July 12, 1955 R. G. MARZOLF 2,712,836

COIL WINDING MACHINE

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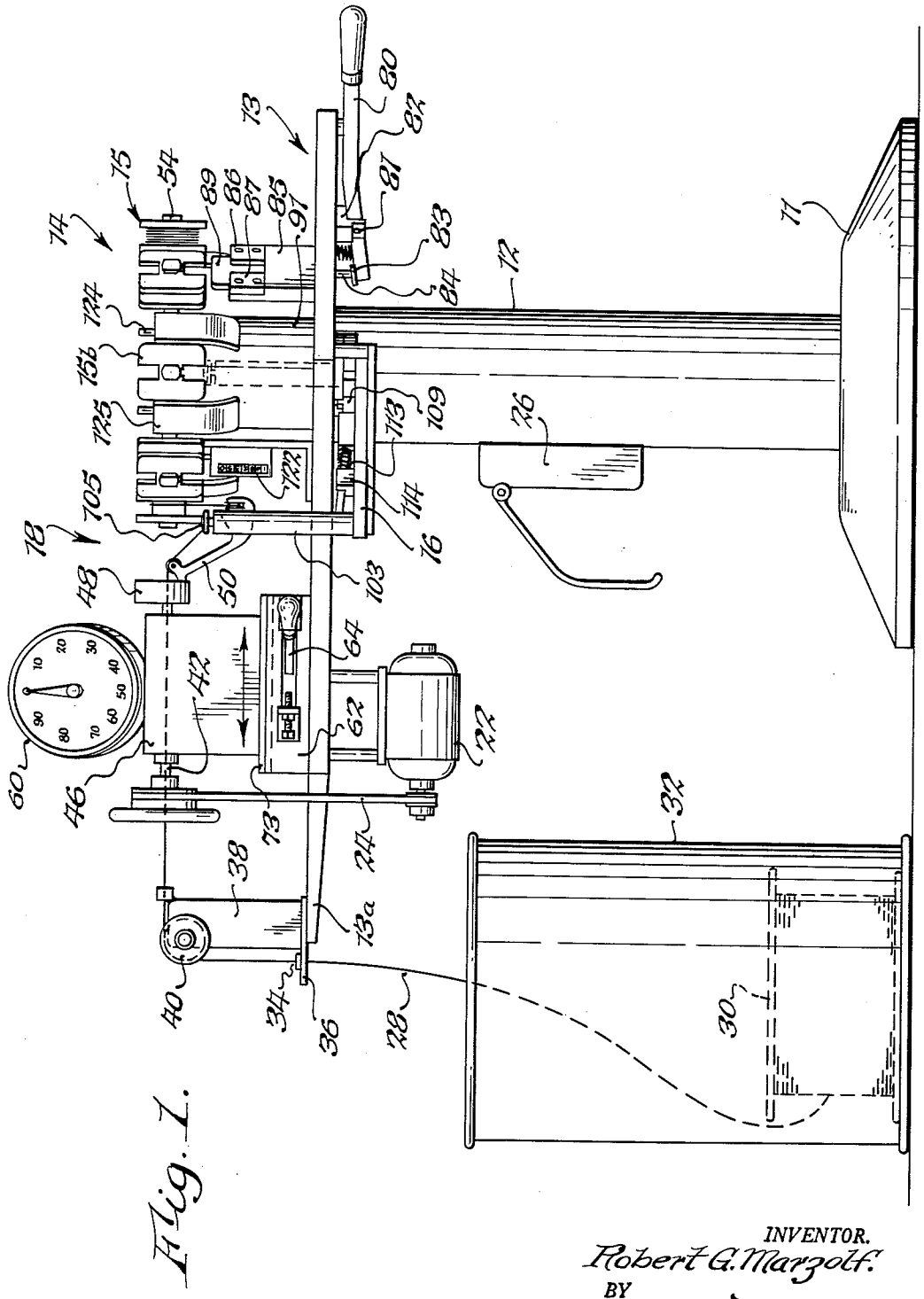


Fig. 1.

