May 1, 1951 F. G. WEISBECKER 2,550,893

APPARATUS FOR FORMING DESIGNS IN KNITTED OR WOVEN FABRICS OF SYNTHETIC POLYAMIDE FIBERS

Filed Nov. 29, 1947 3 Sheets-Sheet 1

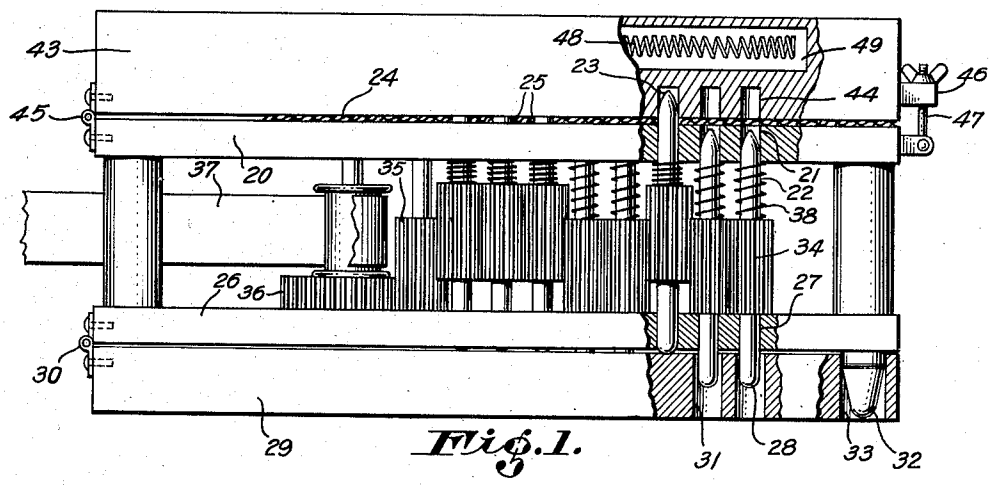

Fig. 1.

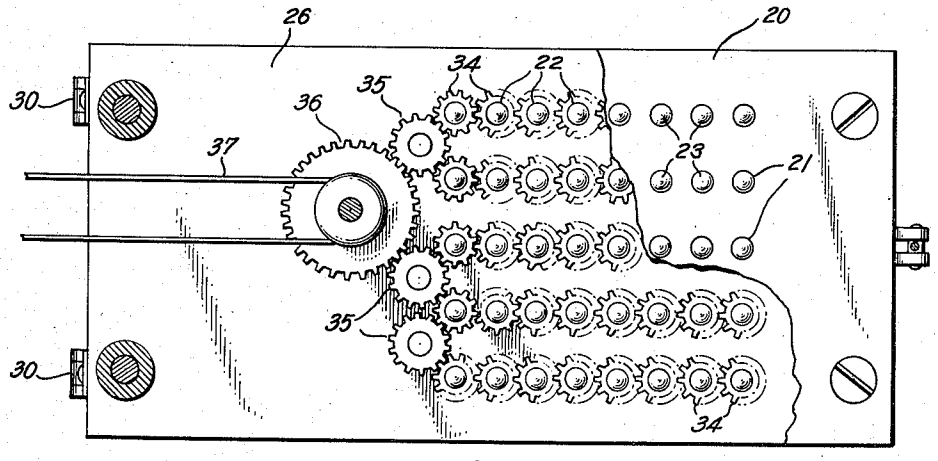

Fig. 2.

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Fig. 3.

