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APPARATUS AND METHOD FOR MAKING SEPARABLE FASTENERS

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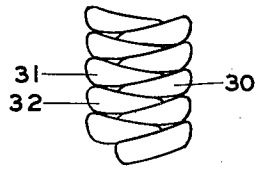


fig. 1

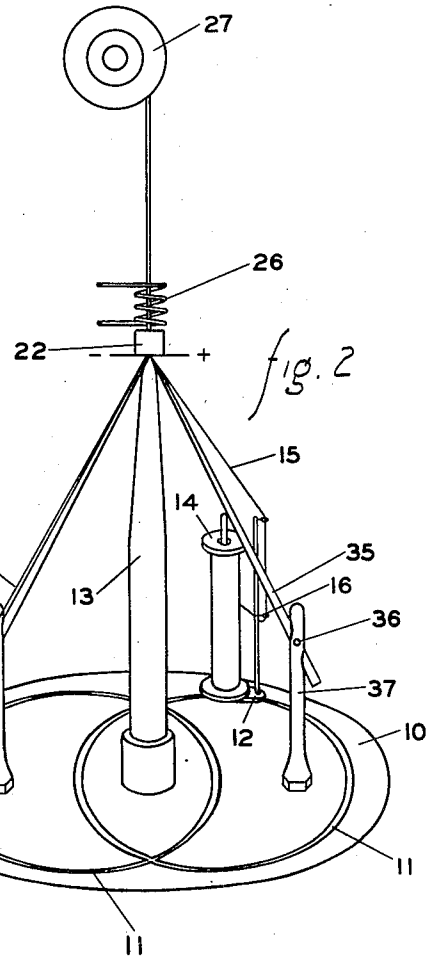


fig. 2

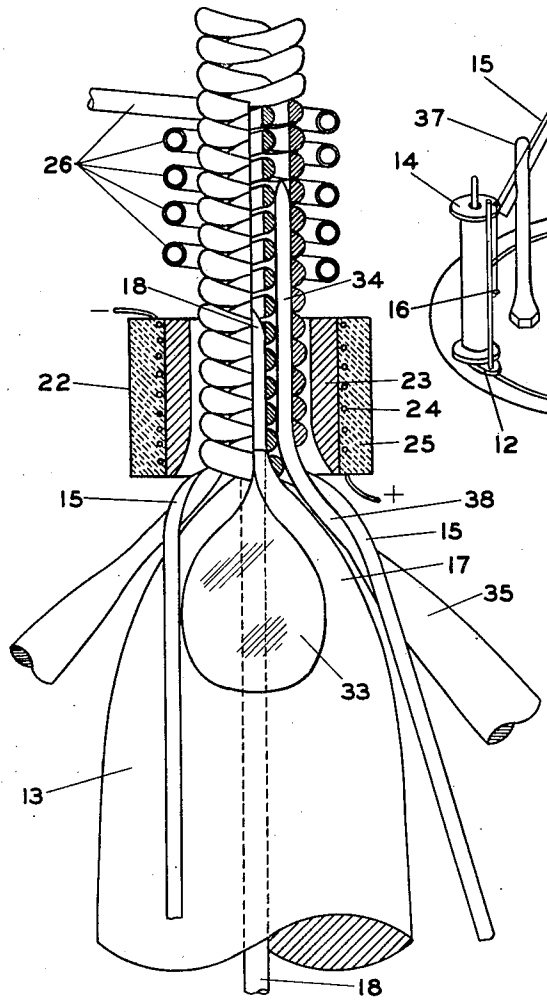


fig. 3

INVENTOR.
NICHOLAS A. WAHL
BY
Dean Lawrence

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APPARATUS AND METHOD FOR MAKING SEPARABLE FASTENERS

Nicholas A. Wahl, New York, N. Y., assignor to Wahl Brothers, New York, N. Y., a partnership

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13 Claims. (Cl. 18—5)

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This invention relates to a method and apparatus for making separable fasteners, particularly separable fasteners having loops of coils as the interlocking elements.

Separable fasteners wherein the interlocking elements are individual loops of continuous elongated coils of roughly helicoidal form have certain advantages in the way of flexibility, appearance and low production cost not possible to attain with the older types of separable fasteners wherein the interlocking elements are rows of separate links or teeth, usually of metal, having hooks and eyes or other engaging devices formed in the ends thereof. Coils for use in separable fasteners are generally fashioned from continuous filaments of metal or plastic.