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COIL WINDING MACHINE

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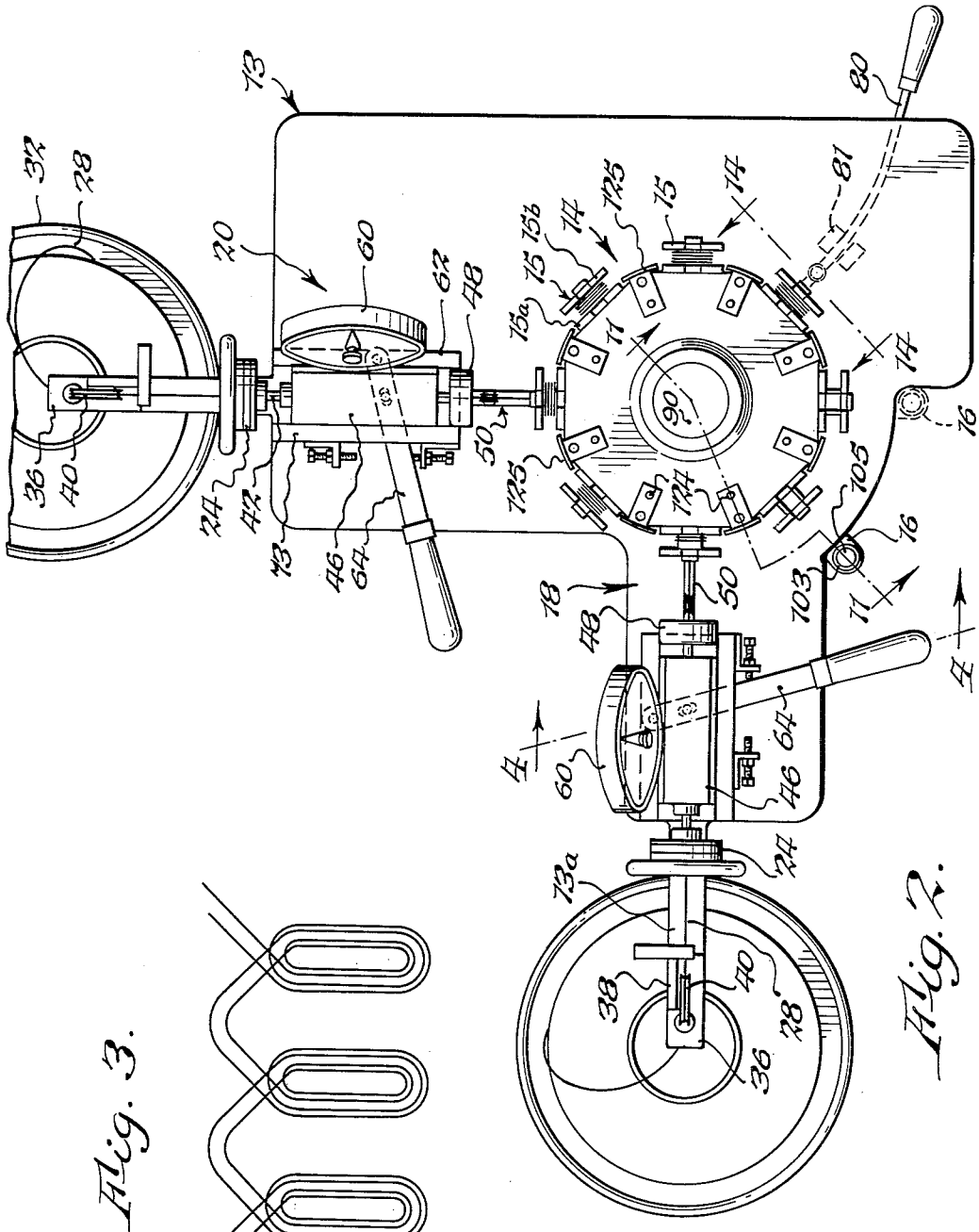


Fig. 2.

Fig. 3.

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COIL WINDING MACHINE

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Fig. 4.

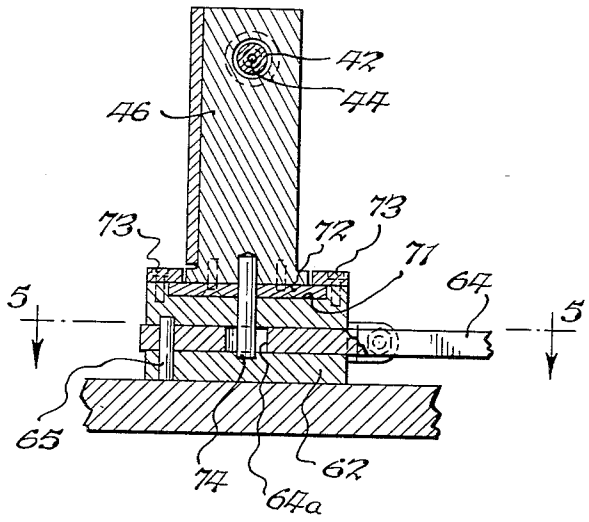


Fig. 5.

