

Dec. 30, 1952

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2,623,496

MACHINE FOR PROCESSING SYNTHETIC THREADS

Filed June 2, 1949

2 SHEETS—SHEET 1

Fig. 1.

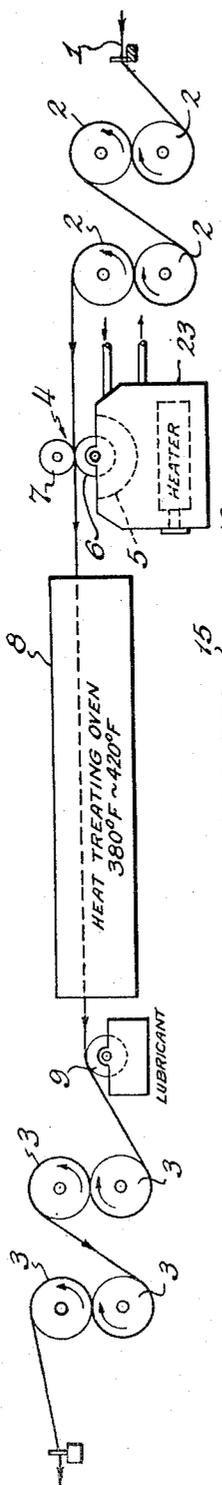


Fig. 2.

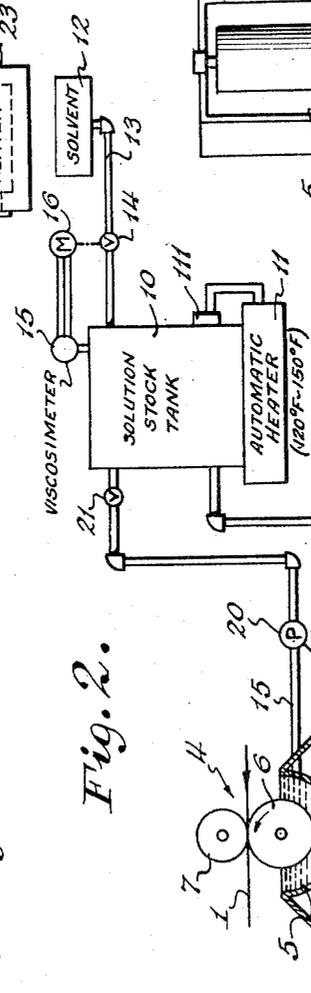
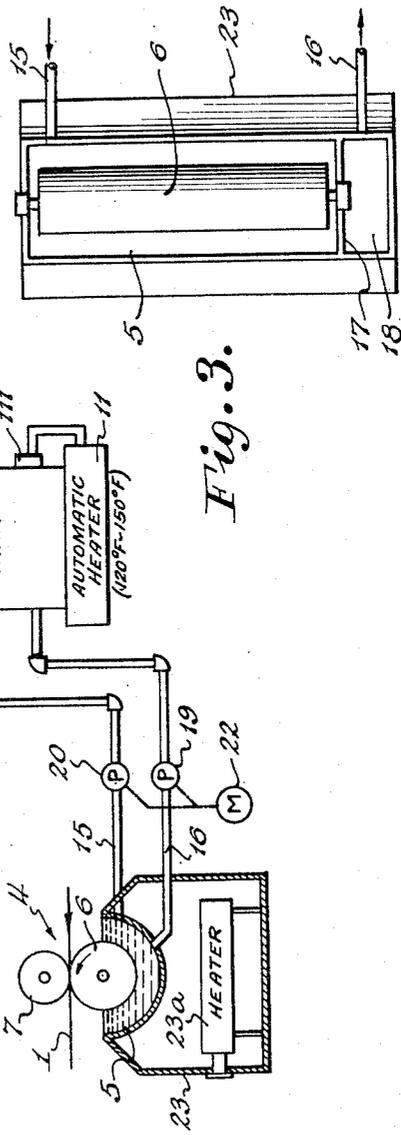


Fig. 3.



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2 SHEETS—SHEET 2

Fig. 4.



Fig. 5.

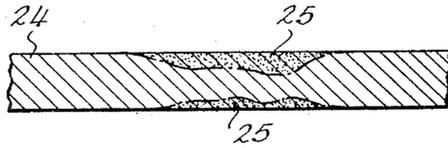


Fig. 6.

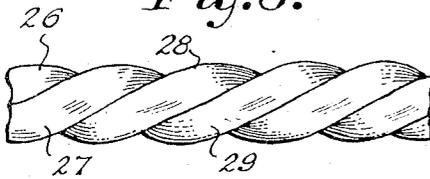


Fig. 7.

