

Dec. 6, 1960

W. A. WOOD, JR., ET AL
YARN AND METHOD OF MAKING SAME

2,962,857

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2 Sheets-Sheet 1

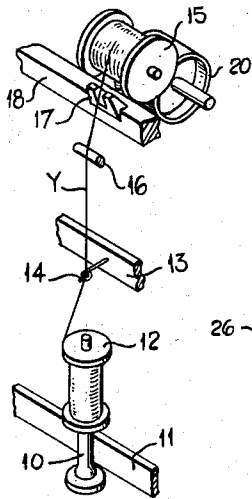


Fig-1

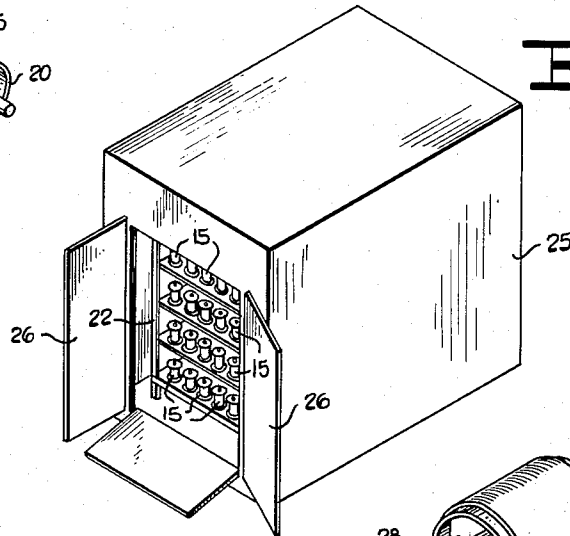


Fig-2

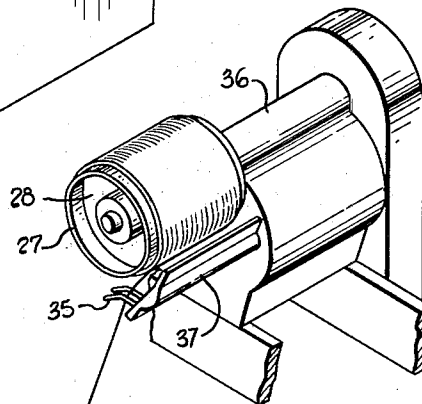


Fig-3

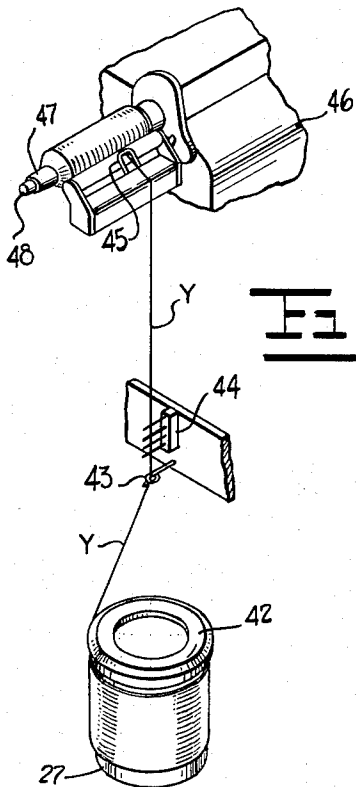


Fig-5

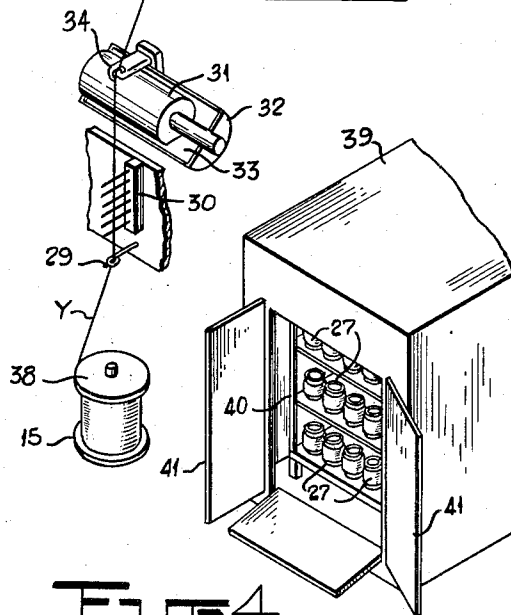


Fig-4

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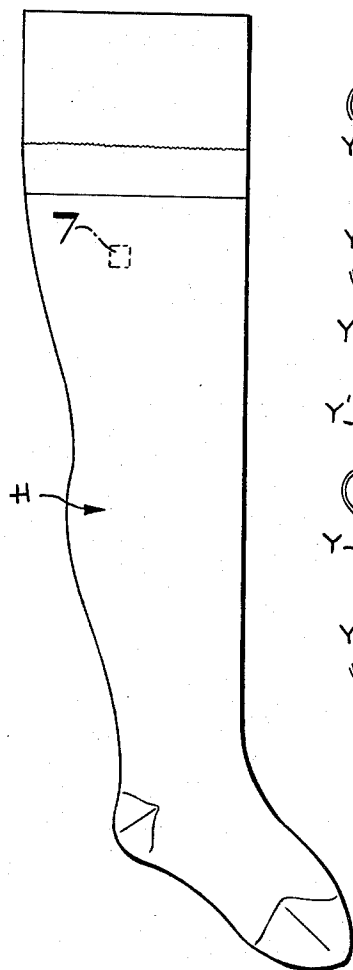


Fig-6

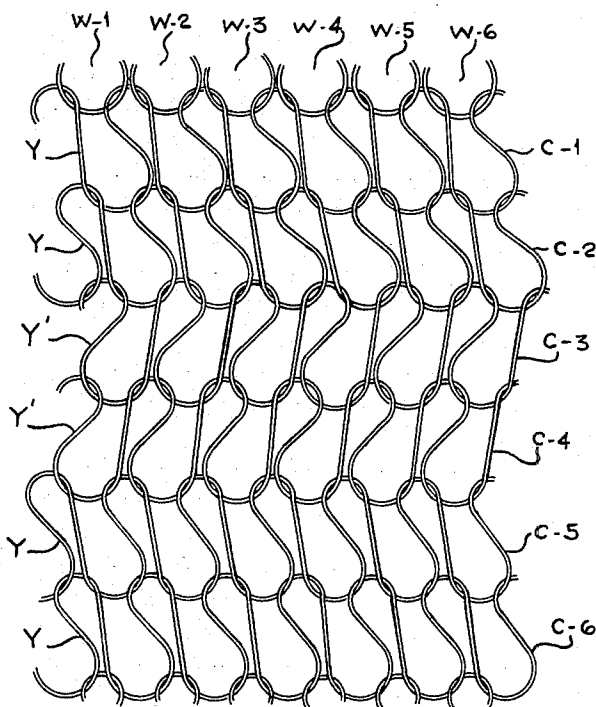


Fig-7

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1

2,962,857

YARN AND METHOD OF MAKING SAME

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4 Claims. (Cl. 57—157)

This invention relates generally to the art of treating a normally inelastic thermoplastic yarn to produce a yarn having a permanent liveliness and which yarn, when knit into a fabric, produces a stretchable fabric.

Heretofore, it has been the practice, when producing a lively yarn for knitting a stretchable fabric, to supertwist a thermoplastic yarn within the range of from twenty-five to sixty turns per inch on a conventional twisting machine, knit the twisted yarn into a fabric and then set the twist in the yarn forming the fabric by heat. This high twisted yarn is extremely wild or lively and is therefore hard to control during subsequent processing, such as winding, sizing and knitting. Although this high twist wild or lively yarn is highly elastic or stretchable when knitted into a fabric, the loops formed during knitting are extremely distorted and cause the fabric to curl unless the torque or distortion is equalized by knitting alternate or spaced courses from yarn which has been twisted in opposite directions. While using oppositely twisted yarns tends to balance the torque or curl in the overall fabric a pronounced patterned or herringbone effect is very obvious throughout the length of the knitted fabric or article.