In making coils for separable fasteners, it has been suggested to wind two filaments simultaneously in opposite directions and with alternating turns or loops on the same mandrel and subsequently to treat them while nested to fix them in permanently coiled form, and thus to form two cooperating coils of the fastener at the same time. Although coils for separable fasteners have been made in this fashion and used with a certain degree of satisfaction, the method as practiced heretofore leaves much to be desired in certain respects. Thus it is known that for best results, i. e., for greater ease of aligning the engaging portions of the loops properly and for providing room for attaching the coils to fabric, e. g., by sewing through each individual loop, each loop should, when viewed along the longitudinal axis of the coil, be non-circular, e. g., it should be somewhat ovoid or elliptical in outline. Such coils are frequently referred to as being oblong in cross section.

Filaments which have been used have usually been those whose cross sections have one diameter greater than another. One such filament has a cross section resembling that of a finger ring wherein the inner surface is plane or concave and the outer surface is convex. Such filaments may be wound on a mandrel to form coils with the plane or concave surface on the inside of the coil. In such cases the individual loops of each coil are twisted and pressed out of round so as to accommodate between two of them a loop of a similar but oppositely wound coil. In some instances, particularly in the case of a round filament, notching or indenting of the filaments where they cross one another may be affected. The formation of a pair of cooperating coils wherein each individual loop of each coil has the above desired characteristics is difficult to attain when a pair of filaments is wound on a single mandrel.

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It is, therefore, an object of the present invention to provide a method for preparing elongated flexible coils useful in the construction of separable fasteners.

Another object is to provide a method for forming a pair of elongated coils adapted to be separably joined longitudinally and released with a slider.

An additional object is to provide a method for fabricating a pair of interlocking coils useful in the separable fastener art.

An additional object is to provide a method for fabricating simultaneously and continuously from a pair of plastic filaments a pair of interlocking coils useful in the construction of a separable fastener.

An additional object is to provide a method for making a separable fastener wherein the interlocking elements are the loops of a pair of cooperating coils.

An additional object is to provide apparatus for forming a separable fastener wherein the interlocking elements are individual loops of a pair of continuous elongated coils.

Still an additional object is to provide apparatus for preparing a pair of coils useful in the fabrication of a separable fastener.

An additional object is to provide apparatus for making simultaneously and continuously from a pair of plastic filaments a pair of interlocking plastic coils useful in the fabrication of a separable fastener.

These and related objects are accomplished readily by winding simultaneously two coil-forming filaments of metal, synthetic resin, or of other suitable material in opposite directions and in alternating loops around an elongated primary mandrel or pin in such fashion that each loop or convolution of one coil nestles between adjacent loops of the other coil. In addition to the primary mandrel a pair of elongated secondary mandrels, usually somewhat longer than the primary mandrel, are provided substantially parallel with and on opposite sides of the primary mandrel and in such position that one of the filaments is wound around both the primary mandrel and one of the secondary mandrels during the formation of a single loop from the filament and the other filament is wound around both the primary mandrel and the other secondary mandrel during the formation of a single loop from the said other filament. The pair of interlocking coils are then treated while

still on at least the secondary mandrels in a suitable manner to fix or set the filaments permanently in the form of flexible elongated coils and then removed from the mandrels. To provide for continuous operation the three mandrels are supported on three separate supports at one end only and the treated coils slid continuously from the unsupported ends of the mandrels.

The primary mandrel, which may be of circular, elliptical, oval or of other suitable cross section, is provided at its base, with an enlarged sloping shoulder, which may conveniently be the formed end of the mandrel support, but which is preferably non-circular in cross section, the filaments being wound in sliding contact over the shoulder in such manner that they slide from the shoulder onto the primary mandrel, each new loop formed thus being slid into close contact with the last preceding loop of the other coil and, as it is drawn tightly around the mandrel, pushing the precedingly formed series of loops along the mandrels away from the shoulder and eventually, after treatment to fix the filaments in permanently coiled form, free of the unsupported ends of the mandrels. The process may thus be carried out continuously, the formed interlocking coils sliding or traveling along the mandrels away from the shoulder and being subsequently treated as hereinafter described.

The secondary mandrels, which are used to impart a non-circular shape to each loop or convolution of the two coils and to provide space between the two coils for threads used in securing a tape to the coils, may consist of a pair of metal wires or plastic filaments or may be made from other suitable material. The secondary mandrels are positioned on opposite sides of the primary mandrel and have at least their forward sections, with respect to the direction of travel of the interlocking coils thereon, parallel to the primary mandrel. They are each spaced from the primary mandrel a distance at least substantially as great as the thickness of the coil-forming filament.