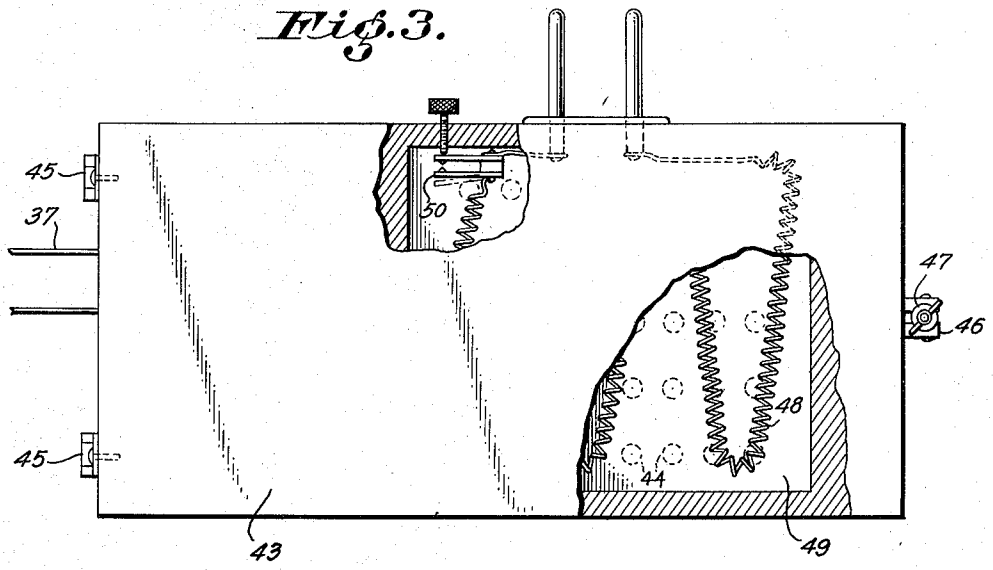
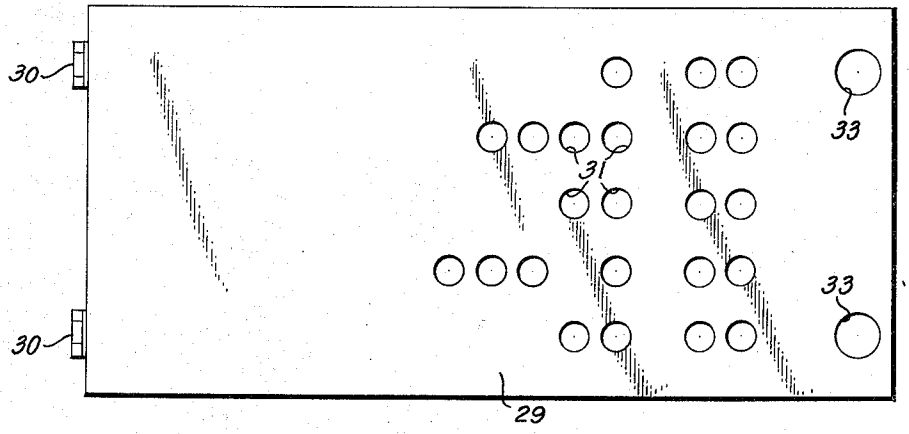


Fig. 4.



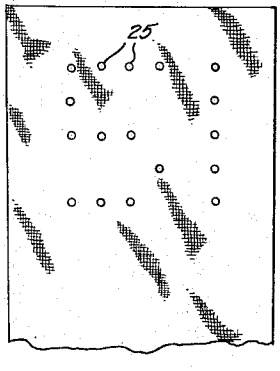


Fig. 6.

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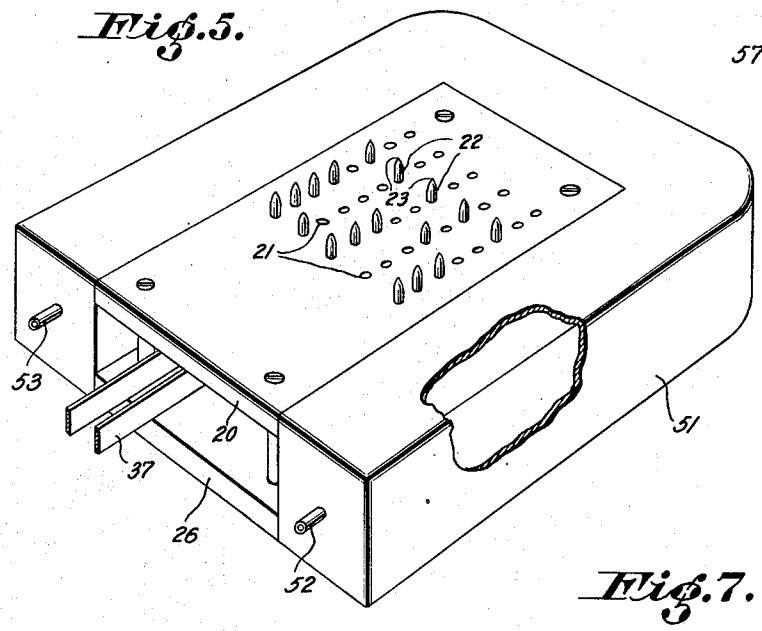
Fig. 5.



