Jan. 25, 1966 D. A. NEWMAN 3,231,060

DUPLICATING RIBBONS AND METHOD OF PRODUCING SAME

Filed Jan. 25, 1963

Fig. 1

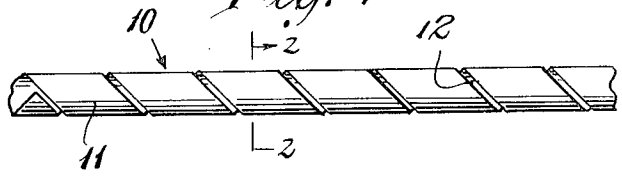


Fig. 2

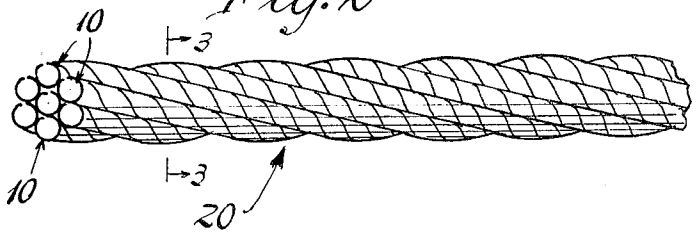


Fig. 3

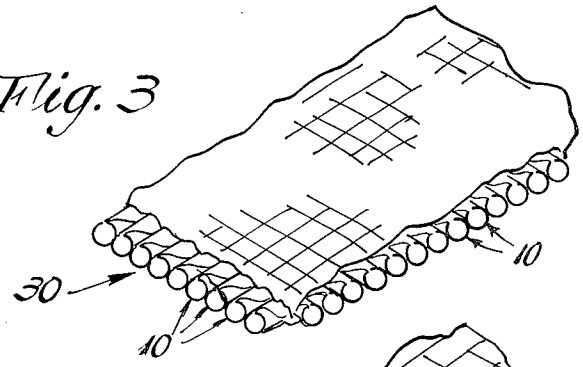


Fig. 4

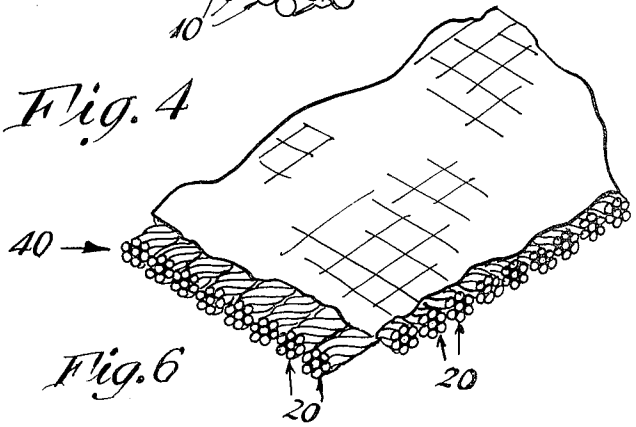


Fig. 5

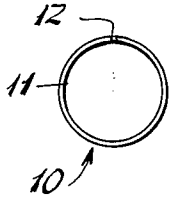
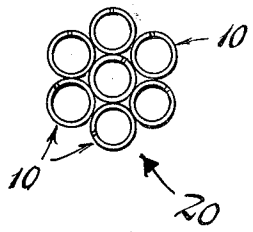


Fig. 6



INVENTOR.
Douglas A. Newman
BY
Johnson and Kline
ATTORNEYS

United States Patent Office 3,231,060 Patented Jan. 25, 1966

3,231,060

DUPLICATING RIBBONS AND METHOD OF PRODUCING SAME

Douglas A. Newman, Glen Cove, N.Y., assignor to Columbia Ribbon and Carbon Manufacturing Co., Inc., Glen Cove, N.Y., a corporation of New York

Filed Jan. 25, 1963, Ser. No. 253,941
9 Claims. (Cl. 197—172)

This invention relates to novel woven printing ribbons formed from relatively flat tubular coils of synthetic thermoplastic film and to the method of making the same.

In the related field of producing printing ribbons such as for typewriters, chain printers and related business machines, synthetic fabrics have met with much success because of their increased strength and durability under the effects of repeated blows from the typewriter bars. However, there is the problem of providing a ribbon which has the ability of absorbing and retaining large amounts of printing ink and the ability of transferring this ink to a copy sheet under the effects of imaging pressure. Since synthetic fibers are solid and impermeable to the ink, the ink must be retained on the surface of the fibers and this places a severe limitation on the amount of ink which can be retained by synthetic fabric ribbons. The ink capacity may be increased by increasing the number and size of the filaments per thread but this results in the formation of a ribbon of increased caliber with resultant loss of ability to form sharp and clear images because of the thickness of the fabric. The sharpness of the imaging blow is partially absorbed by the fabric rather than being transmitted to the copy sheet.