The supported end of each of the secondary mandrels is inclined at an angle for a short distance away from the primary mandrel and its support and thus serves as a sloping guide to assist in guiding one of the coil-forming filaments into proper position on the mandrels and also to provide space for the other coil-forming filament to pass between it and the sloping shoulder of the primary mandrel support onto the primary mandrel. As one coil-forming filament is wound around the primary mandrel it is also caused to include within its convolutions one of the secondary mandrels but passes between the primary mandrel and the other secondary mandrel while the other coil-forming filament, as it is wound around the primary mandrel is caused to include within its convolutions the other secondary mandrel but not the first.

The coiled structure formed on the three mandrels thus consists of nesting alternate loops of the two coils with the primary mandrel passing through the loops of both coils and with each of the secondary mandrels passing through the loops of one coil but not through the loops of the other. As mentioned previously, the secondary mandrels are frequently longer than the primary mandrel. The primary mandrel usually need be only long enough to insure proper forming of the two filaments into properly spaced coils, but the secondary mandrels should be long enough so that treatment of the wound filaments to fix them in permanently coiled form may be completed before they leave the secondary mandrels. A supply of each of the two coil-forming filaments, usually on spools, is carried in proper order around and between the mandrel supports, each filament passing through any suitable tensioning device on its way to the mandrels.

The formed structure consisting of the two interlocked coils is then treated while still on at least the secondary mandrels, to cause the flexible filaments to assume permanently their coiled form, but not so as to destroy their flexibility. In the case of metal coil-forming filaments, the filaments may, depending upon the properties of the metal or alloy used, be sufficiently fixed during the process of winding under tension so that further treatment is unnecessary. In other instances, a modified heat treatment of the metal coils may be desirable to further fix them in the desired shape and to temper them. In the case of interlocking coils made from thermoplastic filaments, e. g., from filaments of polyamides, polyvinylidene chloride, polyvinyl chloride, cellulose acetate, polystyrene and rubber, the structure is usually heated just sufficiently to relieve the strain in the coiled filaments but not sufficiently to cause appreciable softening of the plastic substance, and then cooled. Filaments made from a partially polymerized thermosetting resin may be heated on the mandrels to complete polymerization of the resin.

In certain instances it is advisable to lubricate the filaments or the mandrels, or both, to promote easier sliding of the coils therealong. Soap, oil, paraffin or other substances non-reactive with the mandrels or coil-forming filaments may be used as lubricants. If desired, the primary mandrel may be adjustably retractable into the primary mandrel support and its effective length thus varied to adjust the frictional resistance tending to retard the sliding movement of the coils along the mandrels, and thus to alter somewhat the spacing of the loops on the mandrels. During winding and subsequent treatment of the coils, bending and twisting of the filaments is caused by the pressure of one convolution on another and this provides means for positive interlocking of the coils when assembled in a tape. Also, notching of the edges of the filament loops where they cross one another may be caused to occur during the treating step, if desired. Such notching is particularly desirable when the filaments are of circular cross section. The three mandrels should, of course, be constructed of material which will be substantially unaffected during the treatment to fix the filaments in coiled form.

Following the heating and cooling or other treatment of the interlocking coils, the structure is then slid from the ends of the mandrels and is conveyed to a wind-up reel for storage or is immediately cut into appropriate lengths for assembling in a tape. The entire operation is conveniently carried out continuously using a modified rotary braider as will be hereinafter described.

The apparatus and method of the invention may be understood clearly by reference to the following drawings wherein, for the sake of clarity certain features are shown on a somewhat exaggerated scale and wherein

Figure 1 is a side elevation of a pair of oppositely wound interlocking coils useful in the separable fastener art.

Figure 2 is a diagrammatic view of a rotary braider modified to carry out the process of the invention, and

Figure 3 is an elevation, partly in section, of a primary and two secondary mandrels and portions of their supports showing a method of winding two coil-forming filaments thereon to form the interlocking coils of Figure 1.

The interlocking coils of Figure 1 each comprise a series of loops formed in such manner that each loop of one coil, as loop 30, is nested between two adjacent loops, as 31 and 32, of the other coil in interlocking relationship. When each of the coils are assembled in suitable tapes which maintain the loops of each coil in fixed longitudinal relationship, the coils may be separably joined with a suitable slider in positive interlocking relationship and in such position will withstand a high degree of lateral tension without separating.