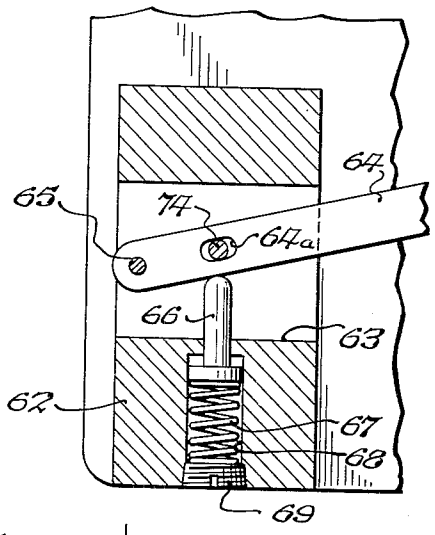
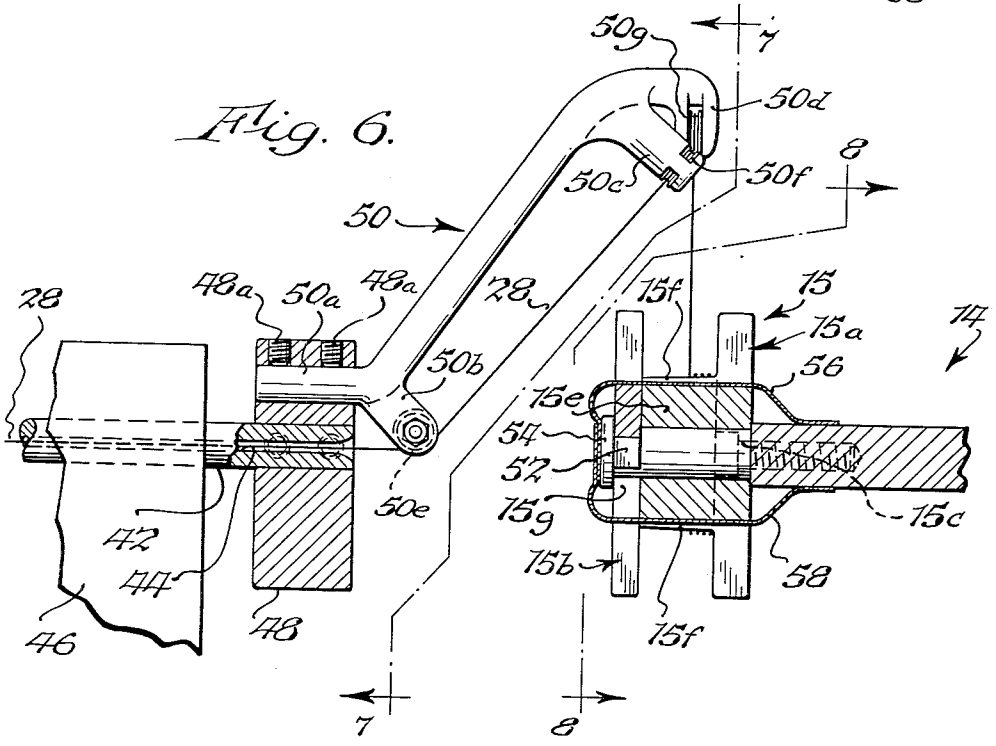


Fig. 6.



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COIL WINDING MACHINE

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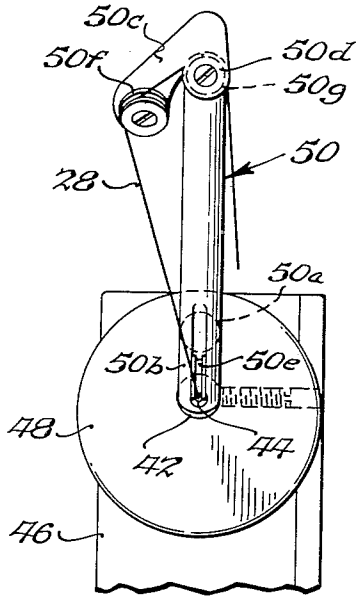


Fig. 7.

