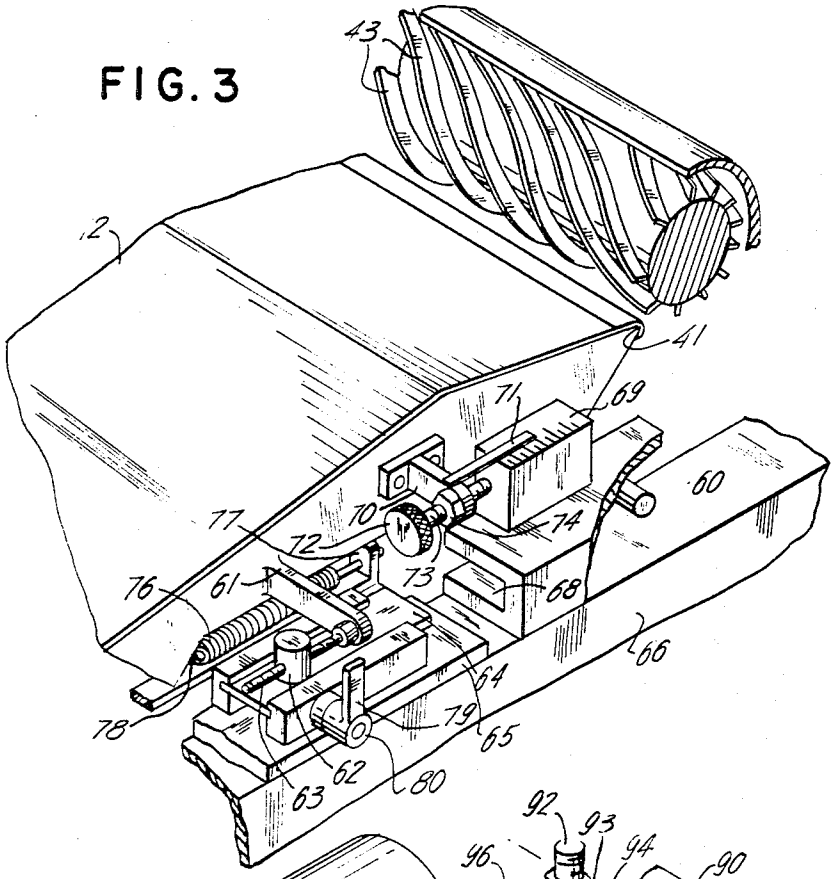
FIG. 3



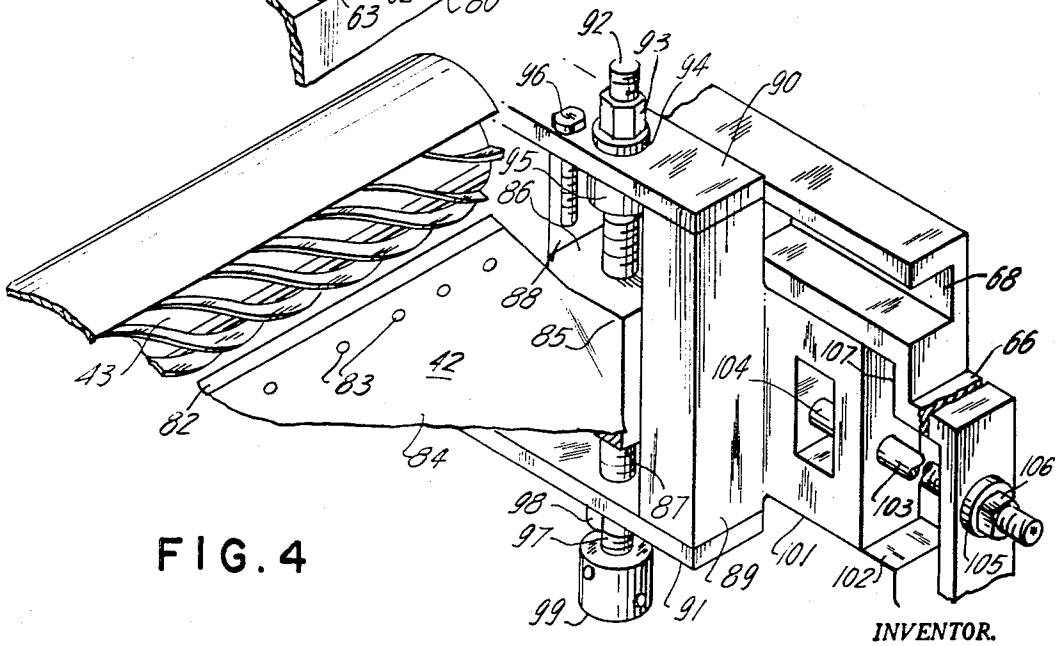


FIG. 4

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METHOD FOR ELECTRIFYING AND SHEARING OF PILE FABRICS

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ABSTRACT OF THE DISCLOSURE

Method for electrifying pile fabric via a heated, grooved, moving surface wherein the fabric is conveyed in a vertical direction through the electrifier and the pile fibers set in erect position immediately after departure therefrom by drawing cool air into contact with the pile while separating and venting the heated air adjacent the point of departure of the fabric from the surface. The vertical feed acts as partial compensation for initial forward lay of the pile and immediate cooling prevents return of crimp to the fibers of the pile. The fabric is subsequently sheared.

This invention relates to the production of natural and synthetic pile fabrics. More particularly, it relates to a novel method of finishing pile fabrics and specific equipment for carrying out the method.

The general classification "pile fabrics" covers an extremely large variety of materials. These materials range from fine velours to heavy carpeting, and include such diverse products as napped liners, suedes, flock prints, velvets, and double-sided blankets. The basic cloth from which the pile fabric is produced may be knitted, tufted, or woven. Almost all pile fabric processing, irrespective of the particular material or final product, is concerned with developing a pile having a desirable appearance. When this objective is achieved, the pile is of uniform length, the individual fibers are untangled, and the lay of the fibers is consistent.

Pile fabrics are as ancient as fur bearing animals, because natural fur may well be considered the first pile fabric. The techniques for treating and conditioning synthetic pile fabrics have drawn heavily upon the earlier skills of fur processors. Thus, to untangle pile fabrics and to establish a uniform lay, the fabric is repeatedly combed and ironed. To obtain uniform pile height, the fabric is stretched taut, and evenly sheared. Of course, modern automatic equipment is used and combing and ironing are now carried out simultaneously on heated electrifiers which also make effective use of static electricity to make the individual fibers stand erect. But, the effects of static electricity were also well known for many years. Shearing has also been automated and large revolving shears now produce many yards of evenly cut pile every minute.