It is an object of this invention to prepare novel woven synthetic fabric printing ribbons having an increased absorbency and capacity for printing ink while retaining excellent imaging properties of sharpness and clarity.

It is another advantage that printing ribbons prepared according to this invention have the ability of stretching or distorting about the image on a printing bar so as to transmit the image pressure sharply to a copy sheet, and the ability of springing back to normal shape when the imaging pressure is released.

Other objects and advantages will be obvious in the light of the following description and accompanying drawing in which:

FIGURES 1 and 3 are diagrammatic side views, to an enlarged scale, of a single filament thread and a fabric woven therefrom, respectively, according to the present invention.

FIGS. 2 and 4 are diagrammatic side views, to an enlarged scale, of a multi-coil strand and a fabric woven therefrom, respectively, according to this invention.

FIGS. 5 and 6 are cross-sections of the filament of FIG. 1 and the strand of FIG. 2 respectively.

The many objects and advantages of the present invention are attained by the discovery that relatively flat strips of synthetic thermoplastic resins may be twisted about themselves to form long tubular coils which may be woven in conventional manner into fabrics of extreme lightness, absorbency and porosity or air permeability.

Such a tubular coil **10** is illustrated in FIG. 1 whereby a relatively flat thermoplastic strip **11** is wound into a long tubular coil having a more or less rounded cross-section as illustrated in FIG. 5 which is the view along line **2—2** shown by FIG. 1. The coil is hollow and the air within is free to circulate in and out by means of the slit **12** which spirals along the entire length of the tubular coil.

As illustrated by FIG. 3, a number of these tubular plastic coils **10** may be woven into a fabric **30**. The

plastic coils may be used for both the warp and filler threads or, if desired, conventional plastic or textile threads may be used for the filler threads.

According to another embodiment of this invention, several of the tubular plastic coils **10** illustrated by FIG. 1 may be wound together to form a multi-coil strand **20** as shown by FIG. 2. The strands **20** are more or less round in cross-section as illustrated in FIG. 6 which is the view along line **3—3** shown by FIG. 2.

The strands may then be woven into a fabric **40** as illustrated by FIG. 4 of the drawing, the threads being used alone or in admixture with conventional plastic or textile threads as discussed supra.

In carrying out the present invention, extruded filaments of synthetic thermoplastic material, such as filaments of nylon, Orlon (polyacrylonitrile), Dacron (polyester fiber), saran thread (polyvinylidene chloride), rayon (cellulose acetate) and the like, may be used as the starting materials. Such filaments are generally more or less round in cross-section and have a denier ranging from a fineness of about 0.5 denier up to a coarseness of many denier, the preferred denier range according to this invention being from 0.5 to 2.0.

The rounded filaments are then flattened by passing them between rollers which are in contact with each other and which are heated to a temperature above the softening temperature of the particular thermoplastic resin but below the melting temperature thereof, i.e. generally between 150° C. and 250° C.

The flattened filaments, because of the stretching thereof, retain about half the denier or weight of the original rounded filaments and the surface area of the flattened filament is much greater than the original surface area since the flattening operation stretches the rounded filament into an extremely thin film strip having a width which is several times greater than the diameter of the original filament.

The flattened filaments are then wound into tubular coils in any desired manner such as by clamping one end of the filament and attaching the other end to the shaft of a motor. Plenty of slack is provided to allow the filament to coil about itself and form the desired structure. The number of winds applied, or the tightness of the coil, may be varied greatly depending upon the type of fabric which is to be prepared therefrom. According to the preferred embodiment of this invention the tubular coil is heated, preferably to the softening point of the particular plastic, while the coil is held at the desired tightness and maintained under twisting stress and then quickly chilled to allow it to set. When the tubular coil is released it will tend to substantially retain the tightness applied. This step is not critical, but heating to some elevated temperature is helpful in forming tubular coils which retain some degree of tightness.

The formed tubular coils, depending upon their diameters, which in turn depend upon the width of the flattened films and the tightness of the formed coils, may be used as monofilament threads and woven into a fabric by conventional methods, or may be twisted together with one or more similar coils or together with conventional synthetic or textile filaments to form threads which may be woven into fabrics by conventional methods.

The following procedure is set forth as illustrative of the use of one type synthetic filament according to one embodiment of this invention, and should not be considered as limitative.

Nylon filament having a circular circumference and a denier of approximately 1.15 may be flattened by passing it between two contacting heated rollers having a temperature of about 200° C. The flattened filament has the ap-

pearance of a narrow strip of film having a width which is approximately equal to the circumference of the original filament and a surface area which is approximately equal to twice that of the original filament.

