July 14, 1970 J. C. ANDERSON ET AL 3,520,494

DWELL CLUTCH FOR FILAMENT WINDING APPARATUS

Filed Aug. 24, 1967 3 Sheets-Sheet 1

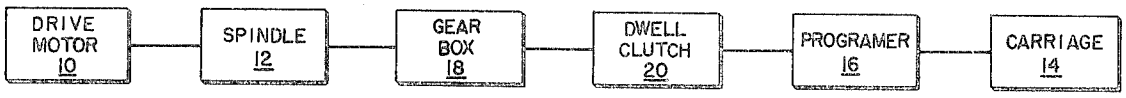


FIG. 1.

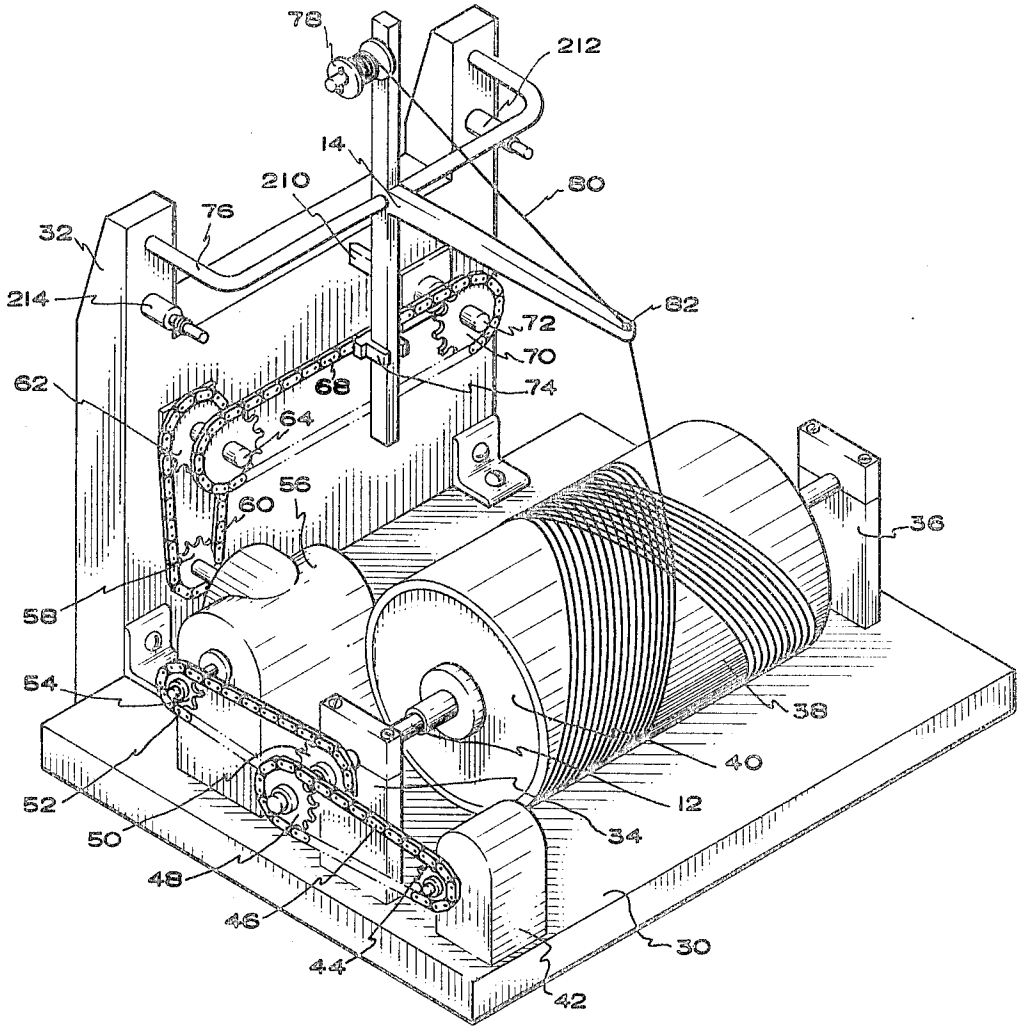


FIG. 2.