Referring now to Fiagure 2, there is shown in diagrammatic outline a modified rotary braider having a stationary table 10 with two tracks or races 11 therein in which a pair of spool carriages 12 travel in opposite directions around a support 13 for a primary mandrel, 18 of Figure 2, fixedly positioned in an upright position on the table 10. The top of the mandrel support 13 is tapered, as shown clearly in Figure 2, to provide a sloping shoulder 17 for the primary mandrel 18. The primary mandrel 18 is in the form of a short upright pin, which may be cylindrical, elliptical or other suitable cross section, and which may be secured at one end to the center of the tapering shoulder 17 in suitable manner. A preferred modification comprises a primary mandrel 18 which may be retracted into the shoulder 17 and held in any desired position by conventional means, not shown. The length of the primary mandrel 18 may be varied considerably but it should be sufficiently long to accommodate at least two or three loops of each coil. The primary mandrel is usually somewhat rounded on its unsupported end to facilitate easy disengagement therefrom of the sliding double coil structure.

A pair of secondary mandrels 34 are provided and each may conveniently be mounted on an arm 35 adjustably clamped, as by a set screw 36, in a hole drilled at an angle through a post 37 mounted vertically on the table 10. The posts 37 are located in such position with respect to the carrier races 11 and the primary mandrel support 13 that one of the spool carriages 12 travels around the primary mandrel support 13 and one of the posts 37 and the other spool carriage travels around the primary mandrel support and the other post. The posts 37 and the adjustable arms 35 are referred to, broadly, as secondary mandrel supports. A pair of wires or stiff plastic filaments 34 may serve as secondary mandrels. The secondary mandrels 34 and their supports are arranged so that the forward section or unsupported end of each secondary mandrel lies parallel to and at a short distance from the primary mandrel. Generally speaking the distance separating the primary and a secondary mandrel will be substantially the width of the coil-forming filament so that the secondary mandrel will lie closely against one series of filament loops and the other series of filament loops will be drawn tightly over it. Secondary mandrels having cross sections of any desired shape and size may be employed to provide a longitudinal opening of desired shape and size between the coils in the finished structure.

The supported end 38 of each secondary mandrel and the adjustable arm 35 to which it is secured are inclined at an angle away from the primary mandrel 18 sufficient to clear the shoulder 17 on the primary mandrel support and permit a coil-forming filament 15 to slide between the two onto the primary mandrel. The other coil-forming filament is guided into its position around the secondary mandrel by the sloping portion 38 thereof and the sloping arm 35.

A pair of spools 14 are carried by the spool carriages 12 which are driven by conventional driving apparatus, not shown. Each of the spools 14 carries a supply of coil-forming filament 15 which, as it leaves its respective spool, passes through a filament tensioning device 16, which is of conventional design and is usually spring loaded, and thence in sliding contact over the shoulder 17 and the sloping ends 38 of one of the secondary mandrels onto the primary mandrel 18 and one of the secondary mandrels 34. The shoulder 17 is preferably non-circular in cross section to provide even sliding contact of the filaments 15 over the shoulder as the spool carriers 12 travel in the races 11 around the primary mandrel support 13 which is not centered with respect to either of the races 11. A flattened area 33 is advantageously provided on one side of the shoulder 17 where the two filaments 15 cross one another just prior to passing between the shoulder 17 and the respective secondary mandrels or mandrel supports.

As each loop of a coil is formed by winding a coil-forming filament around the base of the primary mandrel 18 and one of the secondary mandrels 34, and the loop drawn tight, it lies in close contact with the preceding loop of the other coil and pushes the entire structure of nested loops along the mandrels 18 and 34 toward the unsupported ends thereof. As each of the coil-forming filaments 15 is wound around the primary mandrel 18, it also includes within each of its convolutions one of the secondary mandrels 34, but not the other. In the coiled structure thus formed, each of the secondary mandrels 34 thus lies within the convolutions of one of the coils, but not within the convolutions of the other coil, and the other secondary mandrel occupies the reverse position with respect to the two coils.