The flattened film strip may then be coiled in the manner discussed supra, being heated to 200° C. and quickly cooled while retained in tightly wound position. The formed coil has a circumference and diameter which is somewhat larger than the circumference and diameter of the original solid rounded filament but the surface area of the coil is twice that of the original filament since the coil is hollow. Moreover, the typewriter ink-holding capacity of the formed coil is four or more times greater than that of the original filament because of the increased surface area and because of the hollow tubular structure of the formed coil which acts as a reservoir for the liquid ink and retains it apparently by capillary action.

The nylon tubular coils may then be formed into multi-coil strands of about 20 denier by winding together 30 coils. Although the formed threads are light in weight or denier, they will have approximately the same circumference as threads formed from 30 conventional filaments of 1.15 denier nylon.

The threads **20**, as illustrated by FIGS. 2, 4 and 6, may then be woven into a fabric **40** having a square inch count of 300, e.g., a warp thread count of 160 and a filling thread count of 140, and the fabric may be cut into narrow strips or ribbons about ½ inch wide using a hot cutting edge to fuse the edges of the cut ribbons. The cutting is done along the warp threads so that the warp strands run lengthwise of the cut ribbons and the filler threads run crosswise thereof.

The finished ribbons may be impregnated with any conevntional liquid typewriter ribbon ink such as one comprising oleic acid, carbon black and nigrosine black, and will hold and retain in clean dry fashion many times the amount of such ink as may be held and retained by a conventional nylon ribbon of the same caliper.

The inked ribbon provides typed images of excellent sharpness and clarity and has a useful life of many times the useful life of the conventional nylon ribbon of like caliper.

As pointed out hereinbefore and as illustrated by FIGS. 1, 3 and 5 of the drawing, the tubular plastic coils **10** of this invention may be used as monofilament threads and may be woven into fabrics **30** of increased lightness and air porosity. According to this embodiment, it is preferred to start from rounded filaments having a higher denier, in the order of 3 to 5 or more, and a larger filament circumference. Such filaments provide wider flattened filaments or film strips having a width of 1/32 to 1/16 inch or even greater when desired. Monofilament coils thereof may be woven closely or loosely by altering the square inch count of the coils to provide the desired fabric having the desired caliper depending upon the width of the film strips used and the tightness of the coils formed therewith.

One of the other important advantages of the fabrics of the present invention, other than lightness of air porosity, is their ability to stretch and then return to the original dimensions. This is due to the coil structure of the individual tubular filaments which act as individual springs due to the fact that each length of coil is made up of a much larger length of flattened film strip. Upon stretching, the coil tends to approach the length of the film strip from which it is wound, and upon release, the coil tends to spring back to its wound form particularly in cases where the coil was tightly wound and then heated and quickly cooled to set it in that position.

Although the teachings of this invention have been directed towards the use of flattened filaments, it should be understood that the invention also applies to the use of plastic films of the thermoplastic materials which have been cut into narrow strips of the desired width, such films being available in a caliper of from 0.25 to 0.5 mil and thicker, if desired. The invention also applies to thermoplastic film strips extruded or otherwise cast in the form of narrow, relatively flat strips which can be coiled and woven in the manner taught herein.

It is not necessary that the plastic strips, which are wound into coils according to the present invention, have flat smooth surfaces. It is only necessary that the plastic strips have such dimensions that allow them to be twisted about themselves to form tubular coils. Thus the plastic strips must be at least relatively flat, i.e., they must have greater width than thickness. In this connection it should be pointed out that plastic strips having longitudinally corrugated or ridged surfaces provide excellent results particularly for the preparation of typewriter ribbon fabrics. Such corrugated or ridged strips may be extruded as such by using the proper fitting on the orifice of the extruding apparatus, or may be formed by flattening rounded filaments between calendering rollers having corrugated or ridged surfaces.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. The method of producing duplicating ribbons which are light in weight, resilient and absorbent which comprises the steps of twisting a number of relatively flat strips of thermoplastic film to form a number of individual hollow tubular coils each having a slit which spirals along the entire length of each tubular coil and which provides access to the interior of the hollow coils, weaving together a number of said hollow tubular coils of thermoplastic film to form a fabric, and impregnating said fabric with a printing ink which is absorbed into the interior of said hollow tubular coils through said slit to form reservoirs of ink which is pressure-releasable through said slit under the effect of imaging pressure.

2. The method of producing duplicating ribbons which are light in weight, resilient and absorbent which comprises the steps of twisting a number of relatively flat strips of thermoplastic film to form a number of individual hollow tubular coils each having a slit which spirals along the entire length of each tubular coil and which provides access to the interior of the hollow coils, twisting together a number of said hollow tubular coils of thermoplastic film to form multi-coil strands therefrom, weaving said multi-coil strands to form a fabric, and impregnating said fabric with a printing ink which is absorbed into the interior of said hollow tubular coils through said slit to form reservoirs of ink which is pressure-releasable through said slit under the effect of imaging pressure.