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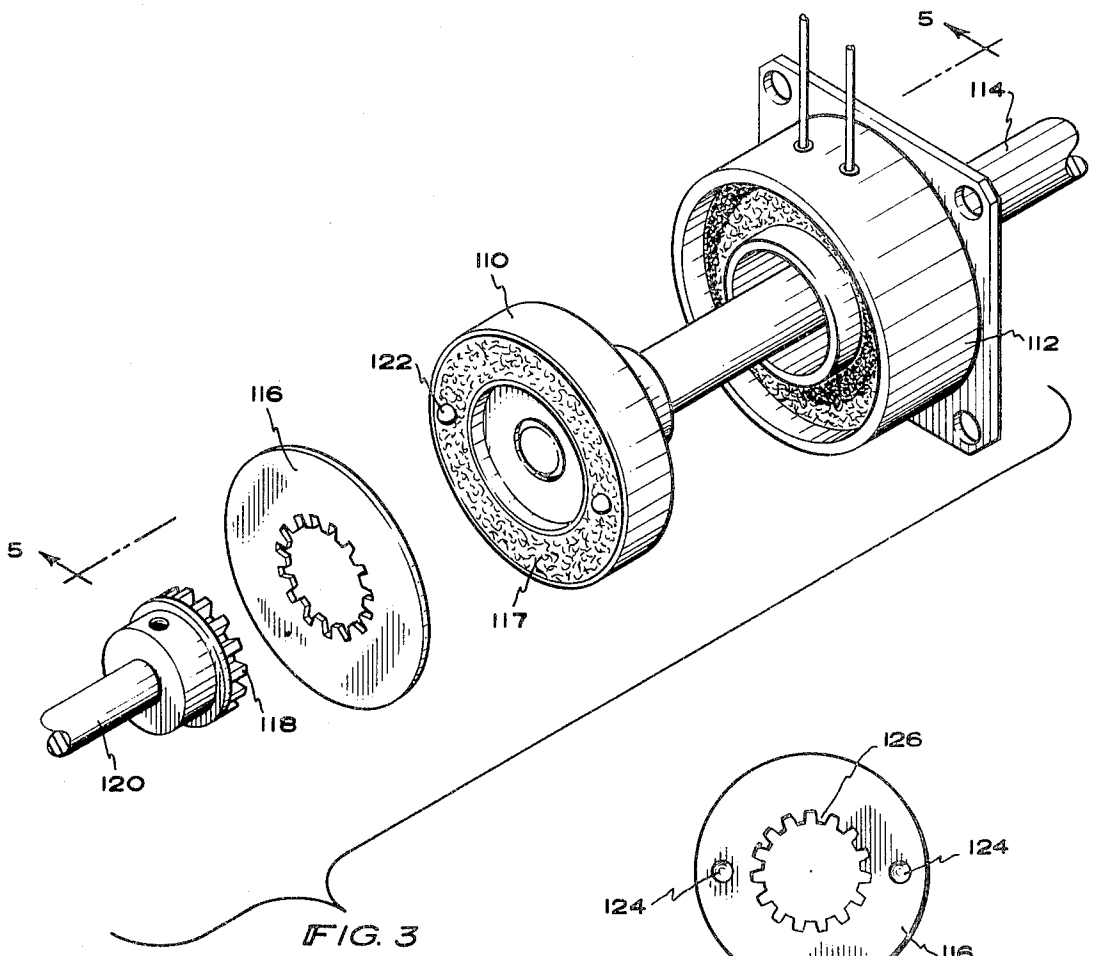