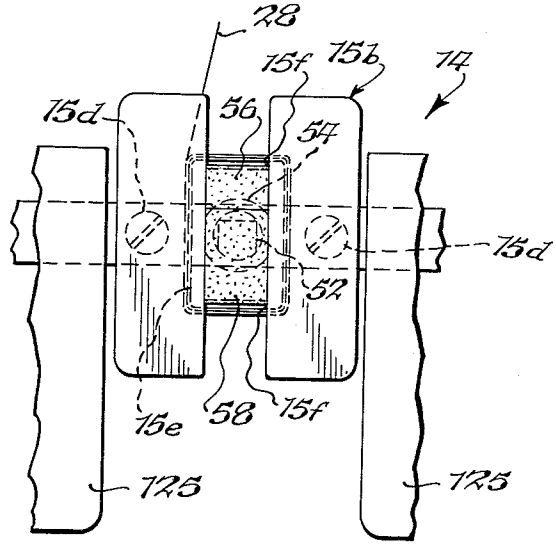


Fig. 8.

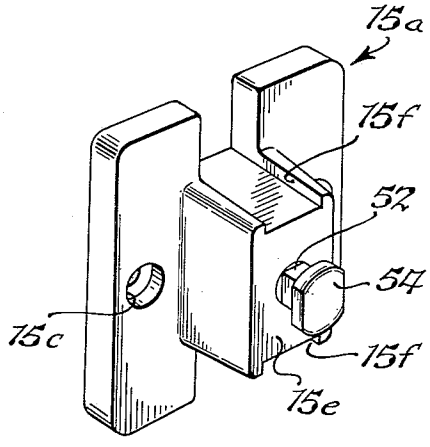


Fig. 9.

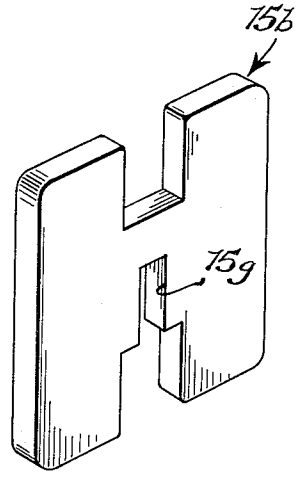


Fig. 10.

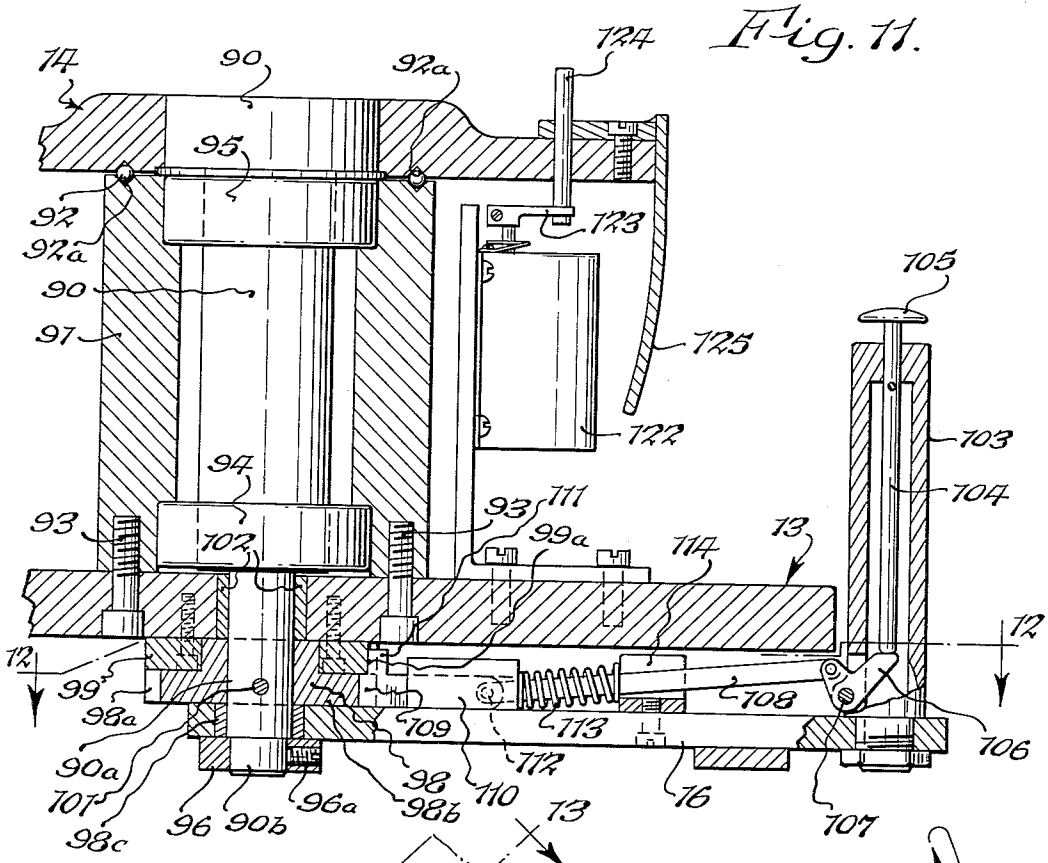
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July 12, 1955 R. G. MARZOLF 2,712,836

COIL WINDING MACHINE

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Fig. 11.



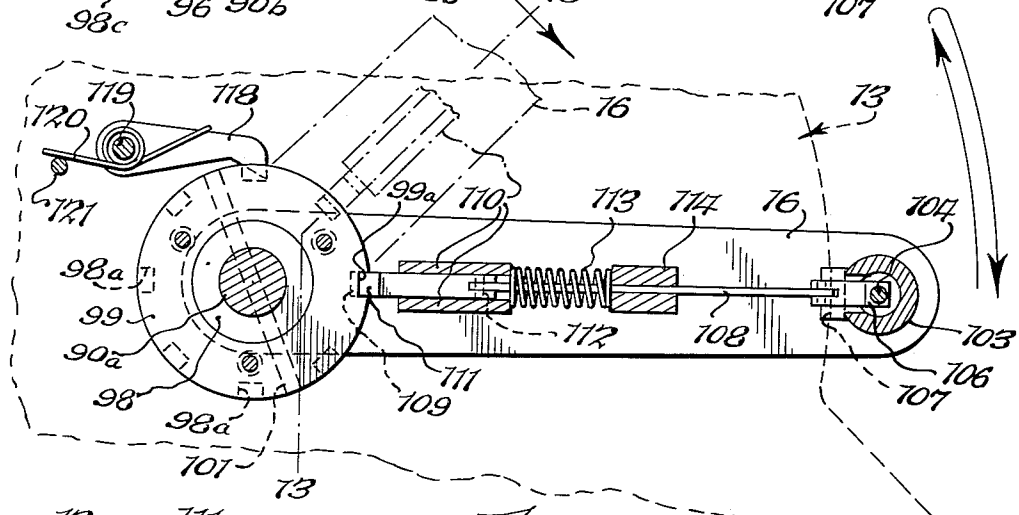


Fig. 12.

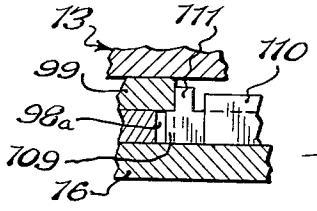


Fig. 13.

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COIL WINDING MACHINE

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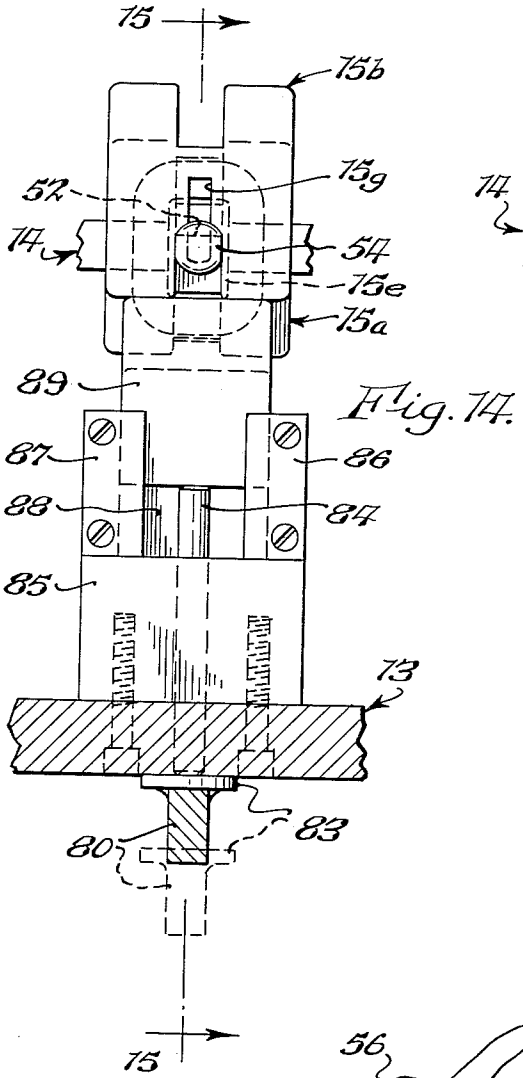


Fig. 14.

