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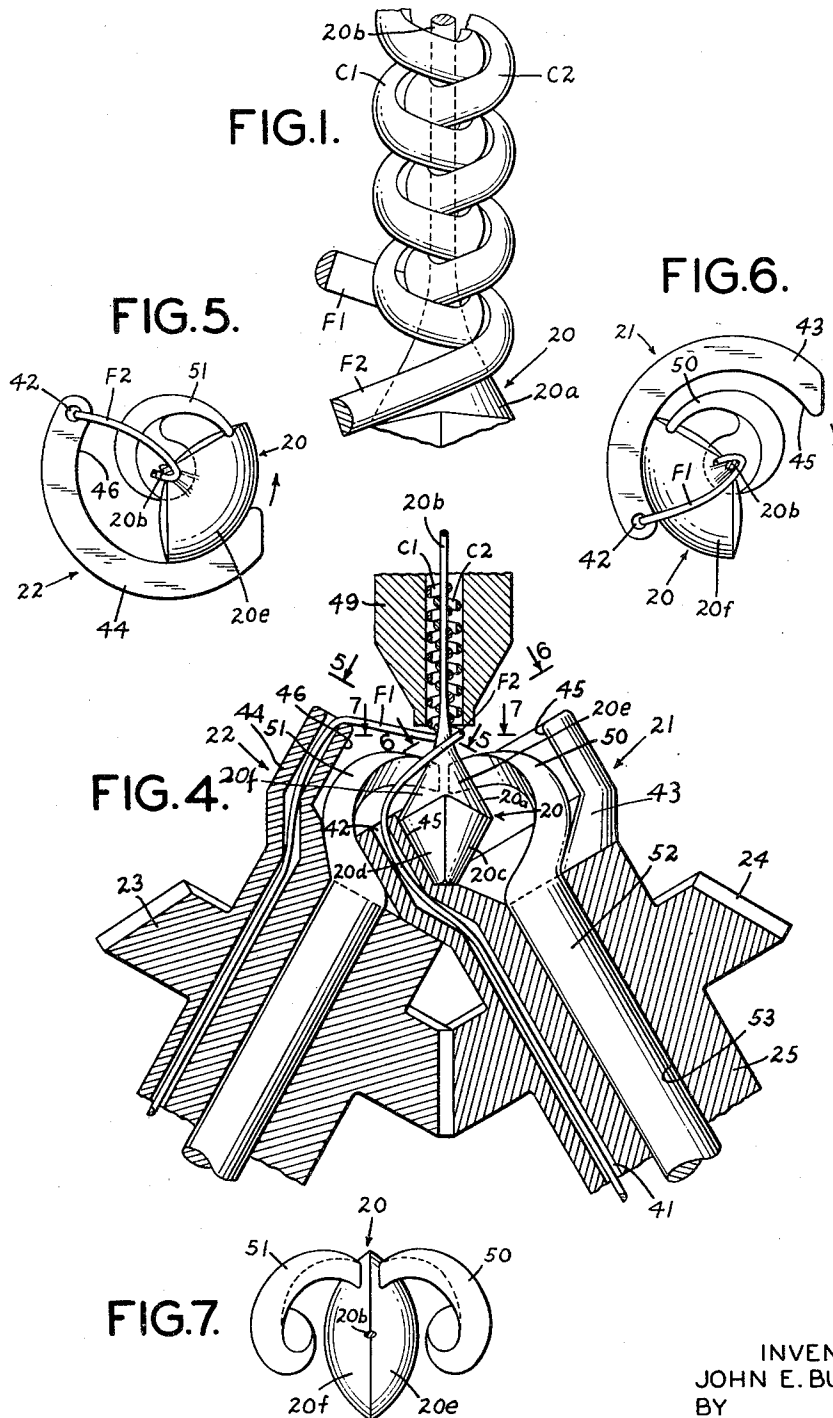
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3,053,288

COILER WITH FLOATING MANDREL

Filed June 27, 1958

5 Sheets-Sheet 1



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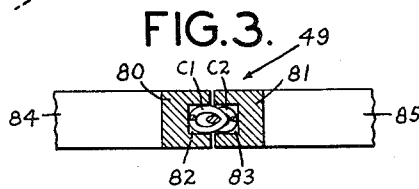
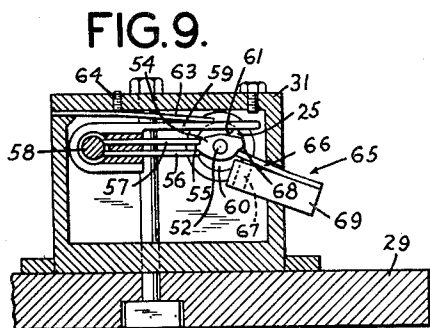
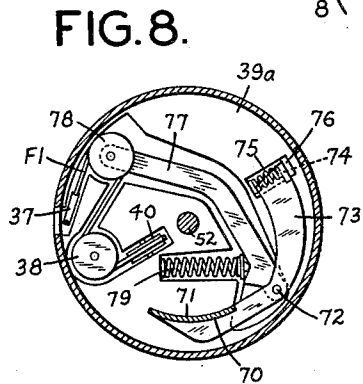
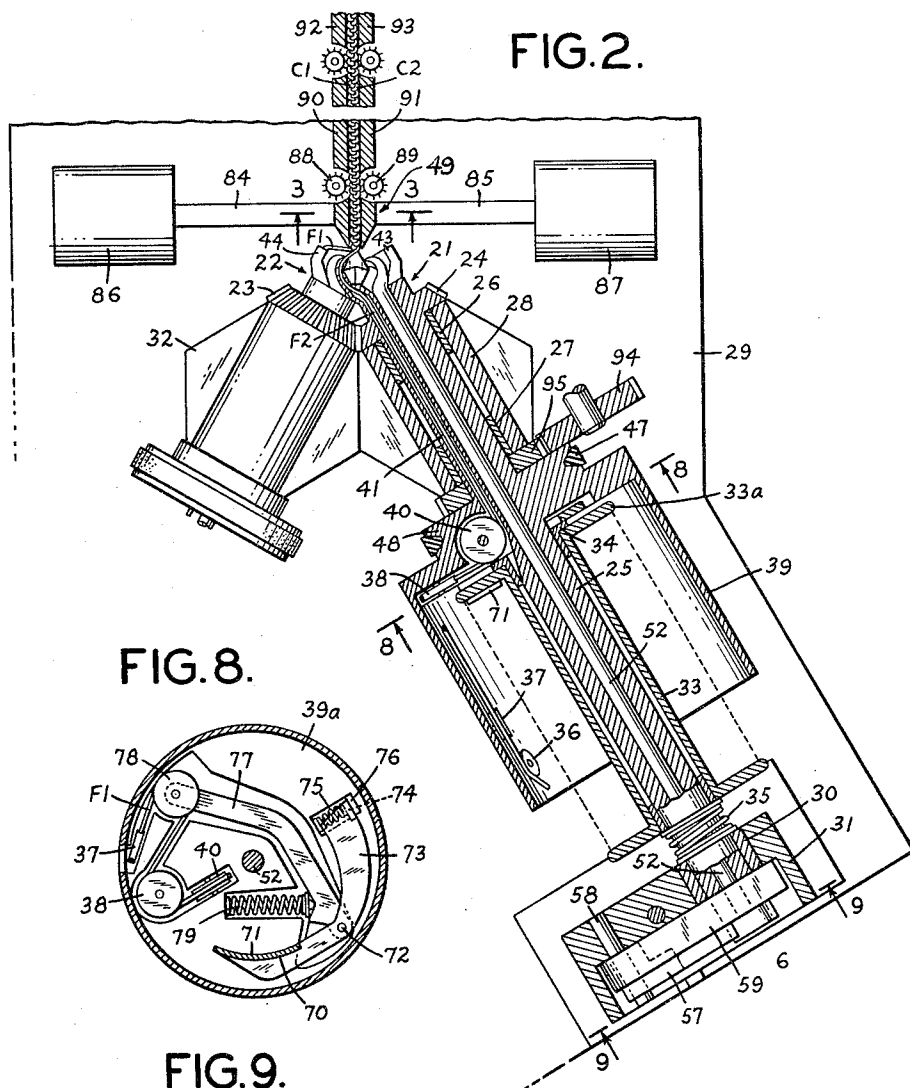
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COILER WITH FLOATING MANDREL

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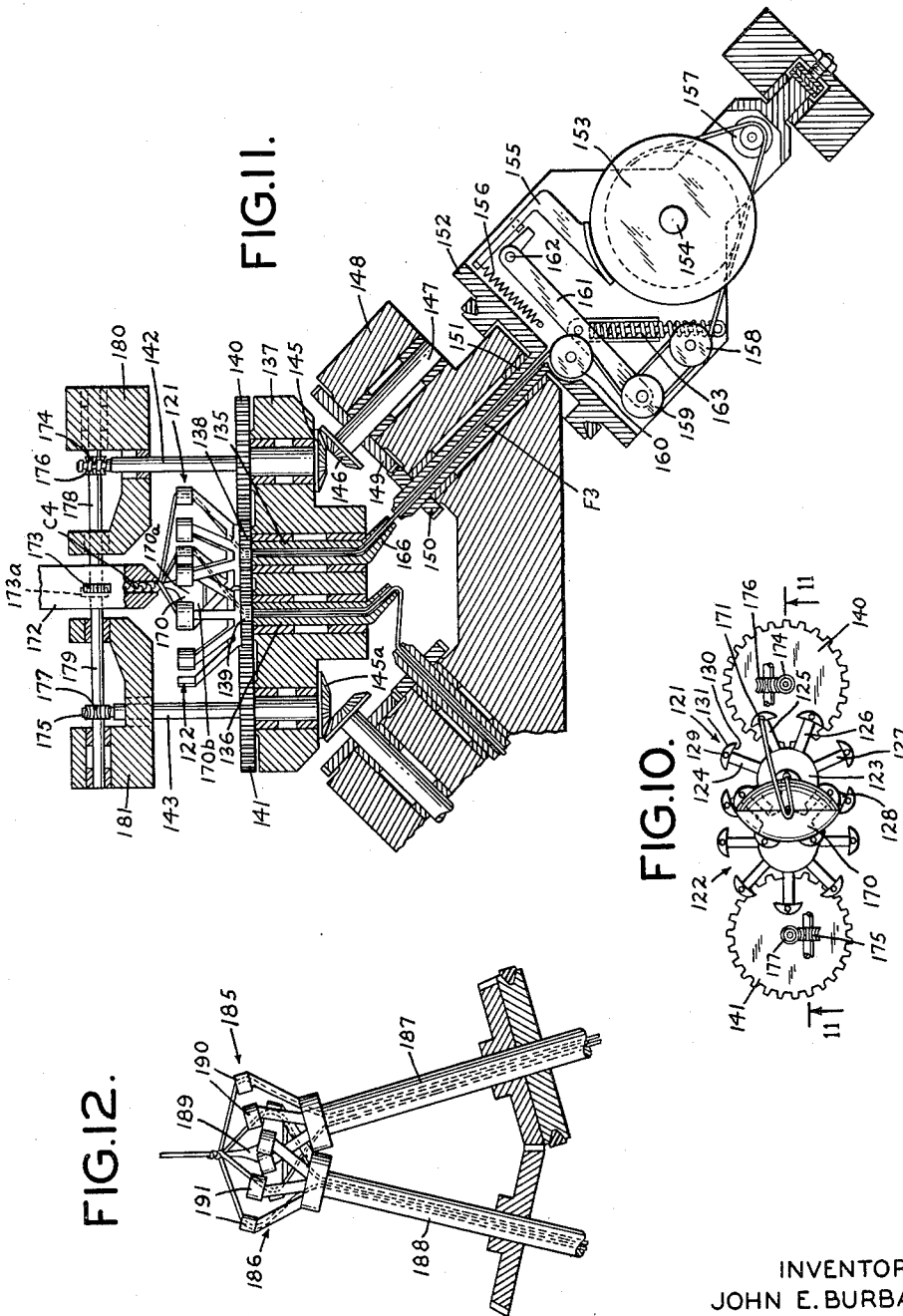
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COILER WITH FLOATING MANDREL

Filed June 27, 1958

5 Sheets-Sheet 3



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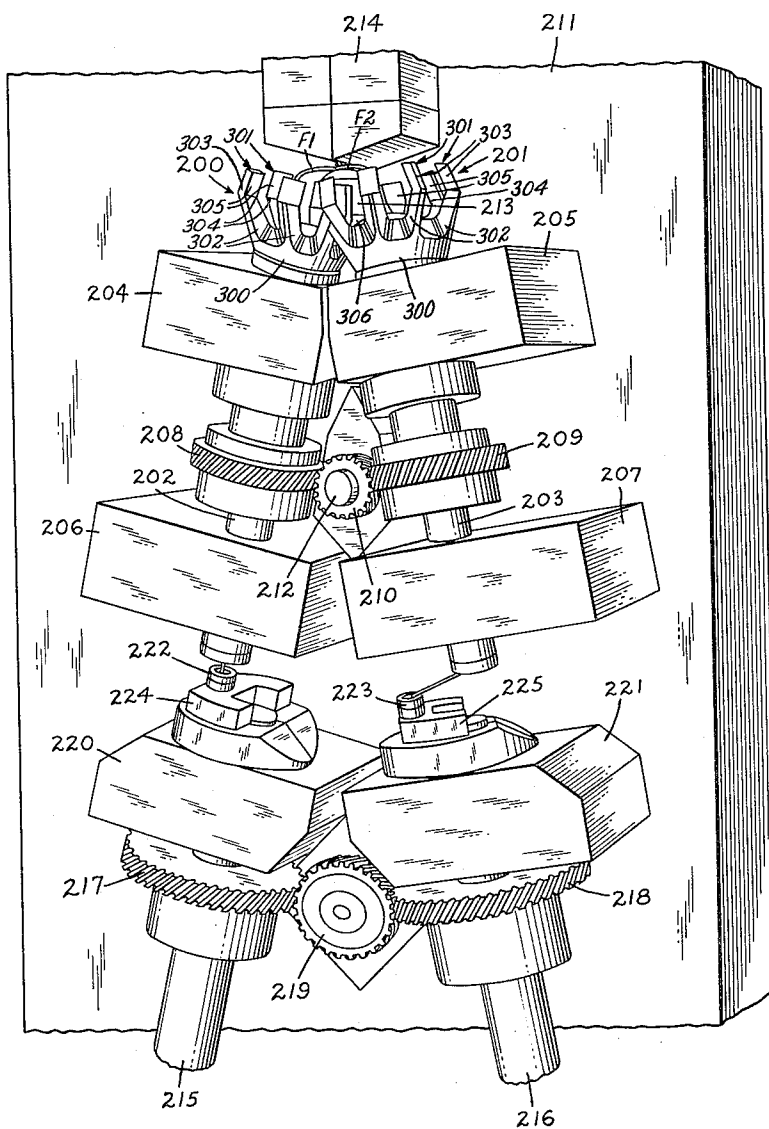
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COILER WITH FLOATING MANDREL

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5 Sheets-Sheet 4

FIG. 13.



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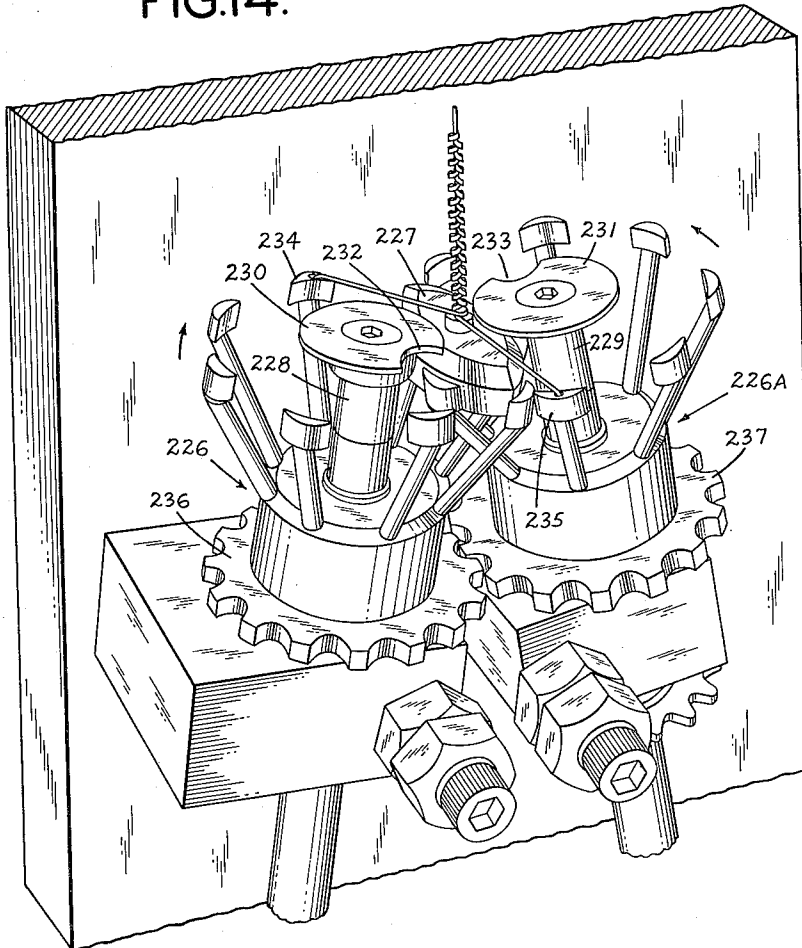
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COILER WITH FLOATING MANDREL

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FIG.14.



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3,053,288

COILER WITH FLOATING MANDREL

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Filed June 27, 1958, Ser. No. 744,973

16 Claims. (Cl. 140—92.1)

This application relates to improvements in apparatus for making coils of filamentary material and it relates particularly to an improved machine for making interlocking coils of filamentary material such as nylon and other plastic filaments, wire and the like which are suitable for use as the interlocking fastening elements of slide fasteners and for making other twisted articles such as cords, cable, ropes and the like.

This is a continuation-in-part of application Serial No. 679,328, filed August 21, 1957 and now abandoned.

Prior machines, similar to braiding machines, used for the formation of interlocking coils of filamentary material, include a post or mandrel around which are passed, in suitable orbits, spools carrying the filaments from which the coils are made. In order to enable the spools to move around the mandrel, they must be mounted on carriers which include interrupted guide rings to enable one ring to pass through the other. These prior machines have a number of disadvantages when used to manufacture interlocking coils. Inasmuch as the spools of filaments must be mounted eccentrically of the axes of the carriers to enable the spools to move orbitally around the mandrel, the carriers are inherently unbalanced. When the carriers are balanced in order to compensate for the weight of full spools of the filament, they become progressively more unbalanced as the filament is withdrawn from the spools, thereby setting up vibrations in the apparatus and preventing high speed operation of the machine.

The segmental or interrupted arrangement of the carriers also introduces a structural weakness in the machine which appears upon attempts to operate the machine at high speed. The ring elements expand due to centrifugal force and bind in the tracks in which they are mounted. Accordingly, the maximum speed of operation of the machine and the productive capacity of the apparatus or machine are limited.

In accordance with the present invention, I have provided a coiling machine which can be operated at much higher speed over much longer periods of time than the prior machines, thereby resulting in greatly increased productive capacities.

More particularly, in accordance with the present invention, the new machines include a floating mandrel or coiling needle which is not directly connected to any other part of the machine but is held in position by cooperation of the parts of the machine so that the filaments can be passed over, around and under the mandrel during operation. The floating arrangement of the mandrel obviates the need for eccentrically mounted parts so that the cooperating elements of the machine can be statically and dynamically balanced at all operating speeds enabling the machines to be operated at speeds not hitherto obtained.

In the new machine, the mandrel is supported against lateral movement, in part, by means of guide elements through which the coils pass as they are formed and, in part, by engagement with the coiling heads which wind the filaments around the mandrel. The structure of the mandrel and the arrangement of the coiling heads is such that the mandrel is subjected to forces applied by the filaments tending to seat it against the coiling heads and also acting to move the coils along and discharge them from the mandrel.

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For a better understanding of the present invention reference may be had to the accompanying drawings in which:

FIGURE 1 is a view in elevation and partly broken away of the mandrel of the coiling machine showing the formation of coils or filaments;

FIGURE 2 is a view partly in side elevation and vertical section and broken away of a machine of the type embodying the present invention for coiling filaments;

FIGURE 3 is a view in section taken on line 3—3 of FIGURE 2;

FIGURE 4 is a view in vertical section through a portion of the coiling elements and the coil guide of the apparatus;

FIGURE 5 is a view in section taken on line 5—5 of FIGURE 4;

FIGURE 6 is a view in section taken on line 6—6 of FIGURE 4;

FIGURE 7 is a view in section taken on line 7—7 of FIGURE 4;

FIGURE 8 is a view in section taken on line 8—8 of FIGURE 2;

FIGURE 9 is a view in section taken on line 9—9 of FIGURE 2;

FIGURE 10 is a plan view of a modified type of coiling apparatus embodying the present invention;

FIGURE 11 is a view in vertical section taken on line 11—11 of FIGURE 10;

FIGURE 12 is a view in side elevation of the coiling elements and mandrel of another form of coiling apparatus embodying the invention;

FIGURE 13 is an isometric view of a modified form of coiling device embodying the present invention, and

FIGURE 14 is an isometric view of another form of coiling head embodying the present invention.

Referring to FIGURE 1 of the drawing in accordance with the invention, a pair of interlocking coils C1 and C2 are formed by wrapping or winding a pair of filaments F1 and F2 alternately in opposite directions around the mandrel 20. A bulbous base 20a on the mandrel 20 having an upper surface of tapering formation guides the filaments upwardly along a needle or wire-like upper end portion 20b of the mandrel as they are wound. The filaments F1 and F2 are of generally semi-cylindrical shape but they may be of any other oblong cross-section such as rectangular, oval, arcuate or the like.

A pair of coiling heads 21 and 22 (FIGS. 2 and 4) of substantially identical construction are driven in opposite directions by means of meshing bevel gears or the like 23 and 24, to wind the filaments F1 and F2 around the mandrel. As indicated in FIGURE 4, the coiling head 22 rotates in a counterclockwise direction while the coiling head 21 rotates in a clockwise direction.

As shown in FIGURE 2, the coiling head 21 is fixed to the upper end of a hollow shaft 25 which has its upper end rotatably mounted in bearings 26 and 27 in a bearing sleeve 28 mounted on a base plate 29 forming the frame of the machine. A bearing 30 mounted in a hollow bearing block 31 detachably mounted on the plate 29 supports the lower end of the shaft 25 rotatably.

An upper bearing block 32 and lower bearing block like the block 31 support the coiling head 22.

The bearing block 31 is detachably mounted on the plate 29 to enable a spool 33 filled with the filament F2 to be slipped onto the shaft 25 over a collar or bearing 34 on the shaft 25. A compression spring 35 holds the spool against endwise movement but permits the spool to rotate relative to the shaft 25 as the filament is drawn off the spool. The filament is directed to the coiling head 21 by means of guide pulleys 36, 37 and 38 carried by a shroud 39 of hollow cylindrical form which is fixed to and carried by the shaft 25. It will be understood that filament

guides such as the pulleys 36, 37 and 38 are mounted on the shroud or other elements of the apparatus at each point where the filament changes direction. A pulley 40 on the shroud 39 guides the filament onto the bore or passage 41 which extends lengthwise of the shaft 25 eccentric to its axis and out through the opening 42 (FIGURE 6) in the edge of an arcuate segmental flange 43 at the upper end of the shaft 25 as best shown in FIGURES 2, 4 and 6. A similar segmental flange 44 is formed on the coiling head 22 in such relation to the flange 43 that they pass by each other without interference as the coiling heads rotate in clockwise and counterclockwise directions. Each of the coiling heads is inclined at an acute angle to the axis of the mandrel 20, and each has a generally cylindrical inner surface 45 and 46 which bears against the opposite downwardly tapering arcuate sides 20c and 20d of the bulbous portion 20a of the mandrel 20 thereby supporting the mandrel against downward movement during rotation of the coiling heads 21 and 22.

From the description thus far, it will be apparent that as the coiling heads 21 and 22 are rotated, for example, by means of a drive belt 47 which engages a pulley portion 48 at the upper end of the shroud 39, the filaments F1 and F2 will be wound in opposite directions around the wire-like extension 20b, and against an upper surface of the enlarged or bulbous portion 20a of the mandrel 20. Downward and lateral movement of the mandrel is prevented by engagement with the contacting surfaces 45 and 46 of the coiling head and by means of the guide 49 through which the coils C1 and C2 pass while moving upwardly along the wire-like portion 20b of the mandrel. Moreover, the tension on the filaments during winding of the coils around the wire-like portion 20b, aids in retaining the mandrel 20 against substantial lateral and upward movement with respect to the coiling heads 21 and 22.

Positioning of the mandrel 20 against upward movement is further assured by means of a pair of arcuate arms 50 and 51 which move intermittently into and out of engagement with the inclined upper surfaces 20e and 20f on the bulbous portion 20a of the mandrel. The arms 50 and 51 are moved in and out in timed relation to the motion of the filaments F1 and F2 around the mandrel to provide a gap between the ends of the arms and the surfaces 20e and 20f through which the filaments pass as they are wound around the mandrel. Such movement is produced by mounting the arm 50 on a shaft 52 which extends through the hollow center 53 of the shaft 25 and rocked by means of a rocker member 54 fixed to its lower end and disposed within the bearing block 31, as shown in FIGURE 9. A projection 55 is formed at one end of the rocker and engages between a pair of levers 56 and 57 on a rock shaft 58 which is journaled in the bearing block 31 as shown in FIGURES 2 and 9. A longer lever 59 is fixed to the rock shaft 58 and engages a cam disc 60 fixed to the lower end of the shaft 25. A flat 61 is formed on the cam disc 60 so that as the cam disc 60 rotates with the shaft 25, the lever 59 and the levers 56 and 57 are alternately rocked in a counterclockwise and clockwise direction resulting respectively in a clockwise and counterclockwise rotation of the shaft 52. Thus, when the lever 59 engages the flat 61, the arm 50 is raised out of contact with the mandrel 20, while engagement with the circular surface of the cam disc 60 causes the arm 50 to engage the surface 20e of the mandrel 20. A similar rocking mechanism is provided for rocking the arm 51. The timing of the movement of the arms 50 and 51 is such that the arms are out of contact with the mandrel 20 when the filaments F1 and F2 must pass the ends of the arms 50 and 51.

A leaf spring 63 is mounted in the bearing block 31 to engage the lever arm 59 to keep it in contact with the cam disc 60 and the pressure of the spring may be adjusted by means of a set screw 64 threaded into the bearing block 31. Movement of the rocker 54 is limited by means

of a stop member 65 including a spring 66 which may be adjusted by means of a set screw 67 to engage an extension 68 or shoulder on the rocker 54. A base member 69 to which the outer end of the spring 66 is anchored and which carries an adjusting set screw 67 is fixed to the bearing block 31.

Inasmuch as the filaments cross each other as they are wound around the mandrel 20, it will be apparent that during a portion of the movement of the filaments they are alternately drawn from the spool at greater and lesser speeds. In order to eliminate this variation in speed, the wire-like portion 20b of the mandrel may be mounted slightly eccentric with respect to the coiling heads 21 and 22 so that the distance covered by the filaments in traveling around the mandrel remains the same during each increment of the coiling movement.

Appropriate means for maintaining tension on the filaments may be provided in accordance with textile filament winding practice. As shown in FIGURES 2 and 8, a suitable form of tension mechanism may include a brake member 70 having an arcuate brake shoe 71 thereon which slidably engages the upper flange 33a of the spool 33 and thus restricts its rotation relative to the shroud 39. The spool 33 is placed on the shaft 25 in such position that it rotates in the opposite direction from the shaft 25 as the filament is unwound from the spool. The brake member 70 is a bell crank element carrying the brake shoe 71 on one arm and is mounted on a pivot member 72 which projects downwardly from the upper end 39a of the shroud 39. A flange 74 on the opposite end of the brake member 70 bears against a coil spring 75 mounted within a recess 76 in the end 39a of the shroud 39 so that the brake shoe 71 is biased against the flange of the spool.

An arm 77 is mounted at one end of the pivot member 72 and carries a pulley 78 at its other end over which the filament F1 is looped in passing from the pulley 37 to the pulley 38. A spring member 79 is also carried by the head 39a of the shroud and biases the arm 77 in a clockwise direction to enable a slack to be taken up in the filament.

The brake member 70 is substantially balanced against centrifugal force so that its pressure on the spool flange is unchanged by the rotation of the coiling head 21. Similar thread tensioning, winding and take-up devices are provided for the coiling head 22.

In order to aid in shaping and advancing the intermeshed coils C1 and C2 as they are formed, the guide 49 may include a pair of opposed plates 80 and 81 having appropriately shaped grooves 82 and 83 in their confronting faces as shown in FIGURE 3. The plates 80 and 81 are connected by means of arms 84 and 85 (FIG. 2) to vibrators 86 and 87 of mechanically or electrically actuated type so that they move toward and away from the coils and desirably are given an upward component during their inward movement in order to feed the coils along to the sprockets 88 and 89. If desired, the guides 90, 91, 92 and 93 in alignment with the grooves 82 and 83 may also be vibrated and all or part of these guides and the guide 49 may be provided with appropriate heating means to aid in shaping the coils. Any number of additional sprocket elements may be provided to advance the coils endwise, and the sprockets can be driven by suitable connections between them and a power takeoff gear 94 which meshes with a gear 95 fixed to the shaft 25.

From the preceding description, it will be apparent that upon rotation of the coiling heads 21 and 22, the filaments F1 and F2 will alternately pass beneath and above the enlarged base 20a of the mandrel and around the wire-like portion 20b with the arms 50 and 51 lifting in order to permit passage of the filaments under them but moving back against the upper surface of the mandrel to hold it against upward movement. Downward movement of the mandrel 20 is prevented by its engagement with inner surfaces 45, 46 on the coiling heads 21 and 22

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and this action is aided by the action of the filaments themselves which alternately pull down against the upper surfaces 20e and 20f of the enlarged base of the mandrel and lift up to force the coils along the wire-like portion 20b of the mandrel. Proper tensioning of the filaments is assured by the spool brake mechanism 70 and proper balance of the elements during high speed rotation thereof is maintained because of the coaxial relation of the filament spools 33 with respect to the shafts supporting coiling heads 21 and 22. Inasmuch as the system can be balanced statically and dynamically and large spools of filament can be used, the machine can be operated at many times the speed of the prior types of braiding or coiling machines and for long periods of time between shut-downs for replacing the spools of filaments.

A modified type of machine operating on the same general principles is disclosed in FIGURES 10 and 11. In this machine, the coiling heads 121 and 122 are of different form than those described above. Inasmuch as the coiling heads 121 and 122 are similar, only one of them will be described. The coiling head 121 includes a disc-like base member 123 which has a plurality of upwardly and outwardly inclined, equally spaced arms 124, 125 and 126, 127, 128 etc. carrying enlargements 129 having inner surfaces forming segments of a circle and arcuate outer surfaces of shorter radii of curvature. The spacing and angular relation of the arms of the coiling heads 121 and 122 is such that upon rotation of the heads in opposite directions, the arms of one head will pass between the arms of the other head. Proper spacing between the coiling heads 121 and 122 is obtained by affixing hollow shafts 135 and 136 to their base members and mounting these shafts rotatably in a supporting block 137 mounted on the frame of the machine so that the coiling heads 121 and 122 rotate about parallel axes. Inasmuch as the heads 121 and 122 are connected by means of the gears 138 and 139, the arms thereon move in properly timed relation. Rotation of the heads is produced by means of the drive gears 140 and 141 which are fixed to the parallel shafts 142 and 143 and which can be driven by means of a suitable power means such as an electric motor. The shafts 142 and 143 are provided with identical power takeoffs for driving a carrier for a filament spool. The power takeoff for shaft 142 includes a bevel gear 145 which meshes with another bevel gear 146 carried by a shaft 147 mounted in a lower portion 148 of the frame. A gear 149 on the shaft 147 meshes with a gear 150 carried by a hollow shaft 151 through which the filament F3 is supplied to the hollow shaft 135 and to the coiling head 121. At the lower end of the hollow shaft 151 is mounted a carrier 152 for a filament spool 153 supported on a shaft 154 that extends perpendicular to the shaft 151.

Thread tensioning means including a brake 155 which bears against a flange of the spool 153 and is biased against it by means of a spring 156 is mounted on the carrier 152. Also, guide and takeup means including the pulleys 157, 158, 159 and 160 are mounted on the carrier for guiding the thread into the hollow shaft 151. The thread takeup means includes the pulley 159 which is mounted on a lever 161 carried by a pivot 162 and normally biased upwardly by means of a spring 163.

The shaft 135 has a laterally extending tip portion 166 which compensates for different lengths of travel of the filaments as they pass around the mandrel 170.

As shown in FIGURE 10, the base 170a of the mandrel 170 is of generally oval shape and fits between and engages the inner surfaces of the meshed enlarged portions 129 at the ends of the arms on the coiling heads 121 and 122. Lateral movement of the mandrel 170 is prevented by engagement thereof with the enlarged portions 125 to 129 etc. Engagement of a tapered under surface 170b on the mandrel 170 with the inclined arms prevents downward movement of the mandrel.

Inasmuch as the filament is fed out through an opening 171 in one arm of each of the coiling heads and these

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arms are disposed somewhat below the level of the upper tapered portion of the mandrel 170, the filaments tend to pull the mandrel downwardly and thereby prevent it from moving upwardly out of engagement with the arms.

The interlocking coils C4 formed by coiling of the filaments around the mandrel move up to a forming device 172 which is similar to the forming device 49 and associated elements of the device shown in FIGURE 2.

Sprockets 173, 173a for advancing the coils are rotated by means of the shafts 142 and 143 which have worms 174 and 175 on their upper ends engaging worm gears 176 and 177 on the shafts 178 and 179 to which the sprockets 173 and 173a, respectively, are fixed. The shafts 179 and 178 as well as the upper ends of the shafts 142 and 144 are mounted in suitable brackets 180 and 181 at the top of the machine.

Operation of the machine shown in FIGURES 10 and 11 is similar to that of the machine disclosed in FIGURES 1 to 9.

A modified machine shown in FIGURE 12 differs from the machine shown in FIGURES 10 and 11 in that the coiling heads 185 and 186 are mounted in inclined relation on the downwardly diverging shafts 187 and 188. The mandrel 189 differs from the mandrel 170 in that its surfaces are appropriately inclined for engagement with the small enlarged portions 190 and 191 on the arms of the coiling heads 186.

FIGURE 13 discloses a modification of the form of the invention shown in FIGURES 10, 11 and 12. This form of coiling device, the coiling heads 200, 201 are similar to the coiling heads 185 and 186 of FIGURE 12 and are similarly mounted on inclined shafts 202 and 203, respectively. Bearing blocks 204, 205, 206 and 207 support the shafts 202 and 203 rotatably. Spiral gears 208 and 209 are fixed to the shafts 202 and 203, respectively, and are driven by means of a spiral gear 210 which extends through the supporting plate or frame 211 which the bearing blocks are secured to. An electric motor or other suitable means may be provided for driving the shaft 212 to which the spiral gear 210 is fixed and thereby rotating the coiling heads.

In view of the fact that these coiling heads 200 and 201 are also similar only one will be described. Each of these coiling heads comprises a shank portion 300 having a plurality of equally spaced apart odontoid or finger-like members 301 arranged circumferentially around the periphery thereof. Each of these finger-like portions has an outwardly radially extending inclined portion 302 terminating in an inwardly inclined portion 303 so as to provide a shoulder 304 therebetween. The inner surfaces of each of the inwardly inclined portions 303 is concavely arcuated, as at 305, so as to form segments of a circle. As before, the spacing and angular relation of these odontoid or finger-like members 301 is such that upon rotation of the respective heads in opposite directions, the finger-like members of one head will pass between the finger-like members of the other head and intersect the rotatable path of each other. That is to say, the finger-like members of one head engage in a gear-like manner with those of the other head so as to provide a space 306 when they overlap one another.

The boat-like oval-shaped floating mandrel or needle holder 213 has arcuated side walls similar to those shown in FIG. 15, arranged on opposite sides thereof which cooperate with the arcuated inner concave surfaces 305 of the inwardly inclined portions 303 of the finger-like members 301. This floating mandrel member is disposed in the space 306 at the overlap of the finger-like members between the coiling heads 200 and 201 as to be disposed floatively therebetween on the shoulders 304 carried thereby as the heads are rotated. As before, the filaments F1 and F2 will pass up through one of the finger-like members 301 of each of the heads 200 and 201 and around the mandrel or needle extending into the guide

As explained in the description of the form of the invention disclosed in FIGURES 10 and 11, means may be provided for compensating for the different distances the filaments must make as they pass around the mandrel 213. To that end, the form of the invention shown in FIGURE 13 includes a pair of auxiliary shafts 215 and 216 provided with spiral gears 217 and 218 which are driven by means of the spiral gear 219 connected to and driven by means of the motor which drives the gear 210. The shafts 215 and 216 rotate at the same speed as the shafts 202 and 203. However, the shafts 215 and 216 are mounted in bearing blocks 220 and 221 with their axes of rotation offset from the axes of rotation of the shafts 202, 203.

Filament is supplied to the coiling heads from spools (not shown) which are mounted on and rotate with the shafts 215 and 216 as shown in FIGURE 11, the filaments passing through the shafts and through the guides 222 and 223 which are mounted on heads 224 and 225 fixed to the upper ends of the shafts 215 and 216. The guides 222 and 223 are eccentric to the axes of rotation of the shafts 215 and 216 as well as the axes of rotation of the shafts 202 and 203, by an amount sufficient to compensate for the eccentricity of the yarn guides of the coiling heads 200 and 201 with respect to the mandrel 213. By disposing the yarn guide of the head 200, for example, so that it is in a position farthest away from the mandrel when the corresponding guide 222 is closest to the axis of the shaft 202, the filament will be withdrawn smoothly and continuously from the spool carried by the shaft 215.

Coiling devices of the type disclosed for example in FIGURES 10 to 14 may also be provided with other kinds of guides for positioning the mandrel with respect to the coiling heads.

Thus, as shown in FIGURE 4, the coiling heads 226 and 226A which cooperate with the mandrel 227 are provided with extension shafts 228 and 229 having discs 230 and 231 fixed to their upper ends. Each of the discs 230, 231 is provided with a peripheral notch 232 or 233 spaced substantially diametrically from the yarn guides 234, 235 of the corresponding coiling heads 225, 226. The discs 230, 231 are inclined to engage the top surface of the mandrel, but the notches 232 and 233 therein permit passage of the filaments around the needle-like extension of the mandrel 227 without danger of pinching and damaging the filaments. The coiling heads 226 and 226A are interconnected for rotation in opposite directions by means of the gears 236 and 237 and may be driven in any suitable way, as described above.

It will be understood that the principles underlying the apparatuses described above can be embodied in machines which differ in size and shape of the elements thereof, and in the mechanism for driving them. Moreover, the types of thread tensioning mechanisms and thread guides disclosed may also be modified widely. Moreover, in making other types of coils, for example, for use of springs, cables and the like, more than one of the enlargements on the arms of coiling heads disclosed in FIGURES 10 to 12 may be arranged to supply filaments to the needle or mandrel to form elements having three or more filaments twisted together. In view of the foregoing, it will be apparent that the forms of the invention described above should be considered as illustrative and not as limiting the scope of the following claims.

I claim:

1. A coiling machine comprising a pair of coiling heads, at least one outwardly extending segmental portion on and extending partially around each head and arranged angularly relative to the axes thereof and having an inner concavely curved surface, guide means for feeding filaments eccentric to the axis of each head, supporting means for a supply of filament rotatable and substantially concentric with said heads, means supporting said heads for rotation with said segmental portion and said guide means

on one head moving in orbital paths intersecting the paths of the segmental portion and guide means on the other head, means for rotating said heads in opposite directions, and a coiling mandrel having opposed arcuated convex sides free from connection with said coiling heads and interposed between said segmental portions on the concavely curved surfaces carried thereby so as to be floatingly supported thereby, said mandrel having a base portion slidably engaging said heads and being positioned against lateral movement by intermittent engagement therewith of the curved surfaces on said heads, said base portion having a shape substantially conforming to the shape of the area outlined by the intersecting paths of said curved surfaces, and means opposing said heads for retaining said mandrel in engagement with said heads and between said segmental portions.

2. A coiling machine comprising a pair of coiling heads, at least one outwardly extending segmental portion on and extending partially around each head and arranged angularly relative to the axes thereof and having an inner concave arcuate surface, guide means for feeding filaments eccentric to the axis of each head, means supporting said heads for rotation with said segmental portion and said guide means on one head moving in orbital paths intersecting the paths of the segmental portion and guide means on the other head, means for rotating said heads in opposite directions and a coiling mandrel having opposed arcuated convex sides free from connection with said coiling heads and interposed between the segmental portions on the concavely curved surfaces carried thereby so as to be floatingly supported thereby, said mandrel having a base portion substantially conforming to the shape of the area outlined by the intersecting portions of the paths of said surfaces, said base portion slidably engaging said heads, and being positioned against lateral movement by intermittent engagement thereof with the arcuate surfaces on said heads.

3. The coiling machine set forth in claim 2, in which each head has a plurality of said segmental portions mounted thereon in angularly spaced relation, the segmental portions on one head being offset angularly with respect to the segmental portions on the other heads to enable the segmental portions on one head to pass between the segmental portions on the other heads in following their orbital paths.

4. The coiling machine set forth in claim 2, in which the filament guide means on one head is offset angularly with respect to the filament guide means on the other head to enable them to move freely around the mandrel in their circular paths.

5. The coiling machine set forth in claim 2, in which said heads are inclined relatively at an acute angle and a portion of one head overlies and is inclined with respect to the other head and said base portion has convexly curved surfaces on opposite sides thereof substantially concentric with said arcuate surfaces on said segmental portions.

6. The coiling machine set forth in claim 2, comprising a shroud coaxial with each head for receiving a spool of filament and means in said shroud for receiving a filament supply spool rotatably and coaxially with relation to the axis of said head.

7. A coiling machine comprising a pair of shafts, means supporting said shafts for rotation about their axes, means for rotating said shafts in opposite directions, means for supporting a supply of filament on each shaft substantially concentric therewith, a coiling head mounted on each shaft, a filament guide mounted on each head eccentric to the axis of the shaft, said filament guides being movable in intersecting circular paths, means mounted on each shaft for directing a filament from the supply to the guide of each head, at least one outwardly extending member on each head offset from the axis of said shaft and having an arcuate concave surface concentric

with the axis of the shaft on which the member is mounted, said members and said arcuate surfaces being mountable in intersecting circular paths, a mandrel floating between said members of said head and having a base portion within and conforming substantially in shape to the area within the intersecting portions of the paths of said surfaces and held against lateral movement by engagement between said surfaces of said members, and a guide member loosely receiving a portion of said mandrel to restrain it against movement away from said coiling heads.

8. The coiling machine set forth in claim 7, in which said mandrel comprises a wire-like extension around which said filaments are wound to form coils, said extension extending into said guide member for guiding said coils into said guide member.

9. The coiling machine set forth in claim 7, comprising means for vibrating said guide member and in which said mandrel comprises a wire-like extension around which said filaments are wound to form coils, said extension extending into said guide member for guiding said coils into said guide member.

10. The coiling machine set forth in claim 7, comprising means for heating said guide member and in which said mandrel comprises a wire-like extension around which said filaments are wound to form coils, said extension extending into said guide member for guiding said coils into said guide member.

11. The coiling machine set forth in claim 7, comprising means for heating said guide member and means for vibrating said guide member and in which said mandrel comprises a wire-like extension around which said filaments are wound to form coils, an arm mounted on each head for rocking movement about an axis coaxial with said head, and means for intermittently rocking said arms into engagement with said base portion adjacent said wire-like extension to restrain said mandrel and out of engagement with said base portion to enable said filaments to pass around said wire-like extension between said arms and said base portion.

12. A coiling machine comprising a pair of rotatable coiling heads, a filament guiding means offset from the center of each coiling head, means for rotating said coiling heads to cause said filament guiding means to describe orbital paths having portions thereof intersecting, a mandrel floating relative to said coiling heads and including a base portion having opposite eccentric arcuate surfaces, segmental surfaces on said heads slidably engaging said arcuate surfaces on said mandrel and supporting it against lateral and rotary movement between the intersecting portions of said orbital paths, means for supplying filaments to said guide means, and means eccentric to the axes of rotation of said coiling heads and offset angularly from said guiding means for causing the filaments to travel equal distances from their respective supply means to said mandrel during rotation of said coiling heads.

13. A coiling machine comprising a pair of rotatable coiling heads, a filament guiding means offset from the center of each coiling head, means for rotating said coiling heads in opposite directions to cause said filament guiding means to describe orbital paths intersecting at two spaced-apart portions of said paths, and a mandrel free of connection with said coiling heads and having a base portion floating between and substantially conforming in shape to the area outlined by the intersecting portions of said orbital paths, said coiling heads passing said filaments in opposite directions around and behind the mandrel as said coiling heads rotate.

14. A coiling machine comprising a pair of rotatable coiling heads, each of said heads having a plurality of outwardly extending equally spaced-apart finger-like members arranged angularly and circumferentially around the periphery thereof, the inner surface of the outer end portion of each of said finger-like portions being concavely arcuated so as to form segments of a circle, the spacing and angular arrangement of said finger-like members being such that upon rotation of the respective heads in opposite directions the finger-like members of one head will pass between the finger-like members of the other head with the finger-like members on one head moving in an orbital path intersecting the path of the finger-like members on the other head, means for supporting and rotating said heads in opposite directions, a floating mandrel holder arranged in the space between the finger-like members of the respective heads, a mandrel carried by said head around which the filaments are adapted to be wound to form coils, said floating holder having opposed convex side walls which cooperate with the inner concave surfaces of said finger-like members, and means for supplying a filament to a finger-like member of each of said heads substantially concentric therewith.

15. A coiling machine, as defined in claim 14, wherein the axis of one head is inclined at an acute angle relative to the other and includes a pair of rotatable shafts which support the same which are also inclined relatively at an acute angle.

16. A coiling machine, as defined in claim 15, wherein one of the finger-like members on each of said heads has an aperture therethrough for receiving a filament and guiding it to the upper end of the same, a filament adapted to pass up through each of said shafts to the aperture and therethrough to the upper end of the respective finger-like members.

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