It is therefore a primary object of this invention to produce a relatively high twist thermoplastic yarn by twisting the thermoplastic yarn on a conventional twisting machine, steaming this twisted yarn to take out or deaden part of the liveliness and part of the inherent shrinkage in the yarn so that the yarn may be more easily handled and controlled during subsequent operations, such as knitting.

It is another object of this invention to provide a lively yarn which, when knitted into a fabric, will produce a stretchable torque free fabric having less distortion of the loops and therefore less patterned or herringbone effect when knitted of oppositely twisted yarns.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

Figure 1 is a schematic isometric view showing one means of imparting a twist to the yarn;

Figure 2 is a schematic isometric view showing a steam box suitable for carrying out the first steaming operation wherein the twisted yarn is steamed on the take-up bobbins;

Figure 3 is still another schematic isometric view showing one means of winding the twisted and steamed yarn onto a sizing tube while applying a size of the twisted yarn;

Figure 4 is another schematic isometric view showing the twisted, steamed and sized yarn being additionally steamed on the size tubes;

Figure 5 is another schematic isometric view showing a preferred manner of carrying out another winding step and wherein the twisted, steamed, sized and additionally steamed yarn is wound from the size tubes to cones preparatory to knitting;

2

Figure 6 is a side elevation of a knitted article or hose, knit of the yarn formed according to this process;

Figure 7 is an enlarged fragmentary elevation showing the structure of the knitted loops and their angular relationship to each other and including substantially the area enclosed by the dotted rectangle 7 in Figure 6.

The improved lively or wild thermoplastic yarn is preferably produced in several steps which include, first winding the continuous filament nylon yarn from the usual pirns on which the yarn is wound by the producer onto twister supply spools in preparation for applying twist to the yarn. After the yarn has been wound from the pirns onto the twister supply spools, the yarn is next twisted on a conventional uptwister or other type of twisting machine, illustrated schematically in Figure 1.

The twisting machine comprises a rotatable spindle 10 which is driven by a continuously moving endless belt 11, only a portion of which is shown in Figure 1, and on which spindle the twister supply spool 12 is positioned to rotate. A suitable support bar 13 is spaced above the spindle 10 and provides a support for a suitable pigtail yarn guide 14 through which the yarn Y is threaded in its upward path from the spool 12 to a yarn take-up bobbin 15. The yarn Y continues upwardly from the pigtail 14 and passes over a tension rod 16 and through a traversing yarn guide 17 carried by a transverse bar 18. The transverse bar 18 is driven in a conventional manner to smoothly thread the yarn Y on the barrel of the yarn take-up bobbin 15 as the bobbin 15 is driven by resting upon a driven take-up roll 20.

In this twisting operation the yarn Y is twisted to impart a twist within the range of from 25 to 60 turns per inch. After twisting, the yarn Y, on the bobbin 15, is very lively and full of torque throughout its length and therefore very difficult to handle when being unwound from the yarn take-up bobbin 15. When knitting fabric with the twisted yarn Y from the bobbins 15 great care must be taken in maintaining the proper amount of tension on the running yarn so that it does not become slack and curl upon itself and loop or kink. Although a fabric can be knit from the yarn Y after twisting and without any further processing, it has been found to be advantageous to steam the yarn before knitting to remove part of the wildness.

After twisting the yarn Y, the yarn take-up bobbins 15 are removed from the twisting machine and placed on suitable racks 22. The racks 22 are then placed in a suitable steam box 25, shown as a "H-W" conditioner made by The Industrial Dryer Corp. of Stanford, Conn. (Figure 2). The doors 26 of the box 25 are then closed preparatory to steaming the yarn on the take-up bobbins 15. The yarn Y and the bobbins 15 are then subjected to a heat within the range of from one hundred and thirty-five to one hundred and sixty-five degrees Fahrenheit dry bulb temperature and from one hundred and twenty to one hundred and forty degrees Fahrenheit wet bulb temperature for a period of time from one and one half to four hours to take out part of the liveliness and part of the shrinkage in the yarn Y. The heat within this range is sufficient to partially set the twist in the yarn and thus to kill part of the liveliness or torque in the yarn which had been placed therein by the twisting operation.