FIG. 3

FIG. 4

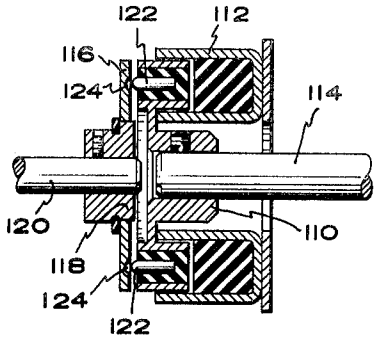


FIG. 5

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DWELL CLUTCH FOR FILAMENT WINDING APPARATUS

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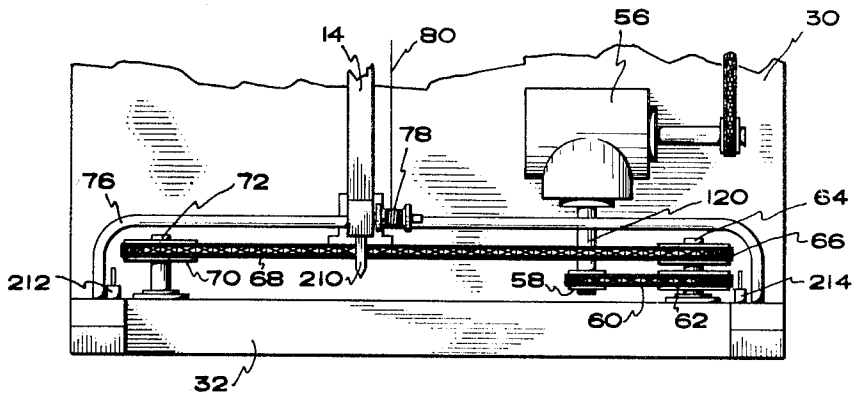


FIG. 6

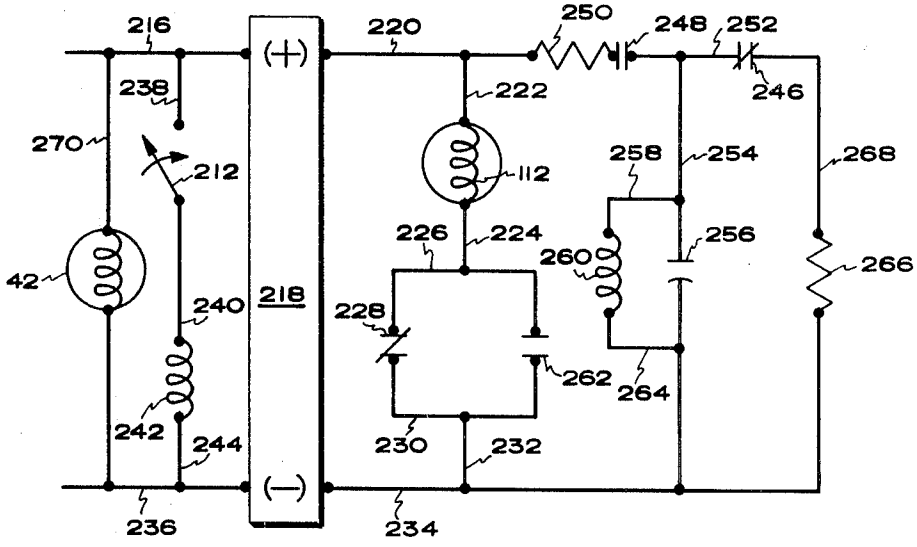


FIG. 7

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DWELL CLUTCH FOR FILAMENT WINDING APPARATUS

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U.S. Cl. 242—158 9 Claims

ABSTRACT OF THE DISCLOSURE

A filament winding apparatus with a carriage, for positioning filament on a mandrel, propelled by drive means including a dwell clutch which is disengaged at the end of each carriage pass over the mandrel. The dwell clutch has coacting clutch plates with detent pins in one plate and detents in the other plate which are programmed to coact and drive the carriage only when the detent pins and detents are aligned.

This invention relates a filament winding apparatus, and in particular to a dwell clutch for a filament winding apparatus which eliminates filmaent slack during helical winding.

In recent years filament winding has become a very popular method for imparting strength to vessels and tubes or for forming vessels and tubes which must be lightweight and yet which must have sufficient strength to maintain fluids under high pressure conditions. Generally such tubes and vessels are formed by winding a filament such as fiberglass about a form referred to as a mandrel constructed from a lightweight plastic or resinous material which if not wound with a filament would not have sufficient strength to retain pressurized fluids. One type of filament winding often used in the production of said vessels and tubing is helical winding. In such winding, the filament is wound about the mandrel in a plane which forms an angle with the center axis of the mandrel substantially less than 90 degrees, i.e., the filament spirals about the mandrel. One problem encountered in helical winding operations, particularly when chain drive filament winding machines are used, is filament slack which occurs when the carriage, which feeds the filament onto the mandrel, reverses its direction at each end of the mandrel. It has been found that this problem can be overcome by programming the carriage to dwell, i.e., to stop for a predetermined time, at the end of each pass over the mandrel thereby allowing the mandrel to take up the slack in the filament as it is rotated. However, as indicated, when a chain drive filament winding device is used it is difficult to obtain a predetermined dwell without the use of extensive programming devices. As a result, winding machines with means for obtaining a dwell of the type described are expensive to construct and, in addition, are complicated in their operation.