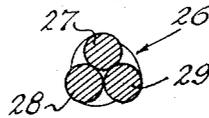


Fig. 8.

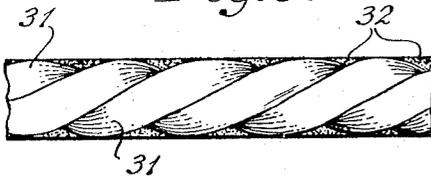


Fig. 9.

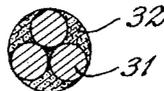


Fig. 10.

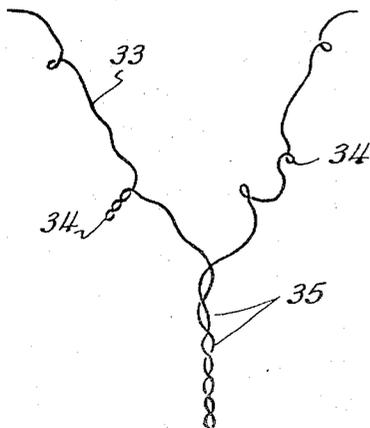
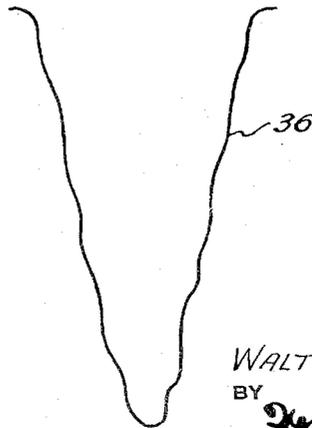


Fig. 11.



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MACHINE FOR PROCESSING SYNTHETIC THREADS

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2 Claims. (Cl. 118—9)

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Of the numerous synthetic materials and threads which have been produced in the last decade or so, nylon threads have become extremely desirable because of the strength and pleasing appearance thereof, for use in the textile industries and other arts. However, these nylon threads have a relatively high percentage elongation under stress, of the order of 20-30%, and also create high friction when employed in high speed sewing machines and the like, rendering them unsuitable for such use. Additionally, due to the inherent nature of nylon threads, they have a tendency to twist and snarl after subjection to tension and when such tension is released. All of these undesirable properties of nylon threads reduce their adaptability for high speed machines and impose a considerable restriction on the practical uses thereof.

The thread of my invention is characterized by the fact that the detrimental qualities of former nylon threads hereinabove set forth are appreciably reduced and substantially eliminated, at least to such an extent that my thread can be used in high speed machines and may be used under speeds greatly in excess of those under which former threads were ill suited.

It is an object of the present invention to provide apparatus for processing nylon threads and the like so as to produce an improved thread which, adapted for automatic and high speed machine use, among other things, is characterized by one or more of the following features: a thread which is characterized by its low percentage elongation under stress, a thread of improved strength; a thread which has a substantially even and smooth surface whereby friction under high speed conditions is greatly reduced; and a thread which will not twist or snarl to any undesirable degree when placed under tension and the tension is then slackened or removed.

It is another object of the present invention to provide a machine for producing improved nylon thread of the character above set forth. It is an object to provide a machine for producing an improved nylon thread in which the ordinary nylon thread, as for example, that produced in extrusion processes, is subjected to nylon in solution and the nylon in said solution is fused to surface portions of the nylon thread or core.

More particularly, it is an object of this invention to provide a machine of the foregoing character in which a nylon thread or core is subjected to a nylon solution while said core is maintained under tension. It is a further object to provide a machine of the foregoing character in which the nylon thread or core bearing the

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solution is subjected to heat treatment being performed while drying of the nylon solution occurs or while the nylon in said solution becomes fused to the core.

The resulting thread, comprising a nylon thread or core having indentations or crevices therein as in those cases where the thread comprises a plurality of twisted elements, is characterized by the fact such crevices are filled with nylon derived from nylon solution and fused to the surfaces of said thread to thereby render it of the character above set forth and one which is well suited for use in high speed machines.

Still another object resides in providing an improvement in thread processing machines in which nylon in solution is supplied to a nylon core or thread to provide a finished thread of improved sewing qualities and of the character hereinabove set forth.