After the first steaming operation the yarn Y may be knit into a fabric directly from the bobbins 15 and will be much easier to handle than yarn which has been twisted but not steamed. A better yarn and fabric will be produced however, if the yarn Y is sized and steamed a second time. The sizing is carried out by winding the yarn from the bobbins 15 onto sizing tubes 27 (Figure 3). This winding operation may be carried out on any suitable winding apparatus such as the machine illustrated

schematically in Figure 3 and which includes a pigtail yarn guide 29, a yarn tension fork 30, a size or lubricating roller 31 rotatable in a tray 32 partially filled with a lubricating size solution 33. While the tines of the tension fork 30 are shown as being stationary it is to be understood that a tension fork could be used which has movable tines to vary the tension on the yarn Y. The rotating roller 31 applies the lubricant 33 to the running yarn Y as it passes across the roller 31, through a second stationary yarn guide 34, a traversing yarn guide 35 and to the size tube 27. The size tube 27 is mounted on the rotating spindle 28 of a conventional winding machine 36 and is rotated to wind and guide the yarn Y onto the size tube 27 by a traversing mechanism 37 integral with the winding machine 36 for traversing the guide 35. This winding operation is primarily to reverse the wound yarn so that the yarn which was on the outside of the yarn take-up bobbins 15 will be placed on the inside of the size tubes 27 and expose a different winding of the yarn to the next steaming operation. In operation the bobbins 15 are usually provided with suitable draw off caps 38 which are thin polished removable covers adapted to fit on the upper head of the bobbin 15 (Figure 3) and protect yarn Y as it is drawn from the bobbins 15.

The filled size tubes 27 are placed in a second steam box 39, which may be same steam box as the one used in the first steaming operation, (Figure 4) for steaming the yarn a second time in order to level out the shrinkage and twist setting of the yarn and to provide even dyeability throughout the length of the yarn. This second steaming operation insures that the yarn which was wound next to the bobbin in the first steaming operation will be on the outside winding of the size tubes 27 and thus the full length of yarn will be exposed to equal steaming temperatures and provide equal shrinkage, twist setting and dyeability throughout the length of the yarn. The size tubes 27 are placed on racks 40, the racks 40 placed in the box 39 and the doors 41 closed to carry out a second steaming operation. The second steaming operation is similar to the first steaming operation in that the temperatures are within the same range of from one hundred and thirty-five to one hundred and sixty-five degrees Fahrenheit dry bulb temperature and one hundred and twenty to one hundred and forty degrees Fahrenheit wet bulb temperature and the amount of time which the yarn is exposed to this temperature is cut approximately in half or within the range of from three quarters to two hours. The shorter length of time which the yarn is steamed in this second operation is due to the thinner package of yarn wound on the yarn sizing tubes 27.

After the second steaming operation the yarn Y is next transferred from the yarn size tube 27 to suitable cones or tubes on any conventional type of winding machine, illustrated schematically in Figure 5. In this second winding operation the yarn Y passes upwardly from the size tube 27 around a suitable yarn draw off cap 42 resting on the top of the size tube 27, through a yarn guiding pigtail 43 and through a suitable tensioning fork 44 fixed on any stationary part of the winding machine. From the tension fork 44 the yarn extends upwardly and through a traversing yarn guide 45 mounted on a winding machine 46 and provided to guide the yarn Y as it is wound onto a suitable cone or tube 47 removably mounted on and driven by a rotating spindle 48 of the winding machine 46.

The tubes 47 may then be used as supply packages on any suitable fabric forming machine such as a knitting machine adapted to form a ladies' hose H as illustrated in Figure 6. The hose H may be knit on a full fashioned knitting machine or on a multi-feed circular knitting machine and if knit on a full fashioned machine must be seamed in the usual manner to form the tubular hose. In knitting hosiery or other articles from a twisted lively

yarn, it is the common practice to knit alternate or spaced groups of courses from a yarn which has been twisted in one direction and intervening or spaced groups of courses from a yarn which has been twisted in the opposite direction in order to balance the knitted article as to torque so that the knit article will lie flat after knitting.