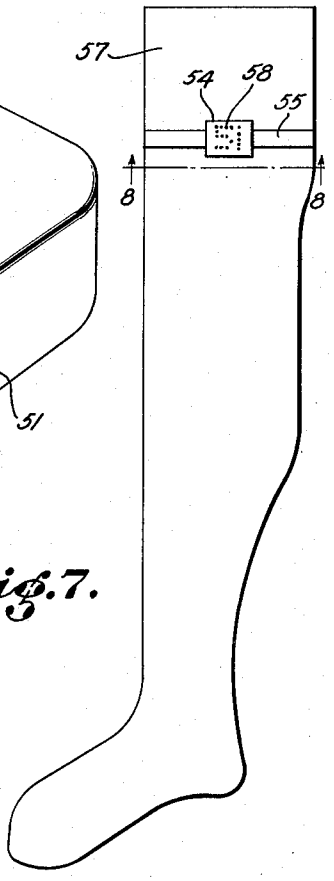


Fig. 7.

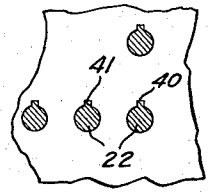
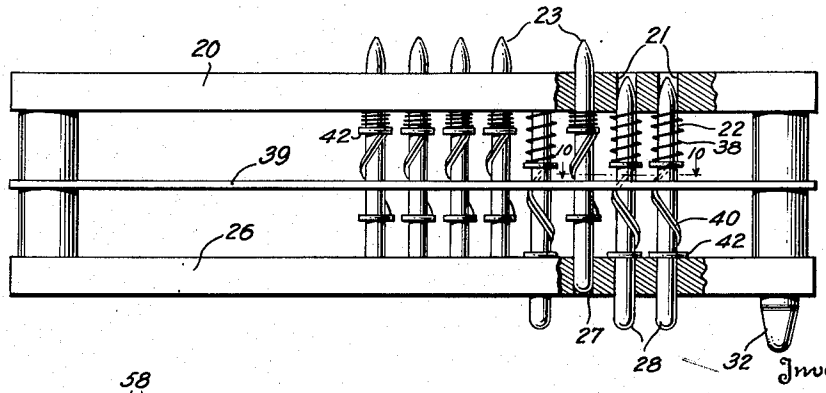


Fig. 10.

Fig. 9.



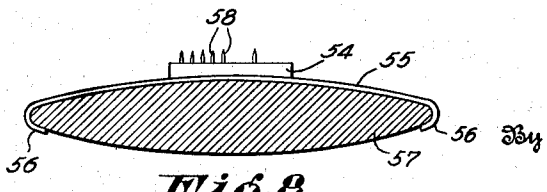


Fig. 8.

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UNITED STATES PATENT OFFICE

2,550,893

APPARATUS FOR FORMING DESIGNS IN KNITTED OR WOVEN FABRICS OF SYNTHETIC POLYAMIDE FIBERS

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Application November 29, 1947, Serial No. 788,852

9 Claims. (Cl. 18—1)

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This invention pertains to the formation of designs in fabrics knitted or woven from synthetic polyamide fibers, commonly known as nylon. The primary field of use of the invention is in the formation of designs in nylon stockings, but it will be seen that in practice designs may be applied to other nylon fabrics as well.

Designs, such as trademark insignia, size or grade numerals or letters, etc., have been applied to the welt of nylon stockings in numerous ways. Such methods have been confined, however, to conventional printing processes which require liquid printing inks, or similar fluids, and which result in a design that is not completely permanent.

Therefore, an object of this invention is to devise an apparatus for applying a permanent design to a fabric knitted or woven from synthetic polyamide fibers without damage thereto.