With the foregoing and still other objects in view, my invention includes the novel thread, machine elements, and combinations thereof, and the steps in the process of forming such thread described below and illustrated in the accompanying drawings, in which—

Fig. 1 diagrammatically represents a machine of the present invention employed in carrying out the process thereof to form my novel nylon thread;

Fig. 2 diagrammatically illustrates a portion of the machine of Fig. 1 wherein a nylon solution of satisfactory consistency is supplied to the nylon thread or core;

Fig. 3 is a plan view of the applicator tank for the nylon solution;

Fig. 4 is a sectional view representing a conventional nylon thread produced in conventional ways;

Fig. 5 is a cross section of the thread of Fig. 4 improved to form a thread of the present invention;

Fig. 6 shows a conventional, multi-filament, twisted thread;

Fig. 7 is a sectional end view of the thread of Fig. 6;

Fig. 8 illustrates the thread of Fig. 6 improved in accordance with the present invention;

Fig. 9 is a sectional end view of the thread of Fig. 8;

Fig. 10 diagrammatically illustrates an objectionable characteristics of ordinary nylon threads under certain conditions; and

Fig. 11 serves diagrammatically to represent the thread of the present invention under similar conditions.

For a better and more complete understand-

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ing of the extremely desirable attributes of the novel thread of my invention, I will first describe my novel process and machine employed in forming the same. Referring first to Fig. 1, wherein I have diagrammatically illustrated a preferred form of machine, I indicates, a nylon thread which is passed entirely through the machine and may be derived through guides from a suitable bobbin (not shown). This thread is of the type ordinarily obtained from conventional thread-forming machines and exhibits the undesirable qualities of prior nylon, hereinabove set forth. Although I have shown but one thread, it will be understood that a great many of such threads may be simultaneously passed through and treated in the machine. The machine of Fig. 1 comprises two pairs of input rollers 2 and similar output rollers 3. All of these rollers are preferably canvas covered and are driven by suitable drive mechanisms (not shown) to cause the thread to pass through the machine at a predetermined rate whereupon it is taken from the rollers 3 and passed through guides to wind-up bobbins. In accordance with my invention, the nylon thread or core while being processed is maintained under a predetermined substantially constant tension. This is accomplished by driving the rollers 3 at a slightly higher rate than roller 2, the difference in rates determining the amount of tension placed upon the nylon threads or cores.

The nylon core is passed from the input rollers 2 between a second pair of rollers embodied in a nylon solution applicator indicated generally at 4 where the core is subjected to a nylon solution. Briefly, this is accomplished by providing a trough or tank 5 to which nylon solution is supplied of the desired consistency and viscosity. The lower roller 6 of a pair rotates in part in the solution and may have a smooth, stainless steel surface. The upper roller 7 which is preferably driven, although either roller may be driven and the other constitute an idler, preferably has a rubber surface. Hence, the nylon core passes between rollers 6 and 7, picking up the nylon solution which will completely fill all indentations or crevices in the core. The rollers 6 and 7 also serve to remove excess solution. A more detailed description of the mechanism employed in supplying the nylon solution to the core will hereinafter appear and provide a clearer understanding of the care and precision required in supplying a solution of the proper character, temperature, viscosity and consistency, controlled to carry out the present process and to provide a continuous process.

The nylon core bearing the solution, after passing rollers 6 and 7, is passed through an oven wherein the thread is heat treated or cured in an atmosphere of approximately 380° F. to 420° F. The extent or length of the oven 8 is so correlated with respect to the rate of movement of the thread that while the thread is being so heat treated, fusion of the nylon in solution to the surfaces of the nylon core will occur. Thereafter, the thread may be passed over a lubricating roller indicated at 9, which, in a manner similar to the roller 6, rotates in a fluid lubricant or wax. The thread passing over and in contact with roller 9 has wax supplied to the surface thereof and the thread thereafter is passed through the output rollers 3 and ultimately to the wind-up bobbins.

It will be noted from the foregoing partial description of the preferred form of machine

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of my invention that it carries out my novel process inasmuch as the thread is maintained under tension while the nylon solution is applied thereto the thread is heat treated.

In carrying out my process and for the purpose of applying nylon in solution to the nylon thread or core, extreme care must be employed to provide a solution in a flow state which, in a continuous process may be applied to and will adhere to the nylon core to form a smooth surfaced thread after the excess is removed, while permitting expedient removal of said excess. Furthermore, the solution should not thereafter spread but remain fixed during heat treatment while the nylon in said solution fuses to the surfaces of the core. Therefore, the consistency, viscosity and temperature of said solution must be closely controlled.

For example, I find that a suitable solution having the foregoing characteristics and maintained at a suitable and usable consistency, may be made from nylon powder and a resin plasticizer in a suitable solvent. As an example of a suitable resin plasticizer, I may employ plasticizers such as that known by the trade name Santisizer, and suitable solvents may be alcohols and those which are available on the market under the trade names of Solox, Shellacol, Quakersol and other suitable solvents. In preparing such solutions, I have found that solutions of, generally speaking, three strengths are suitable, that is, 5%, 10% and 20% solutions by weight of nylon powder in solution. Suitable and preferable solutions are given below by way of example.