When knitting an article or fabric with oppositely twisted yarns the loops formed have a tendency to be distorted and lie at an angle of at least thirty degrees relative to the vertical walewise direction of the knitted fabric. This distortion of the loops results in a definite patterned or herringbone coursewise effect in the knitted fabric. By using the yarn processed according to the foregoing disclosure, since the steaming operations have decreased the liveliness in the yarn, the angle at which the loops are distorted has been reduced so that the loops formed of the improved yarn lie at not more than a fifteen degree angle relative to a vertical line in the direction of the wales of knitting.

This reduction in the distortion of the loops tends to reduce the obvious patterned or herringbone effect in the knitted fabric and also reduces the liveliness and tendency to kink and curl upon itself experienced in knitting the regular or conventional twisted yarn which has not been additionally steamed after twisting. By reducing the tendency of the yarn to kink and curl upon itself control of the yarn during knitting has been made easier and the number of "seconds" has been greatly reduced. A "second" or irregular fabric results when a wild or lively yarn kinks or curls upon itself and is knit into the fabric.

In Figure 7 a portion of the fabric is shown in courses C-1 through C-6 and in the wales W-1 through W-6 and an improved yarn Y which has been twisted in one direction is shown as knitting in the courses C-1, C-2, C-5 and C-6. A yarn Y' is shown as being knit in the courses C-3 and C-4 and which yarn has been twisted in the opposite direction from the yarn Y in order to knit a balanced fabric. While a slight herringbone effect is still evident between courses C-2 and C-3 this angular relationship of the loops is greatly reduced from the usual effect when using unsteamed yarns. Also, when viewed from a distance the slight herringbone effect is not objectionable to the prospective purchaser or to the user when worn.

As a specific but non-limiting example of one type of yarn which may be processed according to this invention, one end of fifteen denier monofilament nylon yarn is wound from the pirn on which this yarn is received onto a twister supply bobbin 12. This step in the process accomplishes the transfer of the yarn from its original package to a bobbin suitable for the twisting operation.

The bobbin 12 is then placed on the spindle 10 of the twisting machine (Figure 1) and the yarn Y is threaded upwardly through the pigtail 14, the traversing guide 17 and wound onto the yarn take-up bobbin 15. The speed of the spindle 10 and the take-up bobbin drive 20 is regulated so that the yarn is given a twist of forty turns per inch to the right throughout its length as it is wound onto the yarn take-up bobbin 15.

The next step in the process includes placing a plurality of the yarn take-up bobbins 15 in the steam box 25 and steaming the yarn thereon at a dry bulb temperature of one hundred and fifty degrees Fahrenheit and a wet bulb temperature of one hundred and thirty-five degrees Fahrenheit for a period of three hours to take out or deaden part of the liveliness and part of the shrinkage in the yarn.

After the first steaming operation the yarn is wound from the yarn take-up bobbins 15 onto suitable sizing tubes 27 in order to reverse the yarn, that is, so that the yarn which was on the inside of the package on the bobbins 15 will be on the outside of the package on the sizing tubes 27. During this winding operation the yarn Y may have, if desired, a size added thereto which is

primarily for lubrication of the yarn in the following operations, such as knitting. A particular size which has been found satisfactory in this operation is Hamico 910 manufactured by the Harry-Miller Company of Philadelphia, Pennsylvania. The Hamico 910 is made up of forty percent water soluble casein and sixty percent mineral oil. It has been found that a three and one half percent in proportion to the weight of the yarn Y is a satisfactory coating for the yarn.

After the winding and sizing operation the size tubes 27 are allowed to dry at room temperature for approximately twenty-four hours or may be dried in a heated dryer with a heat of approximately one hundred and thirty degrees Fahrenheit from four to eight hours. This drying insures that any moisture in the yarn package is dried out before the next steaming operation.

The size tubes 27 are then placed in a second steam box 39 and again subjected to the same steaming temperature of one hundred and fifty degrees Fahrenheit dry bulb temperature and one hundred and thirty-five degrees Fahrenheit wet bulb temperature but for a shorter length of time of approximately one and one half hours. The shorter length of time for the second steaming is due to the fact that the package of yarn wound on the sizing tube 27 is of less thickness than the package of yarn which was wound on the take-up bobbins 15 in the first steaming operation. This second steaming operation levels out the shrinkage, twist setting and dyeability of the yarn throughout the length thereof.