Another object of the invention is to devise a novel apparatus for applying a design to nylon fabrics without the use of printing liquids.

A further object of the invention is to provide simple inexpensive apparatus which not only will perform the function, but also in which the design applied thereby readily may be changed by the substitution of a different simple pattern member.

Other objects and uses of the invention will be evident from the following description and accompanying drawings in which:

Figure 1 is an elevational view of one form of apparatus embodying the invention. Parts are broken away to show details more clearly.

Figure 2 is a plan view of the apparatus shown in Figure 1 with the clamping plate removed and a part of the fabric supporting plate broken away.

Figure 3 is a plan view of the apparatus shown in Figure 1 with parts broken away to show the heating coil details.

Figure 4 is a plan view of the pattern member shown in Figure 1.

Figure 5 is a perspective view of a portion of the apparatus shown in Figure 1 provided with another type of heating means.

Figure 6 is a plan view of a portion of a fabric with a typical design formed therein in accordance with this invention.

Figure 7 is an elevational view of a preboarding form incorporating another form of apparatus for forming a design in accordance with this invention.

Figure 8 is a cross-sectional view taken on line 8—8 of Figure 7.

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Figure 9 is an elevational view of a modification of the apparatus shown in Figure 1 with certain identical parts omitted.

Figure 10 is a cross-sectional view taken on line 10—10 of Figure 9.

This invention makes use of the fact that nylon threads can be given a permanent "set" by the application of heat. In employing the apparatus of the invention selected stitches of a fabric are enlarged, thus stretching portions of the threads without damage thereto, and then subjected to heat to set the thread portions permanently in their stretched condition. The stitches or points in the fabric which are so enlarged form small holes in the fabric, and the location of such points of enlargement may be chosen so that the small holes are arranged to form any open work design desired, such as letters, numerals, pictorial representations, or any other type of design. The selected stitches are stretched and the small holes formed by the insertion of a pointed element through the fabric between the threads at the desired locations or points of the fabric. Heat is applied while the elements thus pierce the fabric, and then the elements are withdrawn, leaving the small holes permanently set in the fabric to form the desired design.

The heat applied to the fabric to set the open work design therein must be confined within certain temperature limits. Nylon melts at about 488° F., while its tensile strength is affected at temperatures over 356° F. Therefore, the temperature must be kept below 488° F. and preferably is kept below 356° F. On the other hand, to impart a "set" to nylon threads, the heat applied should be over about 250° F. Therefore, temperatures in the range from about 250° F. to about 360° F. may be employed safely. The period of time necessary to "set" nylon threads by the application of heat varies somewhat with the applied temperature. It has been found in practice that a period of from about one-half to about five minutes usually is sufficient for temperatures between 250° F. and 360° F.

One form of apparatus constituting the invention is shown in Figures 1 to 4. A fabric supporting plate 20 has a plurality of holes 21 extending normally therethrough, and preferably arranged in a series of evenly spaced rows with the hole-spacing in each row being the same, i. e., the holes are evenly spaced in two dimensions. The actual arrangement of the holes, such as the number of holes 21 in each row and their spacing, depends on the type and number of different kinds of designs for which the ap-

paratus is to be used. A pointed member or pin 22 is supported in each of the holes 21 with the pointed end 23 thereof normally positioned within the holes and below the fabric supporting surface of the plate 20. The pointed ends 23 are adapted to be projected out of the holes 21 and above the fabric supporting surface to pierce a fabric 24 secured in proper position on the plate in order to form small holes 25 therein, as best shown in Figure 6. Any desired pattern or design in the fabric thus may be formed (within the limits of the apparatus) by selectively projecting the pins 22. For example, as best shown in Figure 5 those pins 22 have been projected which will form the numeral "51" to produce the resultant fabric design shown in Figure 6.

The cross-sectional area of the pins 22 and the character of their pointed ends 23, i. e., whether extremely sharp or relatively blunt, depends upon the size of the threads and the number of courses, or threads, per inch in the fabric to be pierced, but the cross-sectional area must be such that the pin may be inserted through the thread loop of a stitch without causing breakage of a thread. The extreme tip of the point of each pin 22 preferably is somewhat rounded so that the pins will penetrate between the threads of the fabric instead of penetrating between the fibers of a thread or yarn with consequent damage thereto. The pins may have any desired shape in transverse section, but preferably are circular, as shown, for a purpose described later.