5% solution

Nylon powder	8 lbs. 2 oz.
Solvent (alcohol)	154 lbs. 6 oz.

10% solution

Nylon powder	16 lbs. 4 oz.
Resin plasticizer (Santisizer)	7 lbs. 8 oz.
Solvent (alcohol)	138 lbs. 12 oz.

20% solution

Nylon powder	32 lbs. 8 oz.
Resin plasticizer (Santisizer)	15 lbs. 0 oz.
Solvent (alcohol)	115 lbs. 0 oz.

These solutions are preferably prepared in a reflex condenser under a temperature of about 190° F. and under approximately 8 lbs. pressure, requiring one half to one hour's time in preparation. Prepared in this way, both time and the amounts of solvent required are materially reduced.

As shown in Fig. 2, a solution, prepared as above indicated, is supplied to a solution stock tank 10 and the solution therein is maintained, by means of automatically controlled heater 11, controlled by thermostat 111, at temperatures of approximately 100° F. to 150° F. depending on the solution strength. Additional solvent is stored in a tank 12 and is supplied to the solution in tank 10 by means of pipe line 13 which embodies a control valve 14. A viscosimeter 15 is subjected to the solution in the stock tank to provide a measure of the viscosity thereof, and when the solution viscosity increases above a predetermined amount, a circuit is established by the meter which energizes motor 16 which in turn is operated in a direction to open valve 14 and thereby admit more solvent to the solution. Variations of the viscosity below the desired value will not be appreciable and therefore, as a prac-

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tical matter, only the supply of additional solvent is controlled.

The solution from stock tank 10 is circulated through the tank 5 of the solution applicator 4 as by means of pipe lines 15 and 16. As shown in Fig. 2, a plate or overflow dam 17 is disposed adjacent one end of the tank 5 to form a well 18 between it and the adjacent end of the tank. In this manner, the interior of the tank is subdivided into two compartments. In one compartment the roller 6 rotates in the solution which is supplied thereto by the pipe line 15 while the solution which overflows the dam or plate 17 is pumped back by means of pump 19 in pipe line 16 to the stock tank. The dam preferably maintains the solvent level at about the axis of roller 6. The pipe line 15 also preferably includes pump 20 and a control valve 21 which may be adjusted to establish a desired rate of flow. Both pumps 19 and 20 may be driven by the same motor 22 if desired. In this manner, since the level of the solution in tank 5 is maintained substantially constant and since the consistency of the solution, its viscosity and the percentage of nylon powder in solution is carefully controlled, the nylon solution may be continuously applied to a thread or core by means of the roller 6 and this solution will fill the grooves crevices or indentations in the surface of such thread or core while the excess, and the excess only, may be removed by virtue of the passage of the thread between the rollers 6 and 7. The solution applicator 4 preferably embodies a casing 23 supporting tank 5 and housing a heater 23a to heat the tank 5 to temperature sufficient to maintain the viscosity of the solution comparable to that in the stock tank.

The nylon thread or core hereinbefore referred to as employed in the process of the present invention may comprise a single filament or multi-filament thread. Multi-filament threads ordinarily comprise a plurality of small filaments twisted one upon the other to produce a multi-filament thread of the desired denier size. Several twisted filaments may be combined by plying or by cabling depending upon the requirements of the trade. However, all of these types of nylon thread or cores may be processed, as hereinabove described and in accordance with my invention, to produce threads having greatly improved properties of the character hereinabove pointed out.

For a better understanding of the novel nylon thread of my invention, I have shown in Figs. 4 through 9, the appearance of conventional nylon threads before and after treatment in accordance with the present invention. In Fig. 4 I have shown a single filament, cylindrical nylon core or thread 24 which may be obtained by any conventional thread forming process such as by extrusion and the like. Fig. 4 shows the thread in a highly magnified manner in order clearly to illustrate the surface irregularities therein. Fig. 5 shows, again in a highly magnified manner, the appearance of the nylon thread or core of Fig. 4 after being processed in accordance with this invention. It will be noted that the indentations of the core 24 are filled with nylon as indicated in the zones 25 which have become fused to the surface of the core. Since the excess of nylon solution has been removed, the cylindrical surface of the finished thread is substantially smooth and even as compared to the surface of the original core.