The treatment of the interlocking coils on the mandrels after forming is, as mentioned previously, varied according to the nature of the substance from which the coil-forming filaments 15 are formed. Generally speaking, in the case of coil-forming filaments of synthetic resin a simple heating and cooling operation is sufficient. This may be effected by a circular hollow heater 22 of Figure 2 positioned around a short section of the interlocked coils on the mandrels, by high-frequency heating, or in any other convenient manner. One type of satisfactory heater of conventional design is shown somewhat in detail in Figure 3 and comprises a metal cylinder 23 with a longitudinal bore slightly larger than the pair of coils traveling on the mandrels. An insulated heating element 24 is wound around the cylinder and covered with insulating material 25. A rheostat, not shown, may be provided to regulate the degree of heating. The degree of heating is regulated so as to relieve the strain within the coil-forming filaments but not to soften them appreciably. Cooling may be effected with a coil 26 carrying cold water around the coils of fila-

ment immediately after they leave the heating zone, or in any other convenient way. In the case of metal coil-forming filaments a somewhat more drastic heat treatment of the coils may be necessary than is the case with plastic coil-forming filaments. Following the completion of the treatment to fix the filament in coil form the traveling interlocked coils may be wound up on a reel 27 or cut into desired lengths for assembling in suitabe tapes.

I claim:

1. In a method for forming a pair of coils for a separable fastener, the steps including: winding a coil-forming filament in one direction in a series of loops around a primary and a secondary mandrel; winding another coil-forming filament in the reverse direction around the primary mandrel and another secondary mandrel in a second series of loops alternating with the loops of the first series, each loop of the second series nestling between but not crossing adjacent loops of the first series and said secondary mandrels being positioned on opposite sides of the primary mandrel; and drawing the loops tightly around the mandrels.

2. The method as claimed in claim 1 wherein the coil-forming filaments are metal filaments.

3. In a method for forming a pair of coils for a separable fastener, the steps including: winding a coil-forming filament in one direction in a series of loops around a primary and a secondary mandrel; winding another coil-forming filament in the reverse direction around the primary mandrel and another secondary mandrel in a second series of loops alternating with the loops of the first series, each loop of the second series nestling between but not crossing adjacent loops of the first series and said secondary mandrels being positioned on opposite sides of the primary mandrel; drawing the loops tightly around the mandrels; and treating the loops on the mandrels to fix the filaments in permanently coiled form.

4. The method as claimed in claim 1 wherein the coil-forming filaments are synthetic resin filaments.

5. In a method for forming a pair of coils for a separable fastener, the steps including: providing an elongated primary mandrel and two elongated secondary mandrels adjacent to and parallel with and on opposite sides of the primary mandrel, each of said mandrels being supported on separate supports at the same ends thereof; winding a coil-forming filament in one direction in a series of loops around the primary mandrel and one of the secondary mandrels; winding simultaneously another coil-forming filament in the reverse direction around the primary mandrel and the other secondary mandrel in a second series of loops alternating with the loops of the first series, each loop of the second series nestling between but not crossing adjacent loops of the first series; treating the loops on the mandrels to fix the filaments in permanently coiled form; and sliding the so-formed pair of interlocking coils from the unsupported ends of the mandrels.

6. In a method for forming continuously a pair of coils of synthetic resin for a separable fastener, the steps including; providing a primary mandrel and two secondary mandrels adjacent to and parallel with the primary mandrel and on opposite sides thereof, said primary and secondary mandrels being supported at the same ends thereof on separate mandrel supports and unsupported at their other ends; winding continuously a filament of synthetic resin in one direction in a series of tight loops around the primary and one of the secondary mandrels near their supported ends; winding simultaneously and continuously another filament of synthetic resin in the reverse direction around the primary mandrel and the other secondary mandrel in a series of tight loops alternating with the loops of the first series and each nestling between but not crossing adjacent loops of the first series; sliding the two coiled filaments continuously along the mandrels toward the unsupported ends thereof; heating the coiled filaments sliding on the mandrels; and sliding the filaments fixed in permanently coiled form continuously from the unsupported ends of the mandrels.

7. In a method for forming continuously a pair of coils for a separable fastener from a plastic filament, the steps including; providing an elongated primary mandrel supported at one end on the sloping shoulder of a primary mandrel support; providing a pair of elongated secondary mandrels adjacent to and parallel with the primary mandrel and on opposite sides thereof; winding continuously a tensioned plastic filament in one direction slidably over the sloping shoulder in a series of loops around the primary mandrel and one of the secondary mandrels; winding simultaneously and continuously another tensioned plastic filament in the reverse direction slidably over the sloping shoulder around the primary mandrel and the other secondary mandrel in a second series of loops alternating with the loops of the first series and in lateral pressure contact therewith, each loop of the second series nestling between but not crossing adjacent loops of the first series; heating the two series of plastic loops on the mandrels; and subsequently sliding the so-formed nestled plastic coils longitudinally and continuously from the mandrels.