The prime need for innovation in the modern pile processing field lies in the improvement of automated processing to reduce the labor required, to improve the quality of the finished product, and to reduce the total cost of the equipment needed. It is the basic object of this invention to provide a process and the equipment for approaching these goals.

The variety of basic materials and the diversity of the fabrics produced, makes it difficult to develop a processing system that can be used for all purposes. Nevertheless, producers must have flexibility and they need equipment that can be adapted to produce the fabrics that are most in demand at any given time.

As already suggested, a number of individual processing steps are required to produce a finished fabric. Basically, these steps include a sequence comprising brushing or napping, electrification, and shearing. Thus, the pile is untangled, rendered erect, and sheared. The latter steps may be repeated a number of times before the desired finish is obtained.

Prior automated equipment has been designed in an attempt to attain the greatest versatility possible. With this in mind, large electrifiers have been developed which can be adjusted to operate at varying feed rates and with various attachments to handle a wide variety of pile fabrics. Similarly, shears have been designed which can be used for cutting a variety of materials to within a given range of heights. Since the basic material may be either tufted, knitted, or woven, it may be extremely stretchable or it may be upon a non-stretchable backing. The fibers may be long and in a tangled mass, or they may be short and in a densely matted mass. The individual fibers may be strong rigid elements or they may be weak and pliable. In spite of prior attempts to design versatile equipment, however, the stringent requirements of this type of processing have heretofore made it impossible to use a unified machine that could simultaneously electrify a fabric and shear it seconds later while the pile was still erect under the influence of the electrification. The need to individually match electrifier and shear equipment to the diverse characteristics of the variety of materials made such a machine too specialized for economical use. The optimum processing or feed rate of the material through electrifiers and shears was another factor that operated to dictate the use of separate units for performing each function.

One advantage of combining the electrifier and shearing functions on a single machine is that the amount of fabric in the middle of processing (i.e. between the electrification and shearing step) can be held to a minimum, i.e. in the neighborhood of two yards. Another advantage lies in tremendous reductions in required floor space, in required labor, and in required capital investment. Of course, to provide equipment of the nature contemplated by this invention, a large number of factors must be taken into consideration. Obviously, the functioning of the individual portions of the combined electrifier-shear must be carefully synchronized. In addition, both the electrification and the shearing portions of the machine must be of superior quality to permit rapid operation with minimum down-time for inspection and adjustments. Whereas the prior use of separate electrifiers and shears permitted inspections to be made between the separately functioning units of equipment, this cannot be done with a combined electrifier-shear. Accordingly, means must be provided for convenient and rapid inspection, easy equipment adjustment, and close control over the processing.

It is an object of this invention to provide a method and equipment for pile fabric processing whereby the fabric is subjected to shearing substantially immediately following electrification.

Another object of the invention is to provide improved equipment for complete pile fabric processing which can be easily adjusted for handling a complete range of material and pile height.

Another object of the invention is to provide a combined electrifier-shear with improved electrifying and shearing components, and means for continuously monitoring the fabric condition between the electrifying and shearing operations.

Several important features of the invention described hereinafter relate to the electrification portion of the equipment. In the past, electrification has been performed by large heated rolls or drums that rotated about a horizontal axis and acted upon the fabric as it was horizontally fed past. Large exhaust hoods were employed to carry away any loose matter in the pile. The present invention quite radically departs from the previous practices.

It has been found that by processing the material during upward vertical movement past a heated electrifying cylinder, the lay of the pile is improved because the normal pull of gravity assists in counteracting the inherent forward lay of the pile. Still further, it is known that synthetic fibers are more responsive to electrification when heated because they tend to be in a more plastic state under this condition. A feature of this invention resides in immediately cooling the fabric as it leaves the electrifying cylinder. This results in effectively "setting" the pile in an erect condition.

Accordingly, a further object of the invention is to improve electrification of pile fabrics by use of vertical processing and cooling after the fabric leaves an electrifying cylinder.

In addition to the development of an improved electrification system, this invention also includes an improved shearing system. The operation of shearing involves the careful cutting of the individual fibers to a predetermined height. To be effective, the shear must cut each fiber to establish exactly the same height across the entire surface of the fabric. The accomplishment of this simple sounding operation is extremely difficult and has heretofore necessitated the use of relatively massive shearing equipment. It will be immediately apparent that the use of a shear for clipping or cutting fibers to produce a fine velour requires operation of the shear upon a very delicate fabric. In order to obtain the desired luster and sheen on such a material, the uniformity of pile height is extremely critical. When the material being handled is of appreciable width, the shear must be accurately aligned across its entire length.

The conventional shearing equipment used today is built upon a massive rigid base and consists of a rapidly rotating cutting revolver spinning in close proximity to a stationary ledger blade. The fabric is controllably advanced past the rotating revolver and the stationary blade and the tips of the fibers are sheared off. Ancillary equipment associated with the shear is used for carefully advancing the fabric at a predetermined rate, and folding it after it is sheared. On velours and the like, care must be taken to uncurl the fabric as it approaches the shear.

During shearing, there are times when it is desired to permit fabric feed to continue while the cutting operation is momentarily suspended. For example, this is sometimes necessary for seam jumping. Prior known shears provided for the movement of the revolver and ledger blade away from the cloth rest during these intervals. In order to make this possible, the revolver and ledger blade combinations were necessarily mounted on movable supports. Each time they were moved, there was danger of disturbing the micrometer adjustments of the ledger blade that controlled its relationship to the rapidly rotating shear revolver.

The present invention includes a novel structure that permits rigid mounting of the ledger blade to the massive base of the machine. This rigid mounting of the blade makes it possible to provide carefully calibrated supports across the entire length of the ledger blade, insuring continuous accurate alignment between ledger blade and shear and also facilitating periodic grinding and honing of the blade. To accomplish this mounting, a movable ledger table is employed. The table is used to deliver the material to the shear and blade, and it is designed for micrometer positioning to control the pile height. When it is desired to suspend cutting during continuous feed, the table is simply backed-off from the cutting area.

Thus, another object of the invention relates to the use of a rigidly mounted ledger blade and a movable ledger table.

The combined features of the invention are embodied in an electrifier-shear wherein pile fabric is vertically processed by a heated electrifier, subjected to immediate cooling after electrification, directly passed over a movable ledger table, and presented to a rigidly mounted ledger blade in proximity to a rotating shear.

A more complete understanding of the invention, along with other objectives and features thereof, may be obtained from the following description made in conjunction with the accompanying drawings wherein:

FIGURE 1 is a pictorial illustration of a combined electrifier shear in the general form contemplated by this invention;

FIGURE 2 is a schematic representation of the essential elements of a combined electrifier-shear as they might be viewed in a plane vertically intersecting the illustration in FIGURE 1 from front to back;

FIGURE 3 is a detailed schematic view showing the mechanism for supporting and transporting the ledger table **12**; and

FIGURE 4 is a detailed schematic showing the ledger blade and shear with respective mountings and adjustment means.

FIGURE 1 illustrates a combined electrifier-shear in accordance with the invention, which is capable of finishing pile fabrics in a single operation. Because of the complete processing performed by this combined electrifier-shear, floor space requirements are reduced by more than half and similar reductions can be made in labor and capital investments.

As viewed in FIGURE 1, the material to be processed is fed into the machine from the front. Electrification takes place underneath the hood **11** and the fabric is fed over ledger table **12** and then down past the high speed shearing drum that is covered by shield **13**. After shearing, the material may be directly led over a folding apparatus **14**. As clearly illustrated in FIGURE 1, a venting hood **15** is positioned over the electrifier hood **11** and provides an air channel for the cooling air that is directly applied to the fabric immediately upon electrification. The vent hood **15** is interconnected by means not shown, to a still larger vent **16** which is positioned over the shear. This latter vent serves to provide a suction that removes the clipped ends of the fiber from the shearing revolver.

The entire operation of the machine is controlled by the automatic control panel **17** which contains the necessary electrical control apparatus for the complete and versatile performance of all operations. In order to present the fabric to the machine, it is initially introduced at **18** and fed down over idler shaft **19**, underneath operator platform **20** and up past feed roller **21**. A more complete understanding of both the process of the invention and the specific feed path of the fabric may be obtained by consideration of FIGURE 2.

In FIGURE 2, it will be seen that the fabric **25** is introduced into the equipment from the left and leaves it on the right. It will also be noted that the condition of the individual fibers has been schematically indicated in order to assist in appreciating the functioning of the various elements of the apparatus. Thus, before the fabric has been electrified, the individual fibers are of unequal length, exhibit a predominantly forward lay, and also are somewhat tangled. This is illustrated on the left of the figure near numeral **26**. As the fabric is presented to the electrifier cylinder **37**, the individual fibers are combed and rendered erect by the electrostatic action of the cylinder. As a result of air flow within the electrifier hood **11** and through vent **15**, the fabric leaves the electrifier with all fibers in a substantially erect position. At this time, although erect, the individual fibers are of uneven length. The fabric is then passed over ledger table **12** and presented to ledger blade **42** and revolver **43**. It is at this point that the pile is clipped to an equal length and thereafter, at numeral **28**, it will be seen that the fabric is in a finished state. It remains simply to prepare the fabric for its next destination. Although a folding apparatus **14** was shown in connection with FIGURE 1, it will be appreciated that there will be occasions when other processing may be desired. It should also be appreciated that in some instances it may be desired to

re-entrantly return the fabric to the beginning of the equipment and once again subject it to the processing steps therein.

Before considering the individual features which characterize this invention, the specific transportation of the pile fabric through the machine will be described. Fabric **25** enters on the left and passes over the carrier unit **18** comprising shafts **29** and **30**. The carrier is pivoted about an axis **31** and serves to permit the flat presentation of the fabric, under variable tension. Adjustable guide discs (not shown) provide initial tracking of the fabric feed.

It is desirable to provide means for an operator to stand directly in front of the fabric in order to inspect it as it leaves the electrifier and approaches the shear. For this purpose a work platform **20** is provided. The fabric is passed beneath an idler shaft **19** and along to a drive shaft **21**. It is held in contact with drive shaft **21** by idler shaft **32** and spring loaded expander roll **33**. The fabric then is brought into contact with the electrifier cylinder **37**. An apron **36** mounted upon rollers **34** and **35** is adjustable in position by pivoting around shaft **35**, in order to control the wrap of the fabric about the electrifier cylinder **37**. This apron is essentially a continuous felt belt stretching across the entire width of the cylinder. After leaving the electrifier cylinder, the material passes over an additional break-roller **40** onto the surface of ledger table **12**.

Ledger table **12** is adjustable within an accuracy of ten thousandths of an inch, in order to control the pile height. The material is fed past the rounded edge **41** of the table and is thereby gradually presented to the shearing action of ledger blade **42** in combination with the rapidly rotating shearing revolver **43**. From the ledger blade, the material proceeds past driving cylinder **47** and is held in engagement therewith by means of rolls **46** and **48**. Upon leaving roll **48**, the material descends to the bottom of the equipment where it is transported by an apron **51** to the rear. From this point on, conventional equipment may be used to either fold, roll, or further process the material.

Particular attention may now be directed toward a number of specific features of the invention.

Electrifier cylinder **37** extends across the entire length of the equipment and in one specific embodiment has a diameter of approximately seven inches. The cylinder is dynamically and statically balanced and is driven to operate within a speed range of, for example, 700 to 1400 revolutions per minute. The surface of the cylinder is grooved with a plurality of helixes wound in opposite directions. Any suitable means may be used to heat the cylinder, but it is preferred to use Calrod heaters cast directly into the body of the cylinder. This heating technique insures air-tight sealing against corrosion and oxidation and assures uninterrupted service. Appropriate thermocouples and temperature controls can be included in order to maintain surface variation in temperature ranging from ambient to 400° F.

It will be understood that as the pile fabric is brought into contact with the electrifier cylinder under the pressure of apron **36**, the cylinder surface provides a beating oscillation, and heats the material while the frictional contact develops a static charge on the individual fibers of the material. This functioning is well known and fully understood in the processing art. It is also well appreciated that the heated surface of the cylinder is effective to render synthetic fabrics more plastic and thereby assist in making them more responsive to the erecting influence of the static charge.

A new feature of the electrifying unit used in this invention is the fact that the material is presented to the electrifying cylinder as it moves vertically upward. All known prior electrifiers were designed to move the pile material in a horizontal plane past the electrifying cylinders. By re-orienting the cylinder and feed mechanism, the equipment of this invention makes it possible to counteract the normal effects of gravity and to reduce the naturally occurring forward lay of pile materials. In the past, the gravitational pull upon the individual fibers tended to emphasize or supplement the inherent forward lay of the pile. In accordance with this invention, the pull of gravity tends to counteract the normal forward lay of the pile and a more erect pile is the result.

It has also been found that the permanency and durability of pile fabrics can be improved by immediately cooling the pile when it leaves the heated surface of the electrifying cylinder. By immediate cooling, the increased plasticity of the fibers that took place while they were proximate to the surface of the electrifying cylinder **37**, is removed substantially instantaneously while the pile is still under the influence of the erecting static charge applied by the cylinder. This rapid cooling "sets" each fiber.

Electrifier hood **11** and ventillating portion **15** are specifically designed to concentrate a uniformly distributed cooling stream of air on the fiber as it emerges from the surface of the electrifier. As will be seen in FIGURE 1, the ventillating hood **15** is of increasing volumetric size as it approaches the intake end on the right of the picture. With an understanding of the principles involved, it will be immediately apparent that cool air is drawn into contact with the pile while separating and venting the heated air adjacent the area of fabric departure and that a variety of specific arrangements may be formulated in order to effect the necessary cooling air stream. It is important to appreciate that the air flow required to produce the necessary cooling must be greater than that previously employed in conjunction with standard electrifiers. It was quite common in the prior art to provide rather massive ventillating hoods as part of electrification equipment. These hoods were disposed above the electrifying cylinders and the air flow was not directed to appear at the exit point of the fabric from the cylinder. Indeed, the basic design of prior known electrifiers would not lend itself conveniently to the production of the necessary cooling streams of air for accomplishing the "setting" features of the present invention.

Immediately after electrification, while the fabric is still highly electrified, it is past across the nose **41** of ledger table **12** and subjected to the shearing action.

The particular manner in which the ledger table or cloth conveyance table **12** is mounted, can be seen most clearly from FIGURE 3. This figure is a pictorial representation of the major table positioning elements on one side of the equipment.

The rear portion of table **12** is supported on a movable plate member **64** by means of interconnecting elements **61**, **62**, and **63**. Element **61** projects from the side of table **12** and is fastened by a threaded member **63** to the post **62**. Post **62** is attached to plate member **64**. Plate **64** is slidably engaged within a channeled block **65** which in turn is fastened securely to the bed **66** of the machine. The front portion of table **12** is supported at each end by a roller **60** positioned to ride within guide channel **68**.

Accurate positioning of table **12** with respect to the shear revolver **43** is controlled by a micrometer located at each end of the table. These micrometers comprise a calibrated block **69**, secured to the bed of the machine, and a threaded micrometer element coupled to the table itself. Thus, there is shown in FIGURE 3 a support **70** bearing pointer arm **71**. The position of the support with respect to the calibrated block **69** is determined by adjustment of threaded micrometer member **73**. The table is advanced or retracted by counterclockwise or clockwise rotation of knob **72**, respectively. A locking member **74** is provided in order to insure stability of adjustment once it is made. As seen in the figure, the end of threaded portion **73** makes butting contact with the calibrated block **69**.

The table is maintained in the most forward position

permitted by the micrometer adjustments, under the tension of a spring **76** which is mounted between the rear edge of the table and a mounting structure **77** which is connected to the bed of the machine. In order to effect seam jumping or temporary removal of the table from the shear revolver, a lever **79** is provided. At the base **80** of this lever, there is connected a gear which engages a rack on plate **64** (not shown). In order to bring the table toward the rear of the equipment, lever **79** is rotated counterclockwise and the cooperating rack and pinion coupling with plate **64** causes it to slide backwards within the channel of member **65**. This in turn retracts table **12** from shear revolver **43**. When the lever is once again pushed forward, the tension of spring **76** is effective to once more accurately align the table with respect to the shear revolver.

Still another important feature of the invention relates to the manner in which the ledger blade **42** is mounted. FIGURE 4 pictorially illustrates the mounting on one end of the machine. As shown in the figure, the cutting blade **82** is in a shearing position slightly below the horizontal axis of shear revolver **43**.

The cutting blade **82** is mounted within a heavy cast iron ledger block **84** by means of a plurality of fastening screws or bolts **83**. Blade **82** is a high quality cutting steel carefully ground and honed to conform with the shear revolver. By mounting to the ledger block **74**, one insures both rigidity and accuracy of positioning.

Ledger block **84** is held at both ends within a guide and support chamber **88** in order to permit both horizontal and vertical adjustments. Cast into the block **84** is a portion **85** having horizontal faces **86** and **87**. The function of these faces is to provide bearing surfaces to adjust the vertical positioning of the block. In order to modify the vertical position, a threaded shaft **92** is provided which is rigidly secured within the upper face **86** of the positioning section **85**. Threaded member **92** projects through a clearance hole in pressure plate **90** and is supported by collars **94** and **95** on the upper and lower faces of this plate respectively. A positioning nut **93** is threadedly engaged with threaded member **92** and upon rotation, effects either the lifting or lowering of the entire ledger block **84**.

The lowermost position of ledger block **84** is determined by the position of threaded member **97** which is threadedly engaged with the lower pressure plate **91**. The bottom face **87** of ledger block **84** rests directly upon the upper end of threaded member **97** which may be suitably designed to provide an adequate bearing surface. The weight of ledger block **84** is borne directly by member **97**. A lock nut **98** is provided to allow variation in positions and insure rigidity of position. The head of member **97** is illustrated in FIGURE 4 as including several holes for the insertion of rods or the like to facilitate rotation thereof.

The uppermost position of the ledger block **84** is determined by the guide pin **96**. This pin projects through pressure plate **90** and may also be threaded to permit changes in position. The end of guide pin **96** is brought into contact with the upper face **86** of the ledger block portion **85** when the blade has been raised to the highest permissible amount.

When it is desired to grind and rehone the blade, the entire ledger block is removed from the cutting position and elevated into a regrinding position by means of vertical lifting bolts. The regrinding position places the blade **82** vertically adjacent to the horizontal shaft center line of shear revolver **43**. A mixture of oil and grinding powder may be used to grind the arc of the ledger blade with the shear revolver running in reverse direction.

Horizontal movement of the ledger blade **42** is effected by sliding upon guide rail **102** which is an integral part of the base of the equipment. The basic positioning block **89** has a projecting portion **101** adapted to rest upon track **102** and fit beneath channel **68** which controls the forward positioning of the ledger table **12** as discussed above. A horizontally disposed shaft **103** is secured at **104** in the positioning block **89**. At the outer end, this shaft is threaded and journaled in the vertical face of the machine frame **66**. As illustrated, a collar **105** is provided and a positioning nut **106**. A similar arrangement is provided at the rear of the machine. Thus, in order to move the ledger blade **42** toward the front of the machine, shaft **103** is drawn toward the front of the machine and its cooperating shaft at the rear is pushed forward. This provides rigid positioning and accurate control over the horizontal position.

The pile processing methods and the specific illustrative equipment described hereinbefore, make possible greatly reduced operational costs. It has been found that the equipment embodying the teachings of this invention, effectively and efficiently produces pile fabrics of superior quality. The equipment is not restricted to specialized forms of fabric; rather, it exhibits a versatility heretofore unavailable. Still further, the features including vertical electrification, ledger blade mounting, and shearing table mounting, make possible both separately and in combination a highly improved processing system. It will be appreciated that modifications of this equipment may be made by those skilled in the art. It is contemplated in the appended claims to embrace within the scope of the invention all developments partaking of the spirit and teachings of this disclosure.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. The method of processing pile fabrics comprising electrifying the individual fibers of said pile with a grooved moving surface to effect a substantially horizontal erection thereof, heating the fabric during said electrifying and rapidly cooling said fabric in the area of its departure from said moving surface by drawing cool air into contact with the pile while separating and venting the heated air adjacent to said surface in said area, and conveying the fabric from the area of charge imposition in a substantially vertical upward direction, thereby setting the pile in said area in said substantially horizontal erect condition.

2. The method of processing pile fabrics according to claim **1**, including shearing the pile immediately after said cooling step and prior to any contacting of the pile surface.

3. The method of processing pile fabrics according to claim **2**, wherein said shearing is done while the fabric is transversing a convex arc and moving in a downward direction.

References Cited

UNITED STATES PATENTS

221,932	11/1879	Moses	26—15
2,206,243	7/1940	Turano	26—15
3,351,990	11/1967	Schuster	26—15
721,903	3/1903	Marble	26—15
815,938	3/1906	Bradley	26—15
2,983,023	5/1961	Hart	26—2
3,099,871	8/1963	Dourdeville	26—17
3,114,957	12/1963	Schaab et al.	26—2

FOREIGN PATENTS

1,129,180	9/1956	France.
1,392,220	2/1965	France.

OTHER REFERENCES

"Finisher Upgrades Woolens," by James H. Kennedy, Jr., reprinted from Textile Industries.

"Electrifying Emerges as Major Finishing Process for Pile Fabrics," reprinted from America's Textile Reporter.

"Turbo Shearer for Shearing of High Pile Fabrics," Brochure of Turbo Machine Co.

ROBERT R. MACKEY, *Primary Examiner.*