It is accordingly an object of this invention to provide a filament winding device with a dwell clutch which prevents filament slack.

Another object of this invention is to provide a dwell clutch for a filament winding machine which provides a substantially uniform dwell period at the end of each helical winding pass.

Still another object of this invention is to provide a filament winding machine with a dwell clutch which is easy to operate, simple in design, and inexpensive to construct.

Still further objects of this invention will become apparent to those skilled in the art as the invention is better understood by reference to the detailed description appearing hereinafter.

The foregoing objects and attendant advantages of this invention may be achieved by providing an apparatus for helically winding filament on a mandrel which comprises a spindle for rotating said mandrel, a carriage for positioning said filament on said mandrel, drive means for rotating said spindle and for moving said carriage across said mandrel at a predetermined rate, and carriage disengaging means for interrupting the movement of said carriage at predetermined intervals. According to this invention the disengaging means comprises a clutch having coacting drive plates which, when positioned together in a coacting relationship, transfers motion from said drive means to the carriage. One of the clutch plates is provided with detent pins which extend outwardly away from the face of said plate to coact with detents in the other clutch plate when said plates are properly aligned. By providing a clutch of this type the clutch plates are disengaged for a predetermined intervals, depending upon the spacing of the detent pins and detents, each time the clutch is disengaged.

So that the invention may be more readily understood and carried into effect, reference is made to the accompanying drawings which are offered by way of example only and are not to be taken as limiting the invention, the scope of which is defined by the appended claims, which obviously embrace equivalent structures and processes.

In the drawings:

FIG. 1 is a block diagram showing the relationship between the drive motor, spindle, gear box, clutch, programmer and carriage.

FIG. 2 is a perspective view of a chain drive filament winding device constructed according to this invention.

FIG. 3 is a perspective view of a dissassembled dwell clutch with programmed detent pins and coacting detents, not shown.

FIG. 4 is a plan view of a clutch plate with detents positioned to coact with detent pins.

FIG. 5 is a cross-sectional view of FIG. 3 taken along the plane of line 5—5 showing the dwell clutch in an assembled form.

FIG. 6 is a top view of the back portion of the winding machine shown in FIG. 2.

FIG. 7 is a schematic wiring diagram of one circuit for engaging and disengaging the dwell clutch of this invention.

Referring now more particularly to the drawings, FIG. 1 is a block diagram which illustrates the coaction between the filament winding components of this invention. As shown, drive motor **10** rotates spindle **12** which in turn rotates a mandrel being wound with a filament. Said filament is fed to the mandrel from carriage **14** which reciprocates across said mandrel. Carriage **14** is driven at a predetermined rate and over a predetermined course by spindle **12** which drives gear box **18** and programmer **16**. As carriage **14** reaches the end of a pass across the mandrel programmer **16** is disengaged for a short time from gear box **18** with dwell clutch **20** to prevent filament slack.

A simplified perspective view of a typical filament winding apparatus which can be used in this invention is shown in FIG. 2. Base plate **30**, with attached vertical extending end plate **32**, is positioned to support the component parts used in the winding device. Spindle **12** is journaled at its opposite end to brackets **34** and **36** so that it is freely rotatable. Mandrel **38** is secured to said spindle **12**, through the use of connectors **40**, so that said mandrel **38** rotates about its center axis when spindle **12** is rotated. Motor **42** drives spindle **12** by rotating sprocket **44** which sprocket engages chain **46**. Said chain **46** coacts with sprocket **48** attached to spindle **12** to rotate said spindle. Sprocket **50** is also securely connected to

spindle 12 and is positioned to coact with chain 52 that drives gear box sprocket 54 and gear box 18.