After this second steaming operation the yarn on the size tubes 27 is allowed to dry completely and is then transferred from the size tubes 27 to suitable tubes 47 by the use of a winding machine (Figure 5).

The tubes 47 may then be used as yarn supply packages on any suitable type of knitting machine to form the hose H (Figure 6). The fabric shown in Figure 7 is illustrative of a fabric made on a full fashioned knitting machine in which one carrier makes a reciprocation across the width of the hose and returns to knit two courses from the yarn Y. These two courses being illustrated at courses C-1 and C-2 as well as at C-5 and C-6.

Another end of fifteen denier monofilament yarn Y' is treated identically to the yarn Y in the foregoing step except that in the twisting operation the forty turns of twist are applied in a left-hand direction and when this yarn is used on a full fashioned knitting machine it is used in a second carrier of the knitting machine and as the carrier is moved across the fabric and back the courses C-3 and C-4 in Figure 7 are made with the yarn Y'.

It is thus seen that a heat settable yarn has been provided which is first twisted and then steamed to take out or deaden part of the liveliness applied by the twisting and to take out part of the shrinkage to produce a yarn which is easily handled in knitting without special attachments or precise tension settings and which will not as readily curl or twist upon itself upon the tension being relaxed on this yarn as will a yarn which has been twisted but not steamed. Also, this improved yarn is easily knit into a fabric which has a pleasing appearance and is devoid of a noticeable patterned or herringbone effect in the finished article.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, al-

though specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. A method of producing a lively knitting yarn from a continuous filament sheer nylon yarn which comprises imparting twenty-five to sixty turns per inch of twist to said yarn while transferring said yarn from a first bobbin to a second bobbin by maintaining a speed differential between the first bobbin and the second bobbin, steaming the yarn on said second bobbin at a relatively low temperature to remove a portion of the liveliness imparted thereto by the twisting, transferring said yarn from the second bobbin to a size tube, and additionally steaming said yarn on said size tube at the same temperature as the first steaming.

2. A nylon yarn processed according to the method of claim 1.

3. A method of producing a lively knitting yarn from a continuous filament sheer nylon yarn which comprises imparting twenty-five to sixty turns per inch of twist to said yarn while transferring said yarn from a first bobbin to a second bobbin by maintaining a speed differential between the first bobbin and the second bobbin, steaming the twisted yarn on said second bobbin at a temperature within the range of from one hundred and thirty-five to one hundred and sixty-five degrees Fahrenheit to remove a portion of the liveliness imparted thereto by the twisting, transferring said yarn from the second bobbin to a size tube and coating said yarn with a lubricating fluid during said transfer, additionally steaming said yarn on said size tube, then transferring said yarn from the size tube to a cone without applying additional twist, and knitting a fabric from the yarn on said cone.

4. A method of treating a continuous filament sheer nylon yarn which comprises imparting forty turns per inch of twist to said yarn while transferring said yarn from a first bobbin to a second bobbin by maintaining a speed differential between the first bobbin and the second bobbin, steaming the twisted yarn on said second bobbin at a temperature of one hundred and fifty degrees Fahrenheit for three hours to remove a portion of the liveliness imparted thereto by the twisting, transferring said yarn from the second bobbin to a size tube and coating said yarn with a lubricating fluid during said transfer, additionally steaming said yarn on said size tube at a temperature of one hundred and fifty degrees Fahrenheit for one and one half hours, then transferring said yarn from the size tube to a cone without applying additional twist, and knitting a fabric from the yarn on said cone.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,962,857

December 6, 1960

William A. Wood, Jr., et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 3 and 4, for "of New York, N. Y., a corporation of New York," read -- of Winston-Salem, North Carolina, a corporation of Delaware, --; in the heading to the printed specification, line 5, for "New York, N. Y., a corporation of New York" read -- Winston-Salem, N. C., a corporation of Delaware, --.

Signed and sealed this 28th day of April 1964.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents