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APPARATUS AND METHOD FOR CRIMPING OF NATURAL AND SYNTHETIC TEXTILE MATERIAL

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Fig. 1

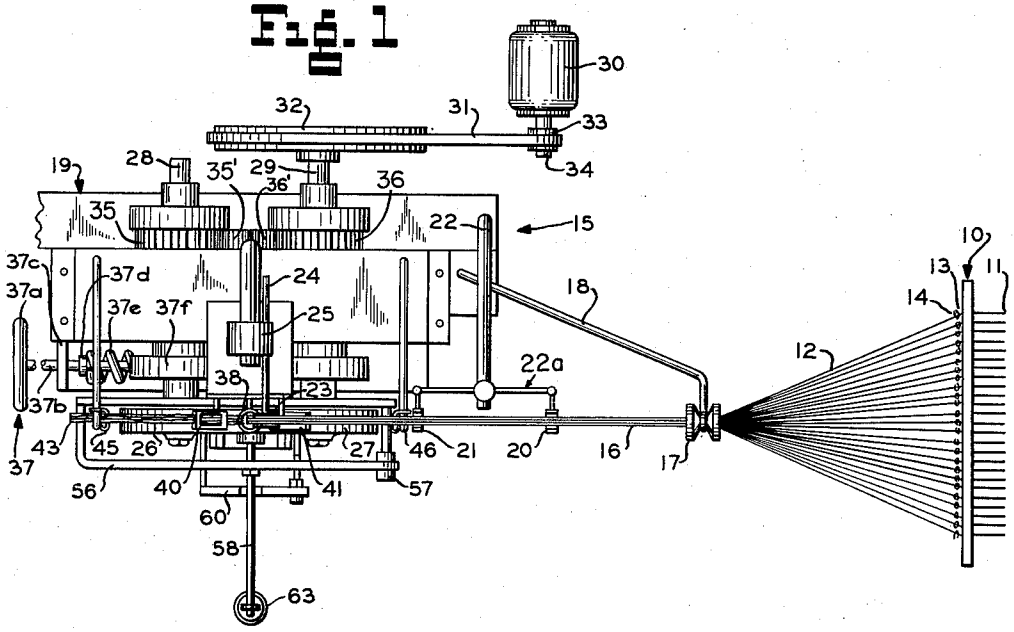
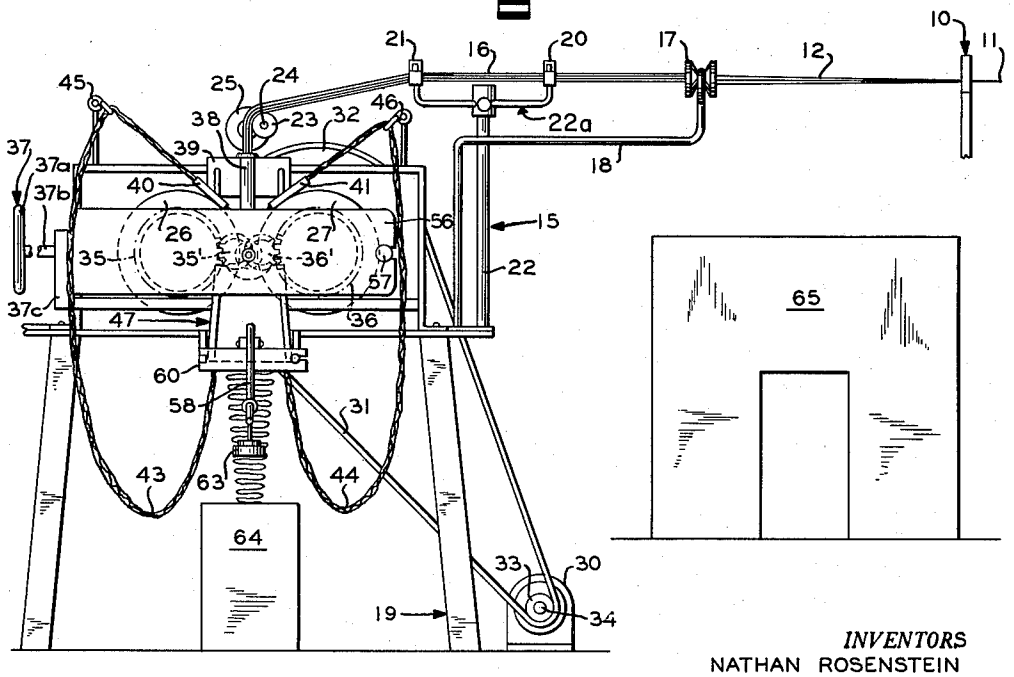


Fig. 2



INVENTORS
NATHAN ROSENSTEIN
ABRAHAM J. ROSENSTEIN

BY Joseph F. Padlon
ATTORNEY

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APPARATUS AND METHOD FOR CRIMPING OF NATURAL AND SYNTHETIC TEXTILE MATERIAL

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Fig. 7

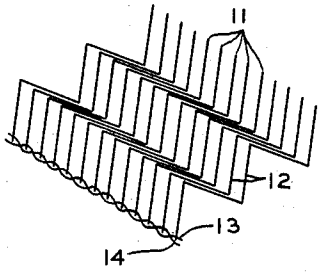
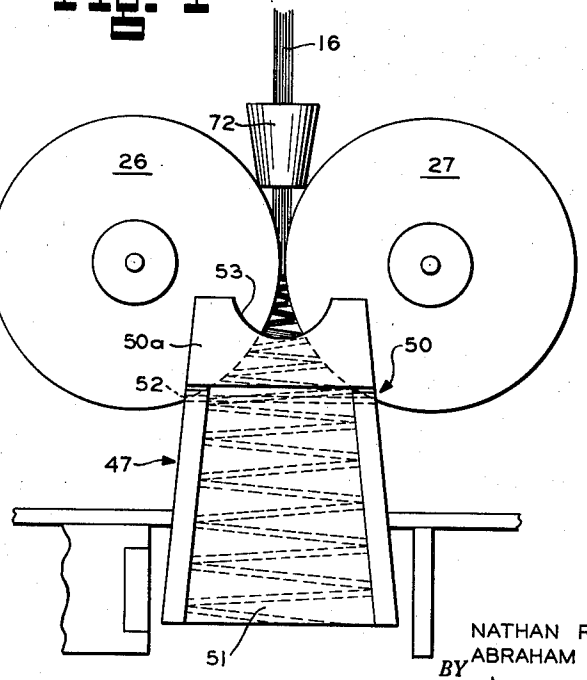


Fig. 5

Fig. 4



INVENTORS
NATHAN ROSENSTEIN
ABRAHAM J. ROSENSTEIN
BY Joseph F Padlon
ATTORNEY

Fig. 5

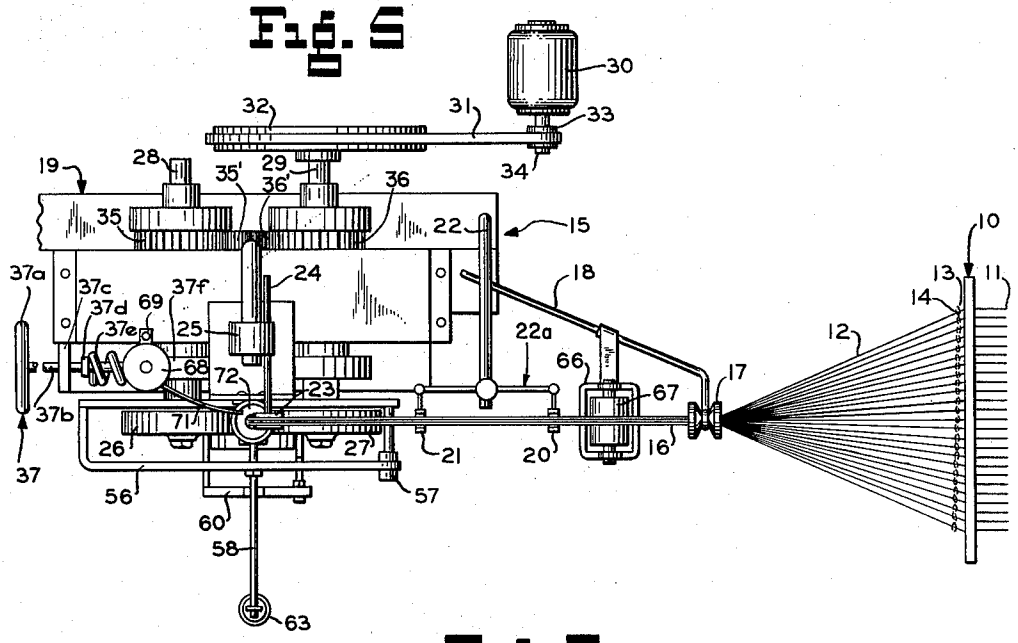
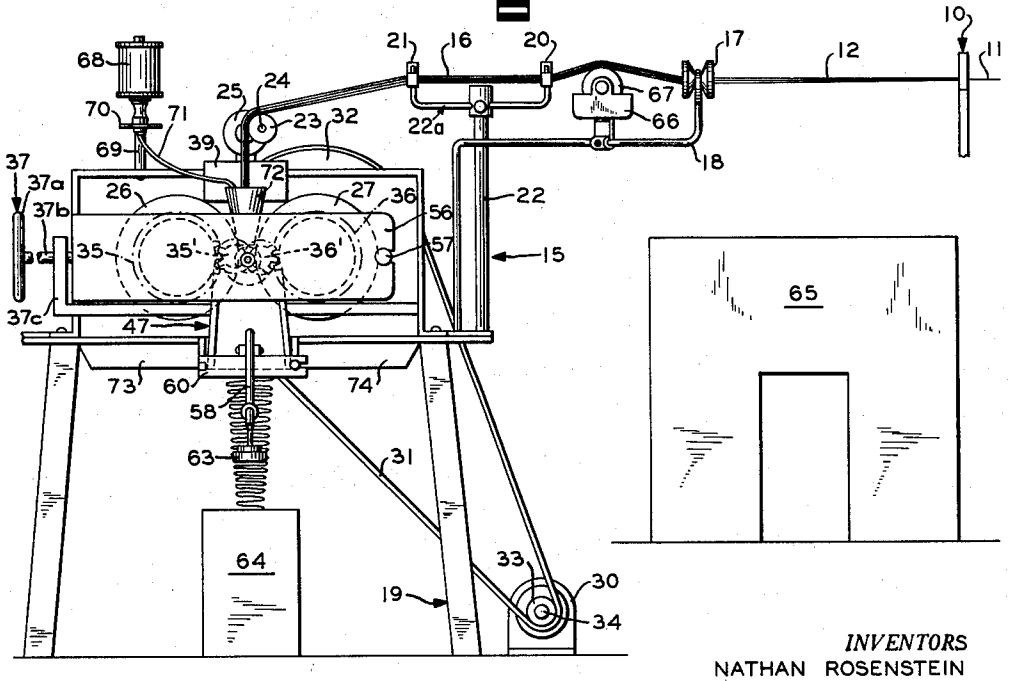


Fig. 6



INVENTORS
NATHAN ROSENSTEIN
ABRAHAM J. ROSENSTEIN
BY Joseph F. Sullivan
ATTORNEY

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APPARATUS AND METHOD FOR CRIMPING OF NATURAL AND SYNTHETIC TEXTILE MATERIAL

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Fig. 8

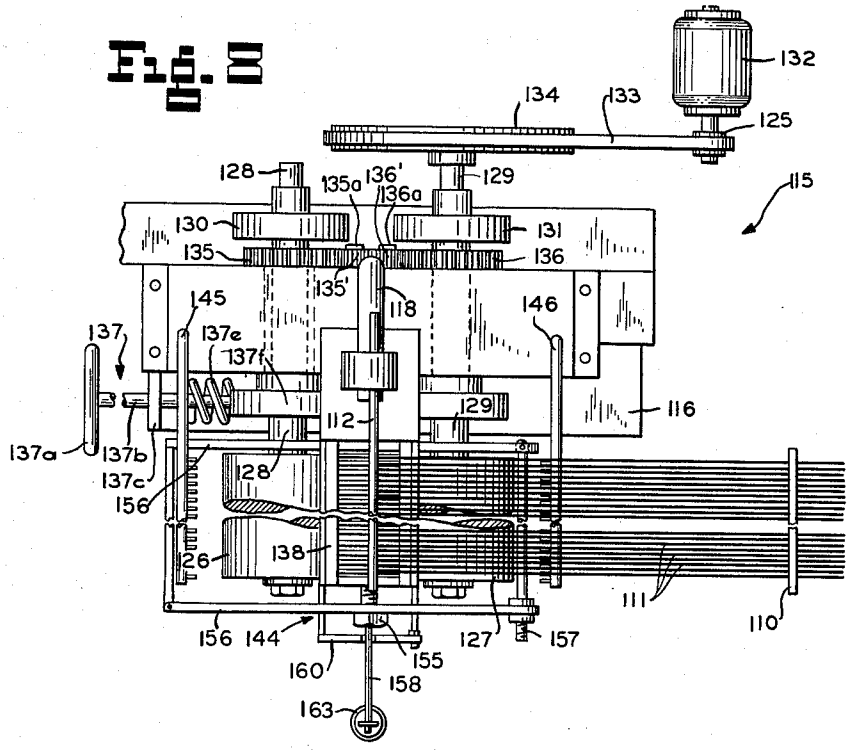


Fig. 9

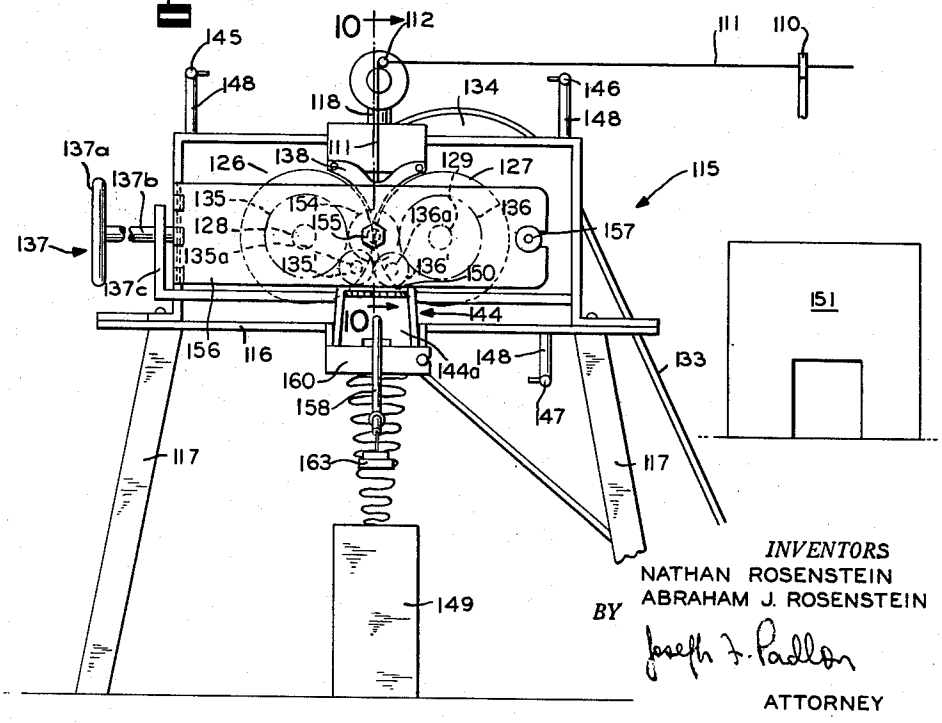


Fig. 10

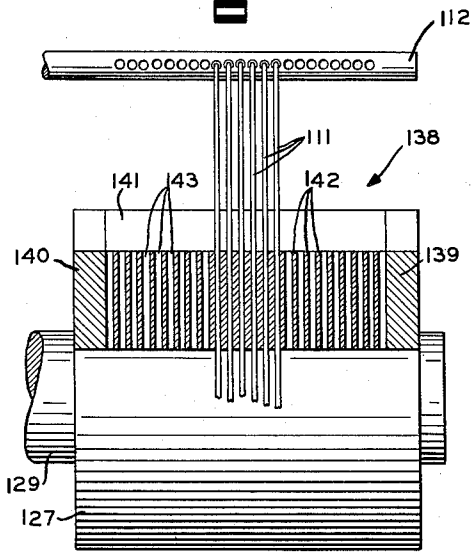


Fig. 12

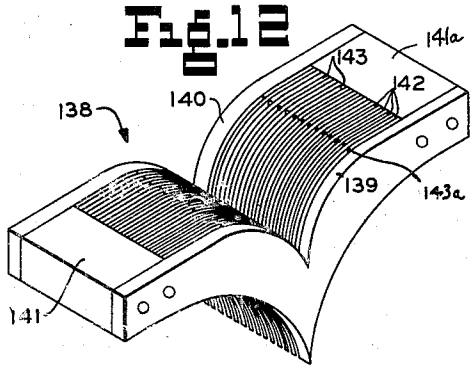


Fig. 11

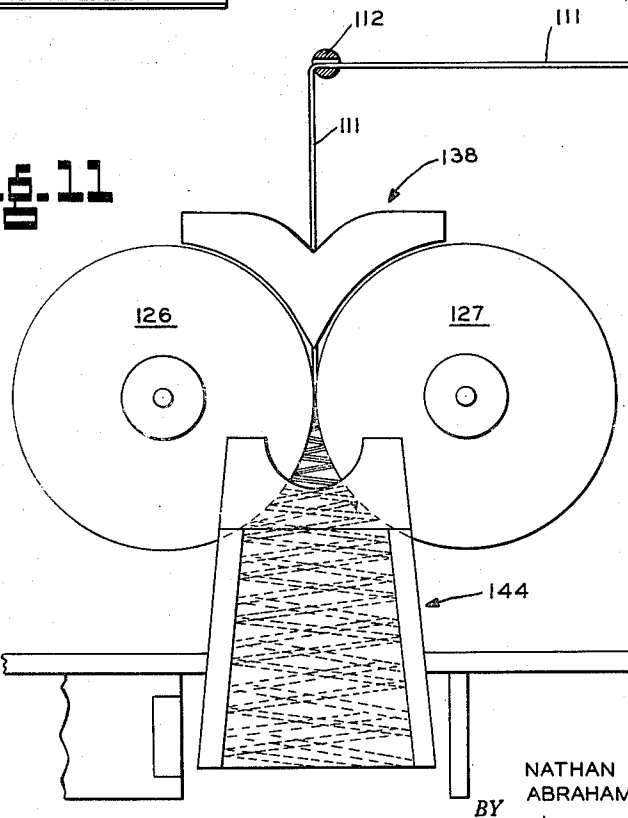
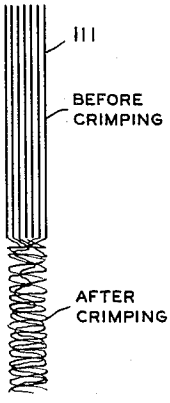


Fig. 13



INVENTORS
NATHAN ROSENSTEIN
ABRAHAM J. ROSENSTEIN
BY
Joseph F. Padlon
ATTORNEY

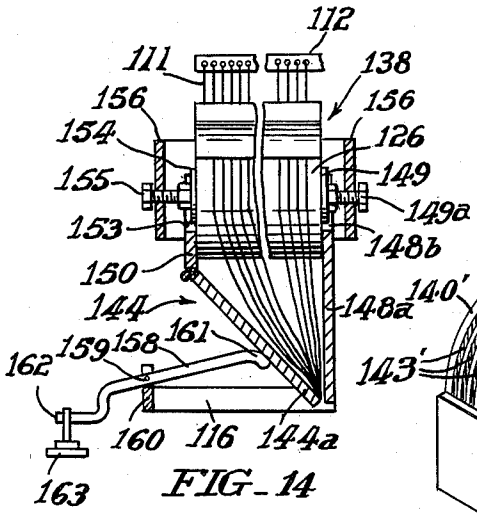


FIG. 14

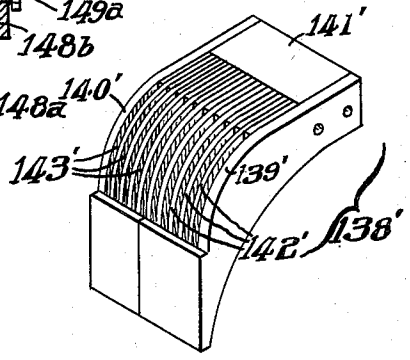
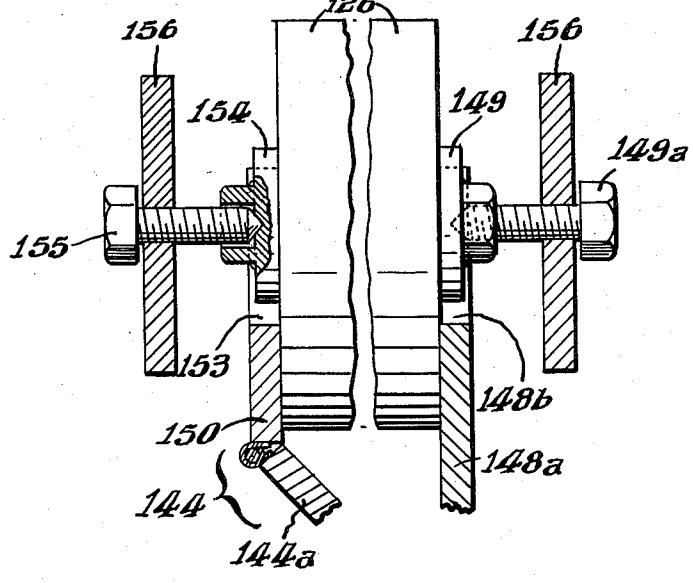


FIG. 15

FIG. 16



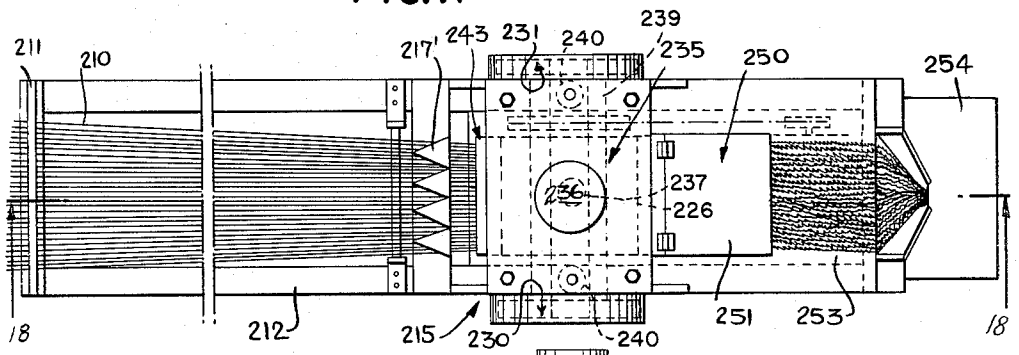
INVENTORS.
Nathan Rosenstein &
Abraham J. Rosenstein,

Jan. 12, 1965 N. ROSENSTEIN ETAL 3,164,882

APPARATUS AND METHOD FOR CRIMPING OF NATURAL AND SYNTHETIC TEXTILE MATERIAL

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FIG. 17



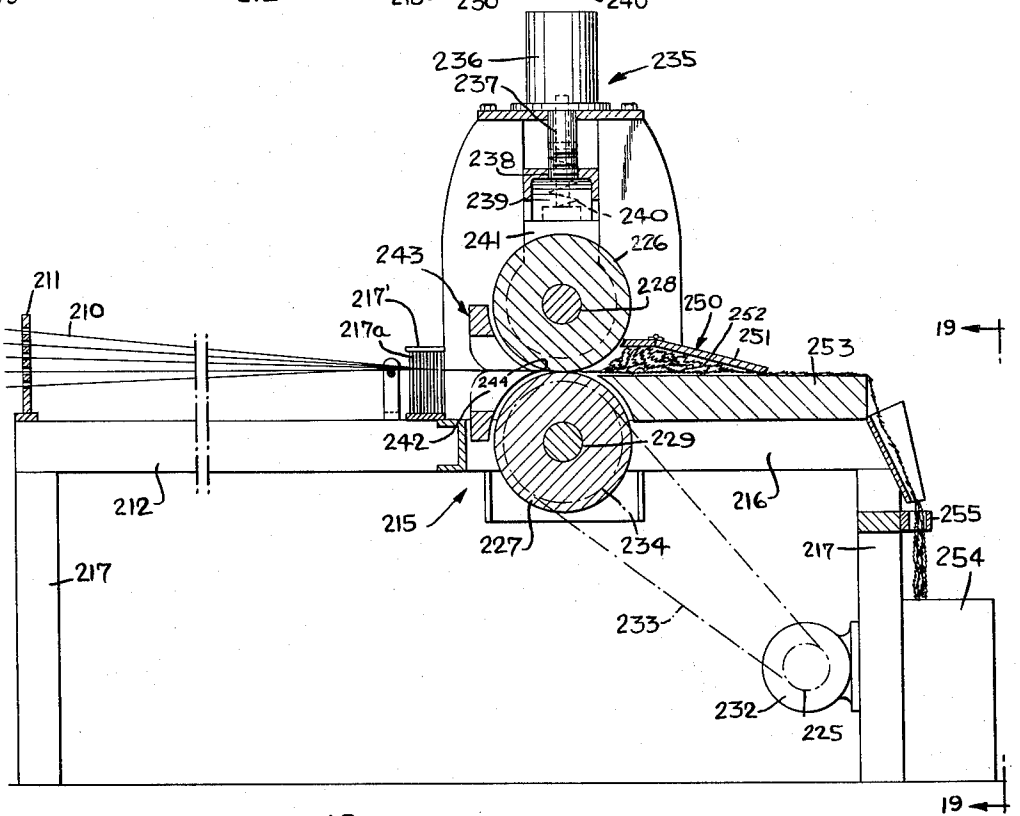


FIG. 18

INVENTORS
NATHAN ROSENSTEIN
ABRAHAM J. ROSENSTEIN
BY
Joseph F. Sudlow
ATTORNEY

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APPARATUS AND METHOD FOR CRIMPING OF NATURAL AND SYNTHETIC TEXTILE MATERIAL
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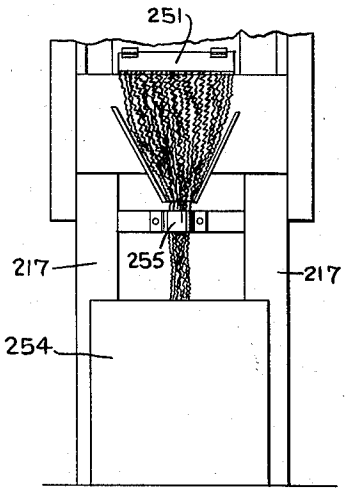


FIG. 19

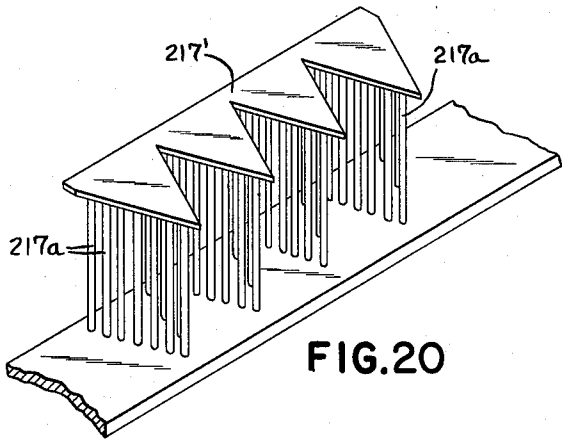


FIG. 20

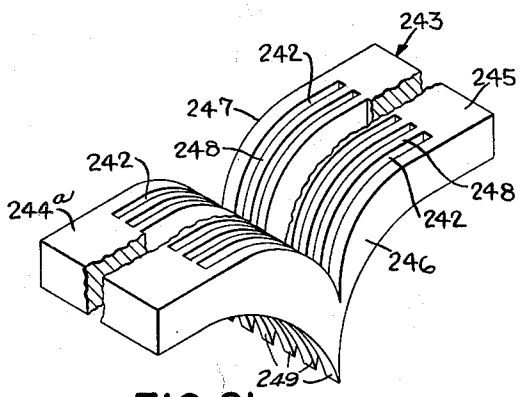


FIG. 21

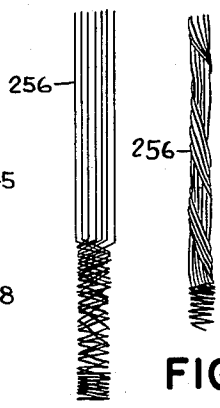


FIG. 22

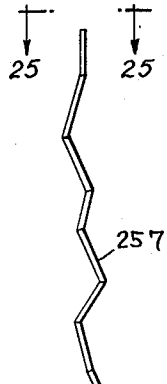


FIG. 23

FIG. 24

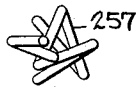


FIG. 25

INVENTORS
NATHAN ROSENSTEIN
ABRAHAM J. ROSENSTEIN
BY
Joseph F. Padlon
ATTORNEY

United States Patent Office 3,164,882 Patented Jan. 12, 1965

3,164,882

APPARATUS AND METHOD FOR CRIMPING OF NATURAL AND SYNTHETIC TEXTILE MATERIAL

Nathan Rosenstein, West Hartford, Conn., and Abraham J. Rosenstein, New Marlboro, Mass., assignors to Spunize Company of America, Incorporated, Unionville, Conn., a corporation of Connecticut

Filed Sept. 19, 1960, Ser. No. 57,070
12 Claims. (Cl. 28—1)

This application is a continuation-in-part of our co-pending applications Serial No. 519,052, filed June 30, 1955, which application was a continuation-in-part of our then co-pending application Serial No. 165,286, filed May 31, 1950, now U.S. Patent No. 2,715,309, Serial No. 556,589, filed December 30, 1955 and Serial No. 706,485, filed December 31, 1957, all of which applications are now abandoned.

This invention relates to apparatus and method for the crimping of natural and synthetic fibers, filaments, yarns, tows, slivers and rovings, and to products thereof. More particularly, this invention relates to a method of and means for crimping and heat-setting a plurality of continuous filament synthetic yarns to obtain a permanent, continuously crimped filament yarn of a synthetic resin.

This invention further relates to means for and a method of processing fibers which heretofore could not be crimped because of their inability to withstand stresses or strains exerted on the same transversely of their longitudinal axes. Also, this invention relates to means for individually crimping and heat-setting a plurality of continuous filament, synthetic yarns to obtain permanently crimped yarns, wherein the individual filaments of each yarn are permanently crimped.

This invention relates still further to means for crimping synthetic or natural filaments, fibers, yarns, tows, slivers and rovings to obtain crimped filaments or fibers wherein the individual fibers or filaments are crimped at different planes and/or angles relative to the longitudinal axes thereof. Also, this invention contemplates and provides for producing crimps in the fibers or filaments in a random angle or zig-zag pattern arrangement where each portion of a crimp may be bent with respect to the longitudinal axis of the yarn at a controlled angle in the range of from about 30° to about 180°.

This invention further relates to the crimping of rovings, or tows, the fibers or filaments of which have been pre-cut and paralleled in suitable staple lengths for conventional spinning to enable drafting and spinning of each highly crimped filaments or fibers that would be difficult to card because of the high angle of crimp that normally resists carding due to the angle of the crimp or due to the excessive number of crimps per inch.

Synthetic continuous filament yarns as distinguished from synthetic spun yarns as now used have certain latent disadvantages which have limited their use. It will be noted that such continuous filament yarns as nylon, "Orlon," glass fiber yarns, saran, Fiber V, Dynel, and other continuous filament yarns have a smooth, slippery, wire-like and or glass-like appearance. Of the aforesaid yarns, "Orlon" is a trade-marked item comprising a polymer of acrylonitrile and is also known as an acrylic resin; saran, also known as "Velon," is a copolymer of vinyl chloride and vinylidene chloride; "Dynel," also known as "Vinyon N," is a copolymer of vinyl chloride and of acrylonitrile, and Fiber V, is a trademarked item comprising polyethylene terephthalate. There is little or no life or resilience in such types of continuous filament yarns due to their lack of porosity or perviousness. Furthermore, such textiles are so dense and non-permeable that there is little air insulation in them. Fabrics made from such

yarns generally do not drape well and are difficult to sew and handle. Also, such continuous filament material in its heretofore used form is difficult to use either as a sewing thread or as a fabric where subsequent coating or covering is required, because of its non-adhesive or slipping properties. Such types of continuous filament yarns, because of the disadvantages hereinabove indicated, greatly limit their use for commercial and industrial purposes.

In the use of such continuous synthetic filament yarns, and other types of continuous filament yarns for the production of textiles, wearing apparel, sewing thread and industrial products, it will be noted that the individual continuous filaments thereof lack bulkiness, flexibility, life, softness, resilience and air space between them to permit "breathing" therethrough. Furthermore, in such yarns there is a great tendency towards pilling. Such disadvantages of these types of continuous filament yarns have prevented the fullest use to which the same can be applied.

While some of the synthetic raw material fibers for producing spun yarns are presently being crimped by other means and methods, many of such fibers and natural fibers, such as cotton, ramie and flax, do not lend themselves readily to crimping by existing means or methods, since such fibers cannot withstand the required amount of stress or strain applied transversely of their longitudinal axes. Where spun yarns are produced from uncrimped fibers for the purposes hereinabove, they possess many of the disadvantages indicated with respect to the continuous filament yarns. Furthermore, where such fibers have resisted crimping by means of previously used methods, such fibers have been most difficult and in many cases impossible to spin.

Also, although there exist devices for crimping a plurality of continuous filament yarns that have been brought together to form a rope, it is often desirable to maintain the various yarns in a flat web-like form. However, in crimping a plurality of separate and independent continuous filament yarns in a continuous filament yarn state, it has been found that the yarns develop an electro-static charge which results in ballooning of the individual filaments of each yarn thereof causing entangling of the same.

Moreover, synthetic continuous filament tows or yarns as well as yarns of staple have previously been crimped with all the angles of the crimp being substantially in one plane. Also, previous crimps had to be limited in number per inch and amplitude to enable carding. Fabrics made from such yarns while having some bulk are limited in use because of the single plane crimp or the amplitude and number of crimps per inch. For example, where a conventional spun yarn made of conventionally crimped staple affords a bulking index of 100, a yarn spun from staple yarn crimped according to the present invention affords a bulking index of 1790 or approximately eighteen times the bulk of a conventionally crimped spun yarn. Also such crimped yarns in their heretofore used form are difficult to use in the spinning and bulking effects of fine yarns. Such types of continuous filament yarns or spun yarns because of the disadvantages hereinbefore indicated, greatly limit or restrict their use for commercial and industrial purposes.

Accordingly, it is an object of the present invention to provide a method of and means for continuously processing synthetic continuous, untwisted or twisted filament yarns to form permanently fixed, novel, crimped yarns.

It is another object of this invention to provide means for continuously crimping continuous synthetic filament yarns and then setting the resultant crimped filaments within each continuous filament yarn for subsequent use.

It is another object of this invention to process synthetic continuous filament yarn in which the yarn and its component filaments are untwisted or twisted, said

yarn having the bulkiness, resilience, flexible texture and breathing characteristics of a crimped spun yarn.

It is another object of the present invention to provide a novel method of and means for crimping natural and/or synthetic yarns as apart from yarns which heretofore could not be crimped because of their inability to withstand stresses or strains transverse to the longitudinal axes thereof.

It is another object of this invention to provide a device for crimping tows of continuous filament material wherein each component may be a multifilament or monofilament yarn, such device having lubricating and saturating means for the wet crimping of said yarns.

It is another object of the present invention to provide a method of and means for the pretreatment of tows of continuous mono or multifilament yarns including wetting the same preparatory to continuously crimping the same.

It is another object of the present invention to provide a means and method for the wet crimping of tows of continuous monofilament or multifilament yarns to prevent fraying of the individual yarns.

It is another object of the present invention to provide means for continuously processing synthetic continuous filament yarn to form a permanently fixed, crimped yarn while keeping the various yarn components separate, but in a web-like form.

It is another object of this invention to provide means for continuously crimping a plurality of separate continuous, synthetic filament yarns in such a manner to permit additional leasing whereever or whenever necessary after crimping and crimp setting.

It is another object of this invention to provide a crimping process which permits separating continuous synthetic filament yarns more effectively after crimp setting of the same.

It is another object of the present invention to provide apparatus for maintaining a plurality of synthetic filament yarns separate while simultaneously crimping the plurality of yarns.

It is another object of the present invention to provide means for continuously dividing and leasing a plurality of continuous filament yarns while being individually crimped in an antielectro-static field to prevent the entangling of the yarns.

It is another object of the present invention to provide means for continuously processing untwisted or twisted filament yarn or tow to form a fixed separate crimped yarn or tow but in a web-like form whose component filaments are splayed and crimped in a zig-zag multi planar arrangement.

It is another object of this invention to provide a process for more effectively maintaining separate continuous filament yarn during the crimping of the same to provide a zig-zag high bulk around the longitudinal axis of the resultant yarn.

It is another object of the present invention to provide apparatus for maintaining a plurality of filament yarns or rovings separate while simultaneously crimping the individual filaments of such plurality of yarns or rovings whereby there are obtained individual yarns or rovings whose filaments are crimped at different angles with respect to the longitudinal axis thereof and in the form of a zig-zag angular arrangement up to 180°.

It is another object of the present invention to provide means for continuously dividing and splaying a plurality of continuous filament yarns, slivers, rovings, or tows while the filaments thereof are being individually crimped.

It is another object of the invention to provide spacer, dividing means for maintaining tows, slivers, rovings, or yarns about to be crimped in spaced relation whereby the resultant product will have crimps at varied zig-zag multiplanar angles with respect to the longitudinal axis of the resulting individual yarns, slivers, rovings, or tows.

It is another object of this invention to obtain a continuous filament yarn or tow whose filaments are provided with a succession of crimps, bends or kinks formed at different angles relatively of the axis of the yarn or tow so that there is effected a high bulk, splayed crimped yarn or tow.

It is another object of the present invention to provide a method of crimping rovings or tows wherein the fibers or filaments of which have been precut and paralleled in suitable staple lengths for conventional spinning to enable drafting and spinning of such higher crimped fibers or filaments that otherwise would ordinarily be difficult to card because of the high angle of crimp which would normally resist carding or due to the excessive number of crimps per inch.

Other objects and advantages of this invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a plan view showing a device for processing synthetic continuous filament yarns according to our invention;

FIG. 2 is a front elevational view of FIG. 1 including a setting oven used according to the process hereinafter described;

FIG. 3 is a fragmental detail sectional view of a portion of the device shown in FIG. 1, the sheathings being omitted for purposes of clarity;

FIG. 4 is a front view of the detail shown in FIG. 3;

FIG. 5 is a plan view of a modification of the embodiment shown in FIG. 1;

FIG. 6 is a front elevational view of FIG. 5 including a setting oven used according to the process hereinafter described;

FIG. 7 is an enlarged perspective view of a portion of the processed continuous filament yarns showing the tied ends thereof and which have been treated according to the process hereinafter described;

FIG. 8 is a plan view showing another device for processing synthetic continuous filament yarns according to the present invention;

FIG. 9 is a front elevational view of FIG. 8 including a setting oven used according to the process hereinafter described;

FIG. 10 is an enlarged fragmental view taken on the line 10—10 of FIG. 9;

FIG. 11 is an enlarged front view of a portion of the apparatus shown in FIG. 9;

FIG. 12 is a perspective view of a portion of the apparatus shown in FIG. 9;

FIG. 13 shows an exaggerated somewhat enlarged view of a yarn comprising a plurality of filaments before and after it has been crimped in the apparatus of the present invention, and wherein the constituent filaments of the yarn appear substantially in overlapping and web-like form;

FIG. 14 is a detailed fragmental sectional view of the apparatus shown in FIG. 11;

FIG. 15 is a view in perspective of a modification of the leasing and dividing device as constructed according to this invention;

FIG. 16 is an enlarged fragmental view partly in section showing a detailed portion of the crimping apparatus as constructed according to this invention and illustrated in FIG. 14;

FIG. 17 is a plan view of a still further embodiment of our invention for processing filaments, yarns, slivers, rovings and fibers;

FIG. 18 is a sectional view of FIG. 17, taken on line 18—18 thereof;

FIG. 19 is an end view taken on the line 19—19 of FIG. 18;

FIG. 20 is a perspective view of a portion of the apparatus shown in FIGS. 17 and 18;

FIG. 21 is a perspective broken view of a portion of the embodiment shown in FIG. 17;

FIG. 22 shows an exaggerated, somewhat enlarged view of a yarn comprising a plurality of filaments before and after crimping in the apparatus, and wherein the constituent crimped filaments of the yarn appear substantially in overlapping and web-like form and the crimp being in random, zig-zag multiplanar fashion with respect to the longitudinal axis of the yarn;

FIG. 23 illustrates a half turn twist of yarn or roving of a non-continuous filament nature;

FIG. 24 is an enlarged longitudinal view of a single filament of yarn partly distended and showing the variable crimp at different angles with respect to the longitudinal axis of the yarn; and

FIG. 25 is a top view taken on line 25—25 of FIG. 24 showing the crimps with respect to the normal longitudinal axis of the yarn.

Referring now to the drawings in which similar reference characters denote like parts throughout, it will be noted that by the hereinafter described method forming part of this invention, individual continuous filament yarns also known as long chains or tows of yarn, in single or ply, in all usable deniers or twists, are passed through a standard type of ball warping machine, not shown, with leasing arrangements **10** in which the ends **11** of each of the continuous filament yarns **12** are initially leased by means of cross-leasing threads **13** and **14** of the same material as the yarns but preferably of a different color for purposes of identification passing through the leasing arrangement. Since ball warping machines are well known in the art, it is not believed necessary to show the details of the same herein. It is to be understood that the term "chains" whenever used herein is intended to mean skein or tow.

It will be noted that the number of individual continuous filament yarns **12** will depend upon the denier of the yarns and the capacity of the equipment hereinafter described, and that said yarns **12** may be drawn longitudinally onto a ball warp so as to produce a long skein of yarn of longitudinally extending continuous filament yarns in the shape of a rope. Furthermore, and in the alternative, a plurality of continuous filament yarns of the mono or multifilament type may be passed through any type of leasing arrangement, such as shown at **10** in FIG. 1, where each end of the filament yarns is individually and initially leased and then fed directly according to the process into a crimping device **15**, as shown in the drawings, and the details of which will be more fully described hereinafter. Said resultant rope or skein or tow **16** after leasing of the component filaments is passed through an annular guide member **17** held in rigidly fixed position by means of a support member **18** mounted on frame **19** in any suitable manner.

For purposes of better understanding of this invention, the term "rope" means a bundle of or a plurality of continuous filament yarns, or a skein or tow of yarns, whether said yarns are parallel with each other or are twisted relatively of each other. A filament yarn according to the present invention encompasses a solid continuous single filament or a multiplicity of filaments formed by extrusion under pressure of a liquid or solution into a solidifying medium.

Said rope **16** after having passed through guide member **17** is passed through a plurality of subsidiary guides **20** and **21** disposed preferably in alignment with guide **17** and mounted on an adjustable yoke **22***a* which is pivoted on a support member **22** fixed on said frame **19** in any suitable manner, such as shown in the drawings. Said rope or bundle or long chain of yarns next passes onto a roller member **23** mounted on a horizontally disposed shaft **24** fixed to an adjustable upright **25**. Said device **15** with its frame **19** is provided with a pair of vertically disposed peripherally smooth pressure rollers **26** and **27**, respectively mounted to shafts **28** and **29**. One of said shafts is driven by means of a power unit **30** through a drive chain **31** inter-connecting sprocket **32** fixed to said shaft **29** and a sprocket **33** fixed to shaft **34** of power unit **30**. Said motor drives a gear **36** which in turn drives intermediary gear **36'** meshed with a gear **35'** driving gear **35** affixed to shaft **28** so as to simultaneously rotate rollers **26** and **27** in a counter-rotary manner.

It will be noted that said rollers are adapted to rotate in a relatively counter-clockwise direction and are in tangential relation with each other on their point of contact with the material as shown more clearly in FIG. 4. As shown, said rollers are not in actual contact because of the presence of the yarn rope **16** therebetween. The pressure of one of said rollers can be relatively adjusted with respect to the other by means of a spring tension regulating unit **37**, which is provided with a handle **37***a*, a threaded shaft **37***b* extending through a threaded opening in bracket **37***c* and having a stop **37***d* for a pressure spring **37***e* which presses against a housing **37***f*. By operating the handle **37***a*, the housing **37***f* containing shaft **28**, can be moved laterally with respect to the other shaft **29**. Said unit **37** is provided in order to permit a slight yielding movement of roller **26** with respect to roller **27** when the long skein or tow or bundle **16** is passed between them. Adjustment of the handle **37***a* turns the threaded shaft **37***b* extending through the opening in bracket **37***c*, thereby compressing the spring **37***e* which in turn presses against the housing **37***f* containing shaft **28**. Clearance is provided for the movement of shaft **28**, and only a slight movement of the roll **26** toward or away from the roll **27** is contemplated in the practice of this invention. The only adjustment that is required is the small one needed to accommodate yarns of different denier, and sufficient play has been provided in the gear train to accommodate such slight movement of the roll **26** as is contemplated. The rolls are never positioned with a distance between them greater than that necessary to accommodate the denier of the particular yarns to be crimped. Disposed above said rollers **26** and **27** is a tubular guide member **38** fixed to a suitable support **39** adapted to accommodate said skein or tow or rope **16**. On each side of said guide **38** and disposed at an incline relatively to said guide in the direction of the meeting edges of said rollers **26** and **27** with the rope are oblong shaped condenser guide members **40** and **41**, respectively, fixed in any suitable manner to said support **39**. Each of said condenser guides, as shown, is provided with a rectangular opening and may be tapered at its end adjacent said guide member **38**. Said condenser guides **40** and **41** are each provided with an endless cushion apron or limp flexible sheathing **43** and **44**, respectively, which passes therethrough and which is made of a filament, sliver, knitted or woven webbing or such like material of a durable and pliable nature. Said guides, as indicated hereinabove, are preferably tapered whereby the narrowed ends adjacent the rollers **26** and **27** permit the cushion aprons **43** and **44** to form a sheath or envelope enclosing the tow or skein of continuous filament yarns **12** as said skein or tow **16** passes between the counter-rotary pressure rollers **26** and **27** so as to protect said continuous filament yarns and their surfaces from any crushing or distorting action of the rollers as the skein or tow or bundle consisting of said continuous filament yarns passes therebetween, and to cushion the pressure of the skein or tow or bundle while being bent transversely of its longitudinal axis as hereinafter indicated. Furthermore, the aprons or sheathings prevent the continuous filament yarns from being surface abraded. It will be noted that the tapered or feeding ends of said condenser or leader guides are no wider than the thickness of said rollers **26** and **27**. Said cushion aprons or sheathings **43** and **44** are shown as being endless and supported by means of members **45** and **46**, respectively.

Disposed beneath said rollers **26** and **27** and extending

upwardly on either side thereof, as shown more clearly in FIGS. 3 and 4, there is provided an enclosed housing 47 which is regulated in any suitable manner on said frame 19. The bottom of said housing is open while the rear wall 48, which is attached to the frame 19, is rigid and straight but has a curved recess 48*a* at the upper end thereof for accommodating a disc member 49 which is disposed in the area of tangential contact of said rollers 26 and 27 with the rope. The front 50 of said housing 47 is provided with an upper fixed wall 50*a* maintained in spaced relation with rear wall 48 by sidewall portions of the housing 47, and a movable truncated section or door 52 is pivoted to said front 50 by means of a removable pin 52 extending therethrough. The upper part of said front 50 is also provided with an annular recess 53 similar to recess 48*a* and is adapted to accommodate a disc 54 held in position against rollers 26 and 27 by means of a pin 55 mounted on a movable bracket 56 and held in position thereagainst by means of a hinged locking member 57. The disc members 49 and 54 comprise restraining members in the area of crimping, and serve as restraining means for the material that is contained in the edgemost areas of the crimping chamber, restraining such material against movement outwardly beyond the edges of the rolls 26, 27.

In order to keep section 51 in relatively inclined position, as shown in FIG. 3, so as to close said housing 47, there is provided a lever arm 58 pivoted at intermediate point 59 to a portion 60 of frame 19. The end 61 of said arm presses against said section or door 51 while the other end 62 of said arm is provided with a groove adapted to retain one or more weights 63.

In the modified form of the invention illustrated in FIGS. 8–16, a plurality of separate yarns 111 are passed through a guide bar arrangement 110 which serves to maintain the yarns separate and independent and in relatively parallel relation. The yarns are then passed to a perforated guide bar 112 of a crimping device 115 which includes a bed or table 116 supported by a plurality of legs 117. The guide bar 112 is mounted on an adjustable upright 118 so that its position and location may be precisely adjusted to properly guide the yarns through the leasing and crimping device as hereinafter more fully described. Said device 115 is provided with a pair of relatively adjustable, horizontally disposed, peripherally smooth, pressure rollers 126 and 127 which are mounted to shafts 128 and 129, respectively. The roller shafts are rotatably mounted in bearings 130 and 131, respectively, which in turn are secured to the framework of device 115. Shaft 129 is driven by means of a power unit 132 through a drive belt 133 interconnecting pulley 134 fixed to said shaft and a pulley 125 fixed to the shaft of motor 132. Said motor drives a gear 136 which in turn drives intermediary gear 136′ meshed with a gear 135′ driving a gear 135 affixed to shaft 128, so as to simultaneously rotate rollers 126 and 127. Gears 135′ and 136′ are affixed respectively to shafts 135*a* and 136*a* journalled in suitable bearings mounted in the frame of the apparatus. With the above described gearing arrangement, roller 126 will rotate in a clockwise direction while roller 127 rotates in a counterclockwise direction as viewed in FIG. 9.

It will be noted that said rollers are in tangential relation with each other on their point of contact with the yarns as shown more clearly in FIG. 11. Said rollers may be placed in face-to-face contact, but are not in actual contact because of the presence of the yarns 111 as will become apparent hereinafter. The pressure of one roller can be relatively adjusted with respect to the other by means of a spring or other suitable tension regulating unit 137 which is provided with a handle 137*a*, a threaded shaft 137*b* extending through a threaded opening in bracket 137*c*. Roller 126 is pressure urged against roller 127 by means of a pressure spring 137*e* or suitable device which presses against a housing 137*f*. By operating the handle, the housing 137*f* containing shaft 128 can be moved laterally with respect to the other shaft 129. Said unit 137 is provided in order to permit a slight yielding movement of roller 126 with respect to roller 127 as the yarns pass between them as discussed above with reference to FIGS. 1 to 7. The guide bar 112 which is clearly shown in FIGS. 10 and 11 has a series of perforations or holes bored therethrough. Each yarn 111 after passing through the guide bar arrangement 110 is directed through an individual hole in the guide bar 112. The yarns then pass downwardly through a novel leasing and dividing device 138 which is located directly below the guide bar 112 and above the tangential point of adjacency of rollers 126 and 127. The lease divider 138 is suitably mounted to the crimping device 115 and includes a rectangular framework comprising side members 139, 140 and a pair of end members one of which 141 is clearly shown in FIG. 10. This rectangular framework supports a plurality of thin flat sheet metal strips 142 which together define a series of slots 143 through which the individual yarns 111 pass. In the divider 138, the plates or strips 142 may be so set or adjusted with respect to each other in the framework to allow for change in size of the intermediate slots 143 to provide for different deniers of the yarns.

It is to be noted that between alternate metal strips 142, there are set filler members 143*a* which act as stops whereby certain of the yarns can be segregated from the others by moving some of the yarns over to either unblocked ends of the slots 143 and moving other yarns in the alternate slots wherein movement thereof is impeded. In other words, the device 138 acts both as a guide for the individual yarns and also as a divider for the individual yarns so that the ends thereof may be leased at certain intervals for subsequent separation or treatment. The flat strips 142 are generally V-shaped as more clearly seen in FIGS. 9 and 11. The points of the depending V-shaped strips are aligned and directed toward the tangential line of the rollers to direct the yarns therebetween. It is seen then that by means of the guide bar arrangement 110, guide bar 112, and leasing device 138, the yarns are maintained separate and parallel with each other before they pass to the crimping rollers 126 and 127. It is, of course, noted that these rollers are elongated and of such length as to accommodate the series of parallel adjacent yarns 111. Disposed beneath the rollers is a housing 144 as more clearly seen in FIG. 11. As the yarns are drawn down between the rollers they enter the housing 144, where they are crimped and are retained in the housing in a crimped or folded condition, that is, disposed angularly with respect to the longitudinal axis of the individual continuous filament yarns. The yarns thus accumulate in the housing in a manner to be described more fully hereinafter in connection with still another modification of the invention. In lieu of the divider 138 as shown, there may be provided a unit merely having individual plates extending downward over one roller and of half the shape shown in FIG. 12 as appears in FIG. 15 in which the elements 139′, 141′, 142′ and 143′ correspond to the similarly numbered elements of FIG. 12.

As the yarn passes through the crimping device 115 as above explained, the friction between the yarns and the various elements of the device over which they pass cause electro-static charges to build up. With the yarns thus electrically charged they tend to repel each other after passing between the rollers and thereby cause bunching and tangling. In order to prevent this, the present apparatus provides a plurality of static eliminators 145, 146 and 147, as shown in FIGS. 8 and 9. These eliminators are suitably mounted on the crimping device by means of supports 148. The supports are preferably made of insulating material so that the eliminators

are insulated from the framework of the crimping device 115. Eliminators 145, 146 and 147 are connected to a source of electricity, not shown, and are thereby charged. Each eliminator comprises a straight, circular shaped bar having a series of projections thereon as more clearly seen in FIG. 8. It is readily understood then that with the eliminators connected to a source of electricity, an antistatic field will be set up in the area of the yarns 111. In this manner, any charge that would normally build up on the respective yarns will be drawn off leaving the yarns in an electrically neutral condition so that they will not repel each other and become entangled.

The housing 144 is open at the bottom thereof as shown in FIG. 14 while a front wall 150, part of which is pivoted to the housing, forms a movable portion or door 144*a*. A rear wall 148*a* of the housing 144 is fixed and has a curved recess 148*b* at the upper end thereof for accommodating a disc member 149 which is disposed in the area of tangential contact of said rollers 126 and 127 with the yarns. Said disc is retained in position by means of a bolt member 149*a* extending through the rear of bracket 156. The upper part of said front wall 150 is also provided with an annular recess 153 similar to recess 148*b* and is adapted to accommodate a disc 154 held in position against rollers 126 and 127 by means of a bolt or screw pin 155 mounted on bracket 156. It is to be noted that the front of bracket 156 is firmly held in position by means of a hinged locking member 157 shown in FIG. 8.

In order to keep pivotal wall 144*a* in relatively inclined position as shown in FIG. 14 in the housing 144, there is provided a lever arm 158 pivoted at 159 intermediate end 161 to a portion 160 of frame or table 116. The end 161 of said arm presses against said wall 144*a* while the other end 162 of said arm is provided with a groove adapted to retain one or more weights 163.

As may best be seen in FIG. 16, walls 148*a* and 150 of the housing 144 are positioned adjacent the rolls 126 and 127 and are provided, respectively, with curved recesses 148*b* and 153 in their upper portions. Within the aforesaid curved recesses, 148*b* and 153, are positioned the discs 149 and 154, respectively, which lie adjacent the flat surfaces of the rolls 126 and 127 at the point at which the yarns to be crimped passes therebetween, thereby preventing the aforesaid yarns from sliding out sideways between the rolls and cooperating with the aforesaid rolls to move the yarns downward into the crimping chamber or housing 144. The disc 149 is maintained in position against the aforesaid rolls by the bolt member 149*a* which passes through the rear of bracket 156, while the disc 154 is maintained in a similar position on the opposite side of said roll by a bolt member 155 which passes through the front portion of bracket 156.

In still another modification of the apparatus and method according to this invention, a plurality of separate yarns or tows 210 are passed through a guide or eye board arrangement 211 which serves to maintain said yarns or tows separate and independent of each other and fed in parallel relation when taut into the machine hereinafter described.

The board is mounted on a platform 212 of a crimping device 215 such as shown in FIGS. 17 and 18. Said device includes a bed or table 216 supported by a plurality of legs 217. It will be noted that guide or eye board 211 as mounted is slidable on platform 212 so that its position and location may be precisely adjusted to properly guide the yarns through a pin guide member 217′ mounted on said platform. Said pin guide comprises a frame containing a plurality of spaced pin members 217*a* corresponding to the openings in eye board 211 so as to keep the yarns separate and spaced from each other.

Device 215 is also provided with a pair of relatively adjustable, vertically disposed, peripherally smooth pressure rollers 226 and 227 which are mounted on shafts 228 and 229, respectively. The roller shafts are rotatably mounted in bearings 230 and 231, respectively, which in turn are secured to the framework of device 215. Shaft 229 is driven by means of a power unit 232 through a drive means 233 interconnecting pulley 234 fixed to said shaft 229 and a pulley 225 fixed to the shaft of motor 232. Said motor 232 drives a gear not shown mounted on shaft 229 which in turn drives a gear mounted on shaft 228 and which is meshed therewith so as to simultaneously rotate rollers 226 and 227 in opposite directions.

Said rollers are in tangential relation with each other at their point of yarn contact as shown more clearly in FIG. 18. The rollers are adjustable but are not in actual contact because of the presence of the yarns 210 during the working of the device as will become apparent hereinafter. It will be noted that one roller can be relatively adjusted with respect to the other by means of a spring or other suitable tension regulating frame unit 235, which is provided with a rotatable handle means 236 and a threaded shaft 237 extending through a threaded opening 238 in bracket 239. Roller 226 is pressure urged against roller 227 by means of a pressure spring or suitable device 240 which presses against a housing 241. By operating handle 236 the housing 241 and shaft 228 can be moved vertically with respect to the other shaft 229. Said unit 235 is provided in order to permit a slight yielding movement of roller 226 with respect to roller 227 as the yarns pass between them as shown in FIGS. 17 and 18.

Each yarn 210 after passing through the pin guide member spacing arrangement 217 is directed through individual slots 242 of a dividing device 243 as shown in FIG. 21. The yarns 210 are drawn or passed through said slots in parallel and spaced relation through said dividing device 243 which is so made that it is located directly between the forward or entering bight or nip 244 of rollers 226 and 227 as shown in FIGS. 17 and 18. The divider 243 is suitably mounted to the device 215 and includes for purposes of illustration a substantially rectangular framework when viewed from the top, comprising side members 244*a* and 245 and a pair of front and rear members 246 and 247, one of which 246 is clearly shown in FIG. 21. The rectangular shaped framework supports a plurality of thin flat metal strips 248 formed integrally therewith which are of a curved V-shape and which form a series of slots 242 through which the individual yarns 210 pass. Said strips and framework have a tip or reverse apex 249 which extends into the area, nip or bight of the rollers 226 and 227. Alternatively, the divider 138 illustrated in FIG. 12 may be used in the place of the divider 243, with or without the stops 143*a*.

The flat strips 248 in addition to the above description are generally V-shaped as more clearly shown in FIGS. 17, 18 and 21 and as stated, the points of the depending strips are aligned and directed toward the tangential line of the rollers to direct the yarns individually therebetween. It is to be noted that by means of the eye guide board arrangement 211, guide pins 217*a*, and divider device 243, the yarns are maintained separately and parallel with each other before they are drawn between the nip or bight of crimping rollers 226 and 227. It is to be further noted that these rollers are elongated and of such length as to accommodate the series of parallel adjacent yarns 210 which would appear in the form of a sheet with spaces separated by the strips as shown in FIG. 17.

Disposed on the other side of rollers 226 and 227 is a stuffer box 250 as clearly seen in FIGS. 17 and 18. As the yarns are drawn between the rollers they enter into a stuffer box 250, where because of its restricted area the yarns are backed up, retained and crimped by

the weight and pressure of pivoted or hinged pressure door 251, of the box 250. The yarns thus accumulate in the box in such a manner that they are in spatial relation to each other as in the form of a crimped web or sheet. In lieu of the divider 243 as shown, there may also be used a unit merely having individual plates extending over the lower roller and having one half the shape of the framework and plates shown in FIG. 21, as illustrated in FIG. 15.

In the form of the invention illustrated in FIGS. 1–7, it will be evident that as the long chain of yarns is drawn between the cushion aprons 43 and 44 between rollers 26 and 27 by means of said rollers, the resultant squeezed or compressed long chain of continuous filament yarns as it enters into the housing 47 is enveloped by the cushions as indicated above and is retained in said housing in a crimped or folded condition; that is, disposed angularly with respect to the longitudinal axes of the individual continuous filament yarns. It will be noted that there is an accumulation of such folded filament yarns with the result that as the crimped yarns and cushion aprons accumulate in said housing there is a piling up of pressure in the housing exerted against the yarns and the rollers 26 and 27 particularly in the area beneath the nip of rollers 26 and 27. When the housing 47 is filled with said folded, crimped yarns which are continuously entering thereinto by means of said rollers 26 and 27, front door 51 yields to the accumulation of the crimped yarns and cushions in the housing in an amount directly in proportion to the amount of pressure exerted against end 61 thus permitting the accumulated crimped bundle of continuous filament yarns and cushion aprons 43 and 44 to drop from the open end of the housing in a relaxed, limp, crimped condition into a collecting box 64 or other suitable type of container, as shown in FIG. 2 of the drawings. During this process said cushion aprons 43 and 44 are separated from the continuous crimped yarns and are separated and redirected by means of guides 45 and 46 into guides 40 and 41, respectively, and again between the rollers 26 and 27 forming a sheath for the yarns as they enter between the rollers from guide 38.

The relaxed, crimped continuous filament yarns in container 64 are then moved into a setting oven 65 whereupon after the door thereof has been closed the temperature in the oven is raised to the proper setting temperature for the particular material being treated and kept in the setting oven for the length of time required by the individual material being treated. The heat setting may be accomplished by infrared rays, heat coils, ultrasonic or high frequency means. It will be noted that a setting oven is customarily used in the textile art and that there is an application of heat, pressure and moisture on the yarns or material therein. It has been found that the temperature range to be used may vary depnding upon the type of yarns being treated in the setting oven. The range may be anywhere from 180° F. to 350° F. or higher. It has been found for example, that the desired temperature for setting nylon is about 270° F. and for saran from 180° to 190° F. The length of time required for setting may vary anywhere from fifteen minutes or less to one and a half hour or more up to three hours, while the steam pressure, if used as the setting medium, in said oven may be varied from 30 to 50 pounds per square inch. By this setting operation the crimp is permanently formed in the continuous filament yarns.

In the embodiment shown in FIGS. 5 and 6, it will be noted that there is provided a trough 66 mounted on support member 18. Said trough is provided with a partly exposed roller 67 forming contact with the contents of the trough, which contents may be any suitable substance such as water, a solution of a detergent or wetting agent, or antistatic liquid in clear solution or emulsion. The purpose of passing the long chain or tow over the roller 67 is to wet the same and to keep the yarns together and to facilitate crimping.

In lieu of the guides 40 and 41 and cushioning means 43 and 44 in FIGS. 1 and 2, there may be provided for purposes of wetting and lubrication of the long chain, a feeding reservoir 68 adapted to hold the same type of material as in trough 66, said reservoir being mounted on a bracket 69. Said reservoir has a valve 70 and a feed line 71 extending into a guide member 72 so as to slowly feed the liquid to the long chain or tow 16 as it passes through the guide between the pressure rolls 26 and 27. It will be noted that this treatment of the yarns before passing between the rolls keeps the filaments more closely together, prevents fraying, while at the same time lubricating them to prevent tangling of adjacent filaments being simultaneously treated. Furthermore, by the use of the wetting or lubricating material on the yarns there is a reduction in the amount of required twist and it is therefore easier to separate the individual yarns after they have been crimped. A pair of pans 73 and 74 are set beneath rollers 26 and 27, respectively, to catch the excess lubricant coming off from the rollers.

After the setting operation has been completed the long chain or tow is then quilled and the individual continuous yarns in the chain or tow are then wound upon individual bobbins ready for subsequent twisting, winding and fabrication. Since the long chain or tow is leased where desired, it may be directly placed on warp beams ready for weaving, tricot or warp knitting. It will be noted that said continuous filament yarns are in a permanently crimped condition and may be made into multiple plys of spun-like yarn or manipulated into plied yarns of novelty twist. The method and device hereinabove described and illustrated are also applicable for the processing of a sliver consisting of natural or synthetic continuous or non-continuous fibers which normally cannot withstand the stress or strain applied transversely of the longitudinal axis thereof. When applied to such slivers the use of leasing arrangements and subsequent quilling is obviated. Such sliver when treated, above indicated, is then set and is then ready for subsequent treatment in normal spinning operations.

In order to obtain a highly effective crimping action, as shown and described hereinabove, the chain or tow may be re-run through a crimping box any desired number of times.

The pitch of the crimp may be varied depending upon the requirements of the different materials used by varying the thickness of the cushion aprons in the apparatus shown in FIGS. 1 and 2 and/or by the upward pressure applied against the door of the crimping box shown in FIGS. 1 to 4. The best crimp, however, is effected when the portions of the filament yarns are substantially bent on themselves at or approaching 180°. Also, as will be noted from the drawings and description herein relating to FIGS. 1 and 2 the filaments in the long chain of yarns do not come into contact with any metal during the crimping or bending operation and are non-abraded, whereas in the device shown in FIGS. 5 and 6 the long chain of yarns is lubricated and comes into contact with the rollers 26 and 27.

In the modification of the invention illustrated in FIGS. 8–16, after the yarns, having passed between the crimping rollers 126 and 127, have filled up housing 144, they press against the walls thereof, and force the front door 144*a* to yield against such pressure whereupon the crimped yarns then drop into box 149 or are collected in any suitable manner adjacent the crimping device, for example, as described in U.S. patent to Rosenstein et al., No. 2,715,309.

The resultant, relaxed, crimped yarns are now in a web-like form in container 149 which is then moved into a setting oven 151. After the door thereof has been closed and the temperature in the oven is raised to the proper setting temperature for the particular material being treated,

the web-like yarns are kept in the setting oven for the length of time required by the individual material being treated. The heat setting may be accomplished by use of steam, infra-red rays, heat coils, ultrasonic or high frequency means or other suitable means. It will be noted that a setting oven is customarily used in the textile art and that there is an application of heat, pressure and moisture on the yarns or material therein. It has been found that the temperature range to be used may vary depending upon the type of yarns being treated in the setting oven. The range may be anywhere from 180° to 350° F. or higher as required. It has been found, for example, that the desired temperature for setting one type of nylon is about 270° F. and for saran from 180° F. to 190° F. The length of time required for setting may vary anywhere from fifteen minutes or less to one and a half hours or more up to three hours, while the steam pressure, if used as the setting medium, in said oven may be varied from 30 to 50 pounds per square inch. By the aid of this setting operation the crimp is permanently formed in the continuous filament yarns. A yarn with a permanent crimp therein is shown in FIG. 13.

After the setting operation has been completed, continuous filament yarns are then separated and wound upon bobbins ready for subsequent twisting, winding and fabrication. The yarns may be directly placed on warp beams ready for weaving, tricot or warp knitting. It will be noted that said continuous filament yarns are in a permanently crimped condition and may be retained in single yarn form or may be made into multiple plies of spun-like yarns or manipulated into plied yarns of novelty twist.

In the modification of the invention illustrated in FIGS. 17–25, the yarns are passed or brought through the slots **242** and it will be noted that each of the yarns **210** will have sufficient room on either side of its longitudinal axis for the component filaments to become splayed or disoriented while passing between the rollers **226** and **227** and into the box **250** with the result that the individual filaments while being crimped form a zig-zag pattern relatively to the normal longitudinal axis of the yarns. Also, as they pass into the box **250** the filaments have sufficient room to form lateral crimps at different angles and amplitudes with respect to the longitudinal axes of the filaments. In other words, there is a change in direction of the crimp in the filament. This type of crimp forms a product which is more billowy, bulky and lofty. A product made from yarns of this type exceeds the bulkiness and loftiness of natural wool.

After the yarns have passed between the rollers **226** and **227**, and have filled up box **250**, they press against the walls thereof as a result of the continual increment of yarns forced into the box **250** by the rotation of the aforesaid rolls; as a consequence the yarns force the pivotal pressing door **251** to yield against such pressure of the accumulated yarns **252** exerted against door **251** whereupon the crimped yarns pass onto a table **253**, then drop into a box **254** or are collected in any suitable manner adjacent the crimping device as described in the above cited patent applications and patent.

The resultant, relaxed, crimped web of continuous filament yarns is passed through a condenser **255** mounted on frame **212**, collected in container **254** in a web-like form and is then moved into a setting oven or is set by any other means suitable for setting the yarns which have been crimped. When the setting operation is completed, the crimp is permanently formed.

A yarn **256** with a permanent crimp is shown in FIGS. 22 and 23. A single filament **257** with a permanent crimp is shown in FIGS. 24 and 25.

As heretofore mentioned, this invention is applicable not only to yarns but as well to the crimping of slivers or rovings which may be crimped in the manner aforedescribed. Preferably such slivers or rovings have been pre-cut and paralleled in suitable lengths and after crimping are subjected to heat treatment to set the crimp and are then drafted and spun to produce a yarn which comprises a plurality of crimped heat set fibers. This is accomplished without encountering the difficulty normally experienced as a result of the resistance of crimped yarns to carding.

From the foregoing description, taken in conjunction with the drawings, it will be noted that by our invention there is provided a device and process for obtaining a novel crimped continuous filament yarn which is lofty and has the desirable characteristics of a spun-like yarn known in the art. Furthermore, a textile or product made with the crimped type of continuous filament yarn of the present invention is resilient and provides air spaces which act as an insulation in contrast to the presently made textiles containing synthetic continuous filament yarn. Because the filaments of this novel crimped yarn are continuous there is no pilling of any of the filaments as in products heretofore made from ordinary spun synthetic yarn since there are not likely to be any free exposed ends of the filaments. It is an important advantage of the present invention to provide the characteristics of a spun yarn to the synthetic heat settable continuous filament yarn without any of the defects of a spun yarn and without the higher costs of making such a spun yarn.

With respect to sliver, it will be noted that by this invention as herein described and illustrated, natural and synthetic fibers which heretofore could not be crimped are treated so as to obtain a crimped or sinuous form. Such crimped fibers can now be manufactured into a yarn which results in greater loftiness and warmth as compared with the same fibers when untreated. Furthermore, such crimped fibers lend themselves to easier spinning as well as the production of a spun yarn having fine counts which normally are unobtainable from such types of fibers.

In addition to the above features, the present invention also encompasses a method of and means for obtaining a relatively flat web of crimped yarns which remains as such until separated. Such a web of yarns makes for greater ease in subsequent permanent crimp setting and facilitates separation and handling of the individual yarns comprising the web.

It will be apparent to those skilled in the art that various changes other than those referred to above may be made, that equivalent elements may be substituted for those illustrated in the drawings, that parts may be reversed, and that certain features of the invention may be used to advantage independently of the use of other features, all within the spirit of the invention as defined in the annexed claims.

Having thus described our invention we claim:

1. A device for crimping a continuous elongated flexible textile material, comprising guiding means for the material, adjustable rotary pressing means adjacent said guiding means, means for rotating said pressing means thereby drawing the material toward said pressing means while guiding said material, pressure exerting means for crimping the material, and endless limp sheathings in the form of flexible elongated cushions arranged to extend through the pressing means for protecting the material as said material is passed between said pressing means.

2. Means for the crimping of continuous elongated flexible textile material comprising a plurality of pressure rotary means rotatable counter to each other, means for rotating said rotary means, guide means disposed intermediate the rotary means for continuously feeding said material therethrough intermediate the rotary means, condenser means intermediate the guide and rotary means, means forming endless, protective, flexible sheathings in the form of flexible elongated cushions accommodated by said condenser means, housing means adjacent to the rotary means for collecting the material and sheathings, and pressure means connected to the housing means to

effect a crimping action on the material and sheathings.

3. Means for crimping continuous elongated textile material comprising a plurality of pressure rotary means rotatable counter to each other, means for rotating said rotary means, guide means disposed intermediate the rotary means for continuously feeding said material therethrough intermediate the rotary means, means forming endless protective sheathings in the form of flexible elongated cushions for the material as said material passes between the rotary means, condenser means intermediate the guide and the rotary means forming guides for feeding said sheathings to said rotary means, and pressure housing means immediately adjacent to the rotary means for crimping and collecting the material and sheathings therein.

4. A device for continuously crimping continuous elongated textile material comprising counter rotary means, power means for rotating said rotary means, means for feeding a continuous length of said material intermediate said counter rotary means, means forming flexible elongated cushions arranged for enveloping said continuous length of said material during its passage between said counter rotary means, said rotary means continuously moving said cushions along with said material, housing means immediately adjacent to said counter rotary means for retaining said material as it passes through said counter rotary means whereby the material is retained in said housing means against the feeding force of said rotary means in a manner to crimp said material continuously, and pressure exerting means connected to said housing means and adapted to retain the crimped material in the housing means until the pressure of the crimped material in said housing means exceeds the pressure of the pressure exerting means whereby the material is extruded from the housing means in a limp, relaxed, crimped condition.

5. A device for continuously crimping continuous filament yarn, comprising adjustable counter-rotary means, drive means for rotating said rotary means, continuously movable endless means in the form of flexible elongated cushions for enveloping said yarn prior to its passage between said counter rotary means, housing means connected to said counter rotary means for retaining said yarn under compression as it passes through said counter rotary means whereby the yarn is retained in said housing means in opposition to the feeding force of said rotary means so as to crimp said yarn continuously and pressure exerting means connected to said housing means adapted to retain the crimped yarn in the housing means until the pressure of the crimped yarn in said housing means exceeds the pressure of the pressure exerting means whereby the yarn is extruded from the housing means in a limp, crimped, relaxed condition.

6. A device for crimping previously twisted continuous synthetic monofilament yarn angularly of its longitudinal axis, comprising pressure-exerting, counter-rotary means, means for rotating said rotary means, guide means arranged to guide the continuous yarn before and as it passes between said rotary means, separate guiding means adjacent said rotary means, flexible sheathing means arranged and disposed through said separate guiding means and adjacent said yarn for enveloping the yarn as it passes between the rotary means, a housing connected to said rotary means in a manner to collect said yarn and sheathing means to permit collection of said yarn in said housing, and pressure exerting means operable against said housing to effect the crimping of said collected yarn in said housing.

7. A device for crimping an elongated textile material angularly of its longitudinal axis, comprising a pair of counter-rotary pressure exerting rolls arranged parallel to one another, drive means for said rolls, feeding means intermediate said rolls for feeding said material between said rolls, condenser means adjacent to said rolls, means forming endless limp protective sheathing extending through said condenser means and between said rolls, a housing connected to said rolls and at least partly enclosing the rolls and adapted to collect said material to permit cumulative folding and crimping of said material and sheathings in said housing, and adjustable pressure exerting means operable against said housing to effect the crimping of the material in said housing.

8. A device for continuously crimping an elongated textile material comprising a pair of pressure rolls disposed parallel in a common plane to form a nip, means for rotating said rolls, means for guiding said material into the nip of said rolls, housing means adjacent to the rolls adapted to collect the material as it is fed by the rolls, and to retain the same therein, so as to produce a continuous crimp on the material, and sheathing means passable through the rolls and adapted to cushion the material as it passes into said nip.

9. The process of heating and permanently crimping continuous filament yarns, comprising arranging a plurality of said yarns in generally parallel relation, cushioning yarns, crimping said yarns while maintaining them in a cushioned condition, releasing and collecting the resultant crimped yarn and heating said yarn while in crimped condition.

10. The process of permanently crimping synthetic resinous continuous filament yarn comprising arranging a plurality of separated yarns of synthetic resinous continuous filament material generally parallel to one another, bringing said yarns together in the form of a rope and simultaneously and continuously crimping all such yarns in a common housing by bending them at an angle transversely of their longitudinal axes, applying pressure to all such yarns in said common housing while they are bent, collecting the resultant crimped yarns in a relaxed condition, and heat setting said yarns, whereby the resultant crimped continuous filament heat-set yarns are capable of being separated from one another so that each individual continuous filament yarn is suitable for fabrication.

11. In a method of crimping a plurality of continuous filament yarns, each of said yarns being composed of a plurality of filaments of substantially smooth-surfaced synthetic resin material, the steps which comprise forming and maintaining a resistant mass of said yarns, continuously bringing a plurality of separated yarns of synthetic resinous material together in the form of a rope and feeding said rope of yarns against said mass with a force sufficient to fold the filaments of said yarns back upon themselves with respect to the longitudinal axis thereof, subjecting said filaments to pressure while thus folded, and applying heat to said yarns in a manner to render the crimp thus formed substantially permanent, whereby said permanently crimped yarns are identifiable as yarns and are suitable for fabrication.

12. A method of permanently crimping a plurality of continuous filament yarns, each of said yarns consisting essentially of continuous filaments of a synthetic resin material, including the steps of:

(1) continuously bringing together in the form of a rope a plurality of separated yarns,

(2) continuously guiding said rope of yarns into the nip of a pair of counter-rotating rotary pressure members,

(3) discharging said yarns from said nip into an enclosed housing adapted to accumulate and restrain the yarns, whereby the individual continuous filaments of said yarns are caused to continuously crimp as they are discharged from said nip in such manner that successive portions of each filament are folded upon the following portion of the respective filament through an angle of about 180°,

(4) releasing the resultant crimped yarns from said housing, and

(5) permanently setting the crimp of said yarns acquired within said housing, whereby each of said

permanently crimped yarns is identifiable as a yarn and is suitable for fabrication.

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MERVIN STEIN, *Primary Examiner.*

RUSSELL C. MADER, DONALD W. PARKER, *Examiners.*