The output from gear box 18 drives dwell clutch 20 which in turn drives sprocket 58 when said clutch is engaged. Gear box 18 and dwell clutch 20 are contained within gear housing 56 in a conventional fashion. Said sprocket 58 drives chain 60 and coacting carriage drive sprocket 62 to rotate carriage drive shaft 64. The carriage drive shaft, journaled at one end to end plate 32, drives sprocket 66 and coacting endless carriage drive chain 68 mounted around sprockets 66 and 70. Said sprocket 70 is rotatably mounted on shaft 72 secured to end plate 32 in a plane passing through shaft 64 and substantially parallel with the center axis of spindle 12. Slide adaptor 74 is rotatably mounted to carriage drive chain 68 in a fashion which enables it to follow said chain about its entire course of travel without rotating, i.e., the direction of slide adaptor 74 remains substantially unchanged. Carriage 14 is positioned to coact with slide adaptor 74 and to be moved therewith. Said carriage is also slidably mounted on slide bar 76 which is attached at its opposite ends to end plate 32. Accordingly, carriage 14 moves along slide bar 76 in a predetermined plane as slide adaptor 74 moves with carriage drive chain 68. By providing a device of the type described, chain 68 acts as programmer 16. Filament 80, wound on spool 78 is passed through aligning tip 82 of carriage 14 and is laid upon mandrel 38 as said mandrel is rotated.

In accordance with this invention, carriage 14 dwells for a predetermined period at the end of each pass across mandrel 38 to prevent filament slack. To accomplish this, dwell clutch 20 disengages gear box 18 from sprocket 58 which powers carriage drive chain 68. The clutch may be any conventional clutch modified according to this invention. However, it is preferred to use a magnetic clutch such as shown in FIGS. 3–5 which includes a rotor 110, connected to drive shaft 114 driven at a predetermined speed by the output of gear box 18, which rotates in field 112. When current is passed through field 112 a magnetic flux is produced in rotor 110 which urges armature 116 against face 117 of said rotor 10 to fixedly secure the armature to said face. When current is removed from field 12, armature 116 slides away from rotor 110 on armature hub 118 thereby disengaging itself from said rotor and shaft 120, which drives sprocket 58, even though rotor 110 is turning.

Since armature 116 only forms a driving connection wtih rotor 110 when current is passed through field 112, detent pins 122 are embedded in face 117 of rotor 110 which extend outwardly a distance of about 1/32 to 1/4 inch beyond face 117 of said rotor. Detents 124 are positioned in armature 116 to coact with said pins when properly aligned with said pins. Accordingly, when pins 122 and detents 124 are out of alignment armature 116 is held outwardly away from rotor 110 thereby preventing driving engagement between the armature and the rotor even when current is passed throuhg field 112. As shown in FIG. 4, armature 116 is provided with a toothed port 126 sized to slide freely on the geared end of armature hub 118 to engage with rotor 110. The end of pins 122 which extends outwardly away from face 117 are preferably rounded to slide easily into detents 124.

In operation, dwell clutch 20 is disengaged, i.e., armature 116 is separated from rotor 110, at the end of each traverse path of carriage 14 over mandrel 38. This can be accomplished through the use of trip lever 210, secured to carriage 14, which closes microswitches, generally designated as switches 212 and 214, fixed to end plate 32 at positions proximate the opposite end of each traverse pass of carriage 14. By positioning said microswitches in this fashion, carriage 14 dwells for a predetermined period at the end of each pass prior to reversing its direction of travel across mandrel 38.

FIG. 7 illustrates one preferred circuit which can be used to disengage clutch 20. As previously indicated, the clutch is engaged when current is passed through field 112 and when detent pins 122 coact with detents 124. When said clutch is engaged, current flows along line 216, through D.C. rectifier 218, along lines 220 and 222 to field 112. From field 112, current flows along lines 224 and 226 through closed contacts 228 and along lines 230, 232 and 234 back to D.C. retified 218 and from thence back to its source along line 36. When carriage 14 reaches the proximate end of a lateral winding pass, e.g., the end proximate microswitch 212, trip lever 210 closes said microswitch 212 thereby allowing current to flow along line 238, through closed microswitch 212, along line 240 and through relay 242. From said relay 242 current flows along lines 244 and 236 back to its source.

When relay 242 is activated, normally closed contacts 228 and 246 are opened and contact 248 is closed wherein current no longer flows through field 112 but instead flows along line 220, through resistor 250, and closed contacts 248. From said contact 248, current flows along lines 252 and 254 to capacitor 256 and then along line 258 to relay 260 whereupon said capacitor begins to charge. When the charge on said capacitor reaches a predetermined voltage relay 260 closes contacts 262 thereby allowing current to again flow through field 112. Current flows from relay 260 along lines 264 and 234 back to its source as previously indicated. By using a circuit of this type, field 112 remains deactivated for a period of time determined by the resistance of resistor 250 and the capacitance of capacitor 256.