3. The method of producing duplicating ribbons which are light in weight, resilient and absorbent which comprises the steps of twisting a number of relatively flat strips of thermoplastic film to form a number of individual hollow tubular coils each having a slit which spirals along the entire length of each tubular coil and which provides access to the interior of the hollow coils, weaving said tubular coils of thermoplastic film to form a fabric, cutting said fabric to form ribbons therefrom, and impregnating said ribbons with a printing ink which is absorbed into the interior of said hollow tubular coils through said slit to form reservoirs of ink which is pressure-releasable through said slit under the effect of imaging pressure.

4. The method of producing duplicating ribbons which are light in weight, resilient and absorbent which comprises the steps of twisting a number of relatively flat strips of thermoplastic film to form a number of individual hollow tubular coils, each having a slit which spirals along the entire length of each tubular coil and which provides access to the interior of the hollow coils, twisting together a number of said tubular coils of thermoplastic film to form multi-coil strands therefrom, weaving said multi-coil

strands to form a fabric, cutting said fabric to form ribbons therefrom, and impregnating said ribbons with a printing ink which is absorbed into the interior of said hollow tubular coils through said slit to form reservoirs of ink which is pressure-releasable through said slit under the effect of imaging pressure.

5. The method of producing duplicating ribbons which are light in weight, resilient and absorbent which comprises the steps of twisting a number of relatively flat strips of thermoplastic film to form a number of individual hollow tubular coils, each having a slit which spirals along the entire length of each tubular coil and which provides access to the interior of the hollow coils, maintaining said coils under twisting stress and heating to soften the thermoplastic film and then quickly chilling to set the thermoplastic film in tubular coil form, weaving said tubular coils of thermoplastic film to form a fabric, and impregnating said fabric with a printing ink which is absorbed into the interior of said hollow tubular coils through said slit to form reservoirs of ink which is pressure-releasable through said slit under the effect of imaging pressure.

6. The method of producing duplicating ribbons which are light in weight, resilient and absorbent which comprises the steps of twisting a number of relatively flat strips of thermoplastic film to form a number of individual hollow tubular coils, each having a slit which spirals along the entire length of each tubular coil and which provides access to the interior of the hollow coils, maintaining said coils under twisting stress and heating to soften the thermoplastic film and then quickly chilling to set the thermoplastic film in tubular coil form, twisting together a number of said tubular coils of thermoplastic film to form multi-coil strands therefrom, weaving said multi-coil strands to form a fabric, and impregnating said fabric with a printing ink which is absorbed into the interior of said hollow tubular coils through said slit to form reservoirs of ink which is pressure-releasable through said slit under the effect of imaging pressure.

7. A duplicating ribbon comprising a lightweight resilient and absorbent fabric woven from hollow tubular coils of relatively flat thermoplastic film, said coils each having a slit which spirals along the entire length of each tubular coil and which provides access to the interior of the hollow coils, said ribbon being impregnated with a printing ink which is absorbed into the interior of said hollow tubular coils through said slit to form reservoirs of ink which is pressure-releasable through said slit under the effect of imaging pressure.

8. A duplicating ribbon comprising a lightweight, resilient and absorbent woven fabric having filler and warp threads, said warp threads comprising individual hollow tubular coils of relatively flat thermoplastic film, said coils each having a slit which spirals along the entire length of each tubular coil and which provides access to the interior of the hollow coils, said ribbon being impregnated with a printing ink which is absorbed into the interior of said hollow tubular coils through said slit to form reservoirs of ink which is pressure-releasable through said slit under the effect of imaging pressure.

9. A duplicating ribbon comprising a lightweight, resilient and absorbent woven fabric having filler and warp threads, said warp threads comprising a number of hollow tubular coils of relatively flat thermoplastic film, said coils each having a slit which spirals along the entire length of each tubular coil and which provides access to the interior of the hollow coils, said coils being twisted about each other to form each thread, and said ribbon being impregnated with a printing ink which is absorbed into the interior of said hollow tubular coils through said slit to form reservoirs of ink which is pressure-releasable through said slit under the effect of imaging pressure.

References Cited by the Examiner

UNITED STATES PATENTS

1,995,696	3/1935	Wallach	57—155 X
2,035,320	3/1936	Kniesche	57—165 X
2,393,058	1/1946	Pierce et al.	57—157 X
2,403,317	7/1946	Warren	57—157 X
2,906,000	9/1959	Fujima et al.	28—72
2,918,160	12/1959	Thompson	197—172
3,017,685	1/1962	Heberlein	28—72
3,080,954	3/1963	Newman et al.	197—172
3,093,955	6/1963	Cadario	57—34

ROBERT E. PULFREY, *Primary Examiner.*

DONALD W. PARKER, *Examiner.*