Secured below the fabric supporting plate 20 is a base plate 26 having a plurality of holes 27 therethrough corresponding in number and arrangement to the holes 21 in the fabric supporting plate. The pins 22 extend through the holes 27 in the base plate with the lower ends 28 depending therebelow. A pattern member 29 is mounted beneath the base plate for upward movement against the depending lower ends 28 of the pins. As shown in the drawings, the pattern member may be detachably hinged, as at 30, to one edge of the base plate 26 and any suitable mechanism, not shown, may be employed for moving the pattern member upwardly against the pins. The pattern member 29 has a plurality of holes 31 therein of larger diameter than the lower ends of the pins 22. The holes 31 correspond to those pins which are not to be raised during the formation of a selected design. As shown best in Figures 1 and 4, the holes 31 correspond to those pins which are not raised during the formation of the numeral "51." Accordingly, it will be seen that upward movement of the pattern member 29 against the depending lower ends 28 of the pins projects the points 23 of selected pins from the holes 21 in the fabric supporting plate to pierce the fabric 24. It is obvious that the pattern member may have projections thereon to contact those pins desired to be raised, instead of having openings therein to receive those pins which are not to be raised. It also will be seen that the fabric design formed by the pointed ends 23 may be changed by the substitution of a different pattern member. If desired, the pattern member and the base plate may be provided with interfitting guide lugs 32 and openings 33, as shown, to insure proper registration of the holes 31 in the pattern member with the depending ends 28 of the pins.

It has been found that the pointed ends 23 of the pins will penetrate between the threads of fabric more easily and with less chance of damage to the threads when the pins are rotated during their axial piercing movement. If such rotation is effected, that portion of the pins which pierces the fabric must, of course, be cylindrical in transverse section in order to avoid severe damage to the fabric. One method of rotating the pins is by means of gears. As shown best in Figures 1 and 2, the pins 22 in each row are rotatively connected together by gears 34 mounted on an intermediate portion of each pin. The gears 34 have an axial length sufficient to retain their mesh with adjacent gears when axially displaced relative thereto upon projection of selected pins, as best shown in Figure 1. Thus, all the pins in each row will be rotated by rotation of any one pin in the row. Accordingly, one pin in each row may be rotated by any suitable gear train journaled between the plates 20 and 26, such as the idle gears 35, two of which are driven by the driving gear 36 and one of which is in driven engagement with a gear 34 on a pin in an adjacent row. The driving gear 36 may be driven by a belt 37, which is connected to any suitable source of power, such as an electric motor, not shown, or by any other suitable conventional means. It will be noted that the gears 34 serve as stops to retain the pins 22 in proper position between the plates 20 and 26.

Because of the friction between the meshing gears 34 on the pins 22 during relative axial displacement, it is desirable to provide springs 38, mounted on the pins between the gears 34 and the fabric supporting plate 20, to retract or withdraw the pins from the fabric when the pattern member 29 is lowered into inoperative position.

If desired, suitable connections (not shown) may be provided between the pattern member and the source of power for driving the belt 37 so that the source of power will be started by the initial movement of the pattern member into operative position and stopped when the member reaches full operative position and the piercing of the fabric has been accomplished.

In Figures 9 and 10 is shown another form of apparatus for causing rotation of the pins 22 during their axial movement to pierce the fabric 24. Mounted between the two plates 20 and 26 is an intermediate plate 39 to which the pins 22 are helically splined, as by a helical thread or spline 40 on each of the pins which cooperates with a notch 41 in the periphery of a corresponding hole in the intermediate plate. Such a helical spline could, of course, be accomplished as well by providing a helical groove, not shown, on each pin into which a tooth projects from the periphery of the corresponding hole in the plate 39. It will be seen that with either spline construction, axial movement of the pins, to pierce the fabric, will cause simultaneous rotation thereof. Hence, movement of a pattern member (not shown in Figure 9) into operative position is sufficient to both rotate and project the pins into a position, such as that shown. In this construction, the pins are provided with collars 42 which serve as stops in place of the gears 34. Withdrawing springs 38 are also provided.