8. In a method for forming continuously a pair of coils for a separable fastener from a plastic filament, the steps including: providing a primary mandrel supported at one end on the sloping shoulder of a primary mandrel support; providing two secondary mandrels on opposite sides of any adjacent to the primary mandrel, each having a section parallel with the primary mandrel and a section inclined at an angle thereto; winding continuously a tensioned plastic filament in one direction slidably over the sloping shoulder of the primary mandrel support and the inclined section of one of the secondary mandrels in a series of loops around the primary mandrel and the said secondary mandrel; winding simultaneously and continuously another tensioned plastic filament in the reverse direction slidably over the sloping shoulder of the primary mandrel support and the inclined section of the other secondary mandrel around the primary mandrel and the said other secondary mandrel in a second series of loops alternating with the loops of the first series and in lateral pressure contact therewith, each loop of the second series nestling between but not crossing adjacent loops of the first series; treating the loops on the mandrels to fix the filaments in permanently coiled form; and sliding the so-formed nestled plastic coils longitudinally and continuously from the mandrels.

9. In apparatus for forming a pair of interlocking coils for a separable fastener, the combination including; a primary mandrel supported at one end on a primary mandrel support; two

secondary mandrels positioned adjacent to and having sections parallel with the primary mandrel on opposite sides thereof and supported on two secondary mandrel supports separate from one another and from the primary mandrel support; means for winding a tensioned coil-forming filament in a series of loops around the primary mandrel and one of the secondary mandrels; means for winding simultaneously another tensioned coil-forming filament in the reverse direction around the primary mandrel and the other secondary mandrel in a series of loops alternating with and in lateral pressure contact with the loops of the first series; and means for treating the wound filaments on the mandrels to fix them in permanently coiled form.

10. Apparatus as claimed in claim 9 wherein the primary mandrel is adjustably retractable into the primary mandrel support to provide means for adjusting the effective length of the mandrel.

11. Apparatus as claimed in claim 9 wherein the primary mandrel support has a sloping shoulder of non-circular cross section for slidably guiding a coil-forming filament wound thereover onto the mandrels.

12. In apparatus for forming interlocking coils for a separable fastener, the combination including: a primary mandrel supported at one end on a primary mandrel support; two secondary mandrels positioned adjacent to and having sections parallel with the primary mandrel on opposite sides thereof and supported on two secondary mandrel supports; a sloping shoulder on the primary mandrel support immediately adjacent the base of the primary mandrel for slidably guiding a tensioned filament wound in sliding contact thereover onto the mandrels; means for winding a tensioned coil-forming filament in a series of loops slidably over the sloping shoulder onto the primary mandrel and one of the secondary mandrels; means for winding simultaneously another tensioned coil-forming filament in the reverse direction slidably over the sloping shoulder around the primary mandrel and the other secondary mandrel in a series of loops alternating with the loops of the first series and in lateral pressure therewith; and means for treating the wound filaments on the mandrels to fix them in permanent coiled form.

13. In apparatus for forming continuously a pair of interlocking coils for a separable fastener,

the combination including: a primary mandrel supported at one end on a primary mandrel support; two secondary mandrels adjacent to the primary mandrel and supported at the same ends as the primary mandrel on two secondary mandrel supports separate from one another and from the primary mandrel support, each of said secondary mandrels having a section parallel to the primary mandrel and a section inclined at an angle away from the primary mandrel; a sloping shoulder on the primary mandrel support immediately adjacent the base of the primary mandrel, said sloping shoulder and inclined sections of the secondary mandrels being adapted to guide a filament wound in sliding contact thereover onto the mandrels; means to carry a supply of a coil-forming filament in one direction continuously around the primary mandrel support and one of the secondary mandrel supports and to feed the coil-forming filament in sliding contact over the sloping shoulder of the primary mandrel support and the inclined section of the secondary mandrel in tight loops encircling the primary mandrel and the said secondary mandrel; means to carry another supply of a coil-forming filament simultaneously in the reverse direction around the primary mandrel support and the other secondary mandrel support and to feed the coil-forming filament in sliding contact over the sloping shoulder of the primary mandrel support and the inclined section of the said other secondary mandrel around the primary mandrel and the said other secondary mandrel in tight loops alternating with and in lateral pressure contact with the loops of the first filament; and means for treating the interlocking coils while sliding on the secondary mandrels to fix them in a permanently coiled form.

NICHOLAS A. WAHL.

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