In Fig. 6 I have shown a multi-filament thread or core 26 which comprises, for example, three twisted nylon filaments 27, 28 and 29, as shown

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in Fig. 7. It will be noted that the surface of this thread is very irregular due to the grooves formed between adjacent filaments. When the thread or core of Fig. 6 is processed in accordance with my invention, it will have the appearance of that shown at 31 in Figs. 8 and 9 wherein the grooves are filled with nylon as indicated at 32 which is fused to the surfaces thereof and lie substantially flush with the peaks of the filaments to thereby form a thread of cylindrical cross-section, as clearly shown in Fig. 9, having a smooth even surface. In all cases, the finished thread of my invention consists of a homogeneous nylon mass.

By virtue of the fact that in performing the process of my invention, the nylon core is placed under tension sufficient to produce elongation thereof and by virtue of the fact that the nylon in the solution is fused thereto while the core is under tension and is heat treated at temperatures of approximately 380° F. to 420° F. or at temperatures slightly under the fusing temperature of nylon, the finished thread will be extremely stable and of a greatly improved surface finish, being smooth and even throughout. As a further result, the finished thread will have lower percentage elongation; will be of improved strength especially for very fine threads; and will be endowed with generally improved properties. For example, in the case of twisted threads, the nylon which is fused thereto greatly stabilizes the thread, that is to say, percentage elongation is reduced to approximately 10% to 15% and the finished thread has very little tendency to twist and snarl after the thread has been tensioned and the tension then slackened or removed. For example, Fig. 10 demonstrates the tendency of ordinary nylon threads to twist and snarl after subjection to tension and upon the removal of such tension. It will be noted that the thread 33 of Fig. 10 has snarls as indicated at 34 and is twisted as indicated generally at 35, usually many, many times. Fig. 11 illustrates how the finished thread of my invention performs under similar conditions based upon actual test data. The thread 36 of this invention as shown in Fig. 11, after being tensioned and the tension thereafter relieved, will drape substantially as shown, completely without snarling and with practically no twist upon itself. If a specimen about three feet long is tensioned and then relaxed, it may twist two or three times in a loose manner but this is still well below normal specifications in the trade.

As hereinabove indicated, the finished thread of my invention is well adapted for high speed machine use such as high speed sewing machines, being capable of successful operation without breakage at shuttle speeds as high as 5,000 R. P. M. This is primarily due to its greatly improved surface and also to its low percentage elongation and improved strength. Also, its reduced tendency to twist and snarl greatly enhances its adaptability for such use.

It has also been observed that my improved nylon thread is less susceptible to humidity and ambient weather conditions. Such conditions noticeably affect former nylon threads while threads of the present invention have been successfully employed without any appreciably altered performance characteristics in high speed machines while under varied conditions of temperature and humidity.

While I have described my invention in its preferred embodiments, it is to be understood

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that the words which I have used are words of description rather than of limitation and that changes within the purview of the appended claims may be made without departing from the true scope and spirit of my invention in its broader aspects.

What I claim is:

1. In a thread processing machine comprising input rolls, a heating oven and output rolls, said output rolls being driven at a higher rate than said input rolls and said rolls being adapted to pass a thread through the input rolls, the heating oven and the output rolls and apply a tension thereto, a solution applicator positioned to receive said thread between the input rolls and said oven and comprising means for applying solution to said thread and for removing excess solution from said thread, a stock tank for containing a supply of said solution, means for heating said stock tank, means for measuring the viscosity of the solution in said stock tank and means responsive to said viscosity-measuring means for controlling the supply of a solvent to said stock tank to thereby control the viscosity of said solution, and means for circulating solution between said stock tank and said applicator, and means for heating the solution in said solution applicator to maintain the viscosity of the solution in the applicator and stock tank substantially the same.

2. In a thread processing machine comprising input rolls, a heating oven and output rolls, said output rolls being driven at a higher rate than said input rolls and said rolls being adapted to pass a thread through the input rolls, the heating oven and the output rolls and apply a tension thereto, a solution applicator positioned to receive said thread between the input rolls

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and said oven and comprising a solution tank and a pair of frictionally engaging rolls, one of said frictionally engaging rolls being disposed in part within said tank to rotate in the solution therein, a stock tank for containing a supply of said solution, means for heating said stock tank and means for controlling the temperature of the solution therein, means for measuring the viscosity of the solution in said stock tank and means responsive to said viscosity-measuring means for controlling the supply of a solvent to said stock tank to thereby control the viscosity of said solution, and means for circulating solution between said stock tank and the tank of said applicator, and means for heating the solution in said solution applicator tank to maintain the viscosity of the solution in the applicator and stock tanks substantially the same.

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