Cooperating with the fabric supporting plate is a fabric clamping plate 43 which has a plurality of holes 44 therein corresponding in size, number, and arrangement to the holes 21 in the plate 20. The holes 44 receive the ends 23 of the pins when the latter are projected to pierce fabric clamped between the two plates 20 and 43.

The clamping plate 43 may be hinged to one edge of the supporting plate 20, as at 45, and preferably means, such as lugs 46 and pivoted thumb screws 47, are provided for locking the plates together in fabric clamping position.

That area of the fabric clamped between the two plates which is pierced by the pins may be heated in various ways to "set" the design therein. As shown in Figures 1 and 3, the clamping plate 43 may be provided with an electric heating coil 48 mounted in a compartment 49 which overlies the ends 23 of the pins. The electric circuit for the heating coil 48 preferably includes an adjustable thermostat 50, of a suitable type, so that the temperature to which the plate 43, and consequently fabric, is heated readily may be controlled.

There is shown in Figure 5 another method of heating the fabric while it is clamped between the plates 20 and 43. A steam jacket 51 surrounds the apparatus on three sides to heat the fabric supporting plate. Steam under pressure may be supplied to the jacket, through inlet and outlet connections 52 and 53, from any suitable source of supply and the temperature controlled in any conventional manner.

The operation of the apparatus shown in Figures 1 to 5 and 9 is as follows. The fabric to which a design is to be applied is placed smoothly over the supporting plate 20 and the clamping plate 43 lowered and locked to clamp the fabric therebetween. If gears, instead of a helical spline, are provided to rotate the pins 22, the source of power to rotate the gears is started and the pattern member 29 raised to operative position, thus piercing the fabric with the selected pins. Rotation of the pins then may be stopped and the electric circuit to the heating coil 48 closed, or steam let into the steam jacket 51 if the latter type of heating means is provided. The fabric is left in pierced position between the plates for a period of from about one-half to about five minutes while heated to a temperature of from about 250° F. to about 360° F. The pattern member then is lowered to permit the pins to withdraw, the clamping plate unlocked and raised, and the fabric removed. If desired, heat may be supplied to the apparatus constantly, provided suitable apparatus, such as the thermostat 50, is incorporated in the heat supply to maintain the temperature at the desired degree.

Nylon stockings must be preboarded before being dyed in order to give "shape" thereto. If this operation is not performed and if a nylon stocking is dyed loose in a hot dye bath, like silk or other fiber stockings, and dried on a form, the result is a wrinkled misshapen stocking. Hence, nylon stockings are preboarded, i. e. placed on a form and subjected to live steam at about 282° F. for about five minutes before being dyed. The stockings then retain a permanent set. Other setting agents are described in U. S. Patent No. 2,157,119. The process of this invention may be performed on nylon stockings before or after the preboarding treatment. It also has been discovered that the process can be performed as a part of the preboarding treatment.

Suitable apparatus for forming a design in a nylon stocking simultaneously with the preboarding treatment is shown in Figures 7 and 8. A relatively thin plate 54 is secured to an attaching member 55 which has curved ends 56 for adjustable attachment to a preboarding form 57. Projecting from the plate 54 are a plurality of pointed pins 58 arranged to form any selected design,

such as the numeral "51" as shown. The pins 58 are long enough to project through the fabric of a stocking between the threads to enlarge selected stitches and form small holes in the fabric. In use, the apparatus is attached to a preboarding form and the stocking drawn thereon. That portion of the fabric overlying the pins 58 is pressed down to force the pins through the fabric. The stocking is then subjected to the heat and moisture of the preboarding process and afterwards stripped from the form 57. The heat and moisture will have set the design in the stocking.

Numerous changes in the apparatus shown and described herein will be apparent to one skilled in the art. Hence, the invention embraces all variations thereof that come within the spirit and scope of the following claims.