When field 112 is reactivated, armateurs 116 is urged towards rotor 110. However, because said rotor is turned a predetermined distance while clutch 20 is disengaged, detent pins 122 no longer coact with detents 124. Accordingly, the rotor continues to rotate until detent pins 122 and detents 124 are properly aligned to coact with each other. When this occurs, clutch 20 engages and carriage 14 begins to move across mandrel 38 again and microswitch 212 is reopened thus closing contacts 228 and 246 and opening contact 248. When contact 246 is closed, resistor 266 is connected to capacitor 256, i.e., resistor 266 is connected to line 268 which is connected to capacitor 256 through contact 246 and lines 252 and 254, which thereby discharges said capacitor to open contact 262. When carriage 14 reaches the end of another pass across mandrel 38 microswitch 214 is closed by coaction with trip lever 210. Microswitch 214 is connected to circuit means similar to the means previously described in connection with microswitch 212 to thereby again disengage clutch 20 for a predetermined period. As shown in FIG. 7 drive motor 42, which propels carriage 14 over mandrel 38, when clutch 20 is engaged, is powered by current which flows along lines 216 and 270 to said motor and from thence along lines 272 and 236 back to its source.

By merely programming the detents pins and detents in clutch 20 any predetermined dwell may be obtained at the end of each pass of carriage 14. Accordingly, slack in filament 80 is essentially prevented as carriage 14 reverses its direction of travel. While the use of detent pins and coacting detents have been described herein as the means for maintaining the plates of clutch 20 open for a predetermined time, it should be noted that any means can be used which mechanically holds the plates of said clutch open until a predetermined relationship exists between said plates. It is also to be noted that the phrase "clutch plates" as used herein refers to the plates in any clutch which disengage and engage each other during operation of the clutch to transfer driving power through the clutch such as rotor 110 and armature 116.

We claim.

1. A filament winding apparatus for helically winding filament on a mandrel comprising a spindle with coacting drive means for rotating said mandrel; carriage means positioned proximate said mandrel to reciprocate across said mandrel to lay filament thereon as said mandrel is rotated; carriage drive means coacting with said carriage

for reciprocating said carriage across said mandrel; and dwell clutch means interposed in said carriage drive means for disengaging said carriage drive means proximate the end of each carriage pass across said mandrel to prevent filament slack wherein said dwell clutch means comprises a first clutch member, a second clutch member, and drive means connected to said first clutch member for driving said second clutch member when said drive means is aligned in a predetermined position with respect to said second clutch member.

2. The filament winding apparatus of claim 1 wherein said drive means comprises at least one detent pin attached to said first clutch member which coacts with a detent in said second clutch member.

3. The filament winding apparatus of claim 2 wherein said first clutch member and said second clutch member are provided with disengaging means for separating said first clutch member and said second clutch member for a predetermine time, proximate the end of each carriage pass across said mandrel to disengage said detent pin from said detent.

4. The filament winding apparatus of claim 1 wherein said carriage drive means is an endless chain drive and said carriage is positioned to be reciprocated with said endless chain drive along a predetermined plane substantially parallel with the center axis of said mandrel.

5. The filament winding apparatus of claim 4 wherein said drive means comprises at least one detent pin connected to said first clutch member which coacts with a detent in said second clutch member.

6. The filament winding apparatus of claim 4 wherein said first clutch member and said second clutch member are provided with disengaging means for separating said first clutch member and said second clutch member for a predetermined time proximate the end of each carriage pass across said mandrel to disengage said detent pin from said detent.

7. The filament winding apparatus of claim 6 wherein said spindle drive means drives said endless chain drive.

8. The filament winding apparatus of claim 7 wherein said first and said second clutch members are urged together with magnetic field circuit producing means provided in combination with one of said clutch members.

9. The filament winding apparatus of claim 8 wherein said disengaging means for separating said first and said second clutch members comprises switch means in said magnetic field circuit means activated by said carriage for de-energizing said magnetic field for a predetermined time proximate the end of each pass of said carriage along said mandrel.

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U.S. Cl. X.R.

242—7.21