I claim:

1. Apparatus for forming a design in synthetic polyamide fiber fabric comprising: a fabric supporting plate having a plurality of holes extending normally therethrough; a plurality of fabric piercing members having pointed ends supported for projection through said holes, the fabric piercing portion of said members being circular in transverse section; means for selectively projecting said members through said holes to pierce the fabric supported on said plate at selected points to form a predetermined design; means for rotating each of said members while it is being projected to pierce the fabric; and means to heat and thereby set the fabric while pierced by said members.

2. Apparatus for forming a design in synthetic polyamide fiber fabrics comprising: a fabric supporting plate, a base plate mounted parallel to and spaced from said supporting plate, said plates having a plurality of aligned holes extending normally therethrough; a plurality of fabric piercing members mounted in said holes and extending between said plates, said members having pointed ends normally positioned below the supporting surface of said fabric supporting plate; pattern means for axially moving said members to selectively project the pointed ends thereof above said supporting surface to pierce fabric thereon at selected points to form a predetermined design; constant mesh gears secured to that portion of said fabric piercing members located between said plates for rotating said members while they are being projected to pierce the fabric; and means to heat and thereby set the fabric while pierced by said members.

3. Apparatus for forming a design in a stocking knitted from synthetic polyamide fibers comprising the combination of a preboarding form, a relatively thin members detachably mounted on said form and having a plurality of pointed elements arranged in a predetermined pattern projecting outwardly thereof, said elements being adapted and proportioned to pierce the fabric of a stocking placed on said form over said member by penetration between the threads to stretch portions thereof and enlarge the normal distance therebetween; preboarding treatment of a stocking on said form will set the stocking fabric and simultaneously form a design therein by the pattern of holes set therein at points pierced by said elements.

4. Apparatus for forming a design in synthetic polyamide fiber fabric comprising: a fabric supporting plate, a base plate mounted parallel to and spaced from said supporting plate, said plates having a plurality of aligned holes ex-

tending normally therethrough; a plurality of fabric piercing members mounted in said holes and extending between said plates, said members having pointed ends normally positioned below the supporting surface of said fabric supporting plate; pattern means for axially moving said members to selectively project the pointed ends thereof above said supporting surface to pierce fabric thereon at selected points to form a predetermined design; a helical spline secured to that portion of said fabric piercing members located between said plates for rotating said members upon axial movement thereof; and means to heat and thereby set the fabric while pierced by said members.

5. Apparatus for forming a design in synthetic polyamide fiber fabric comprising: a plurality of substantially parallel fabric piercing members arranged in a predetermined pattern and having pointed ends that are circular in transverse section; means supporting said members for rotation about the axis of said pointed ends and in positions substantially normal to the fabric to be pierced; means for rotating said members and simultaneously effecting relative movement between said members and the fabric to pierce the latter by insertion of said pointed ends between the threads to stretch portions thereof and enlarge the normal distance therebetween; and means for setting the fabric while pierced by said members to form a design in the fabric by the pattern of holes set therein at points pierced by said members.

6. The apparatus defined in claim 5 in which the means for rotating the fabric piercing members includes constant mesh gears connecting said members for simultaneous rotation.

7. The apparatus defined in claim 5 in which the means for rotating the fabric piercing members includes helical spline means associated with each of said members to effect rotation thereof upon the said relative movement.

8. Apparatus for forming a design in a stocking knitted from synthetic polyamide fibers comprising the combination of a preboarding form and a plurality of pointed elements mounted on said form in a predetermined pattern and adapted and proportioned to pierce the fabric of a stocking placed on said form by penetration between the threads to stretch portions thereof and enlarge the normal distance therebetween, whereby preboarding treatment of a stocking on said form will form a design in the stocking fabric by the pattern of holes set therein at points pierced by said elements.

9. Apparatus for forming a design in a stocking knitted from synthetic polyamide fibers comprising the combination of a preboarding form and means for stretching portions of the threads of a stocking on said form to enlarge the normal distance between said threads at selected points of the stocking and for maintaining said threads in their stretched condition during preboarding treatment of the stocking, said means including a plurality of pointed elements arranged in a predetermined pattern and insertable through the stocking between the threads at said points while said stocking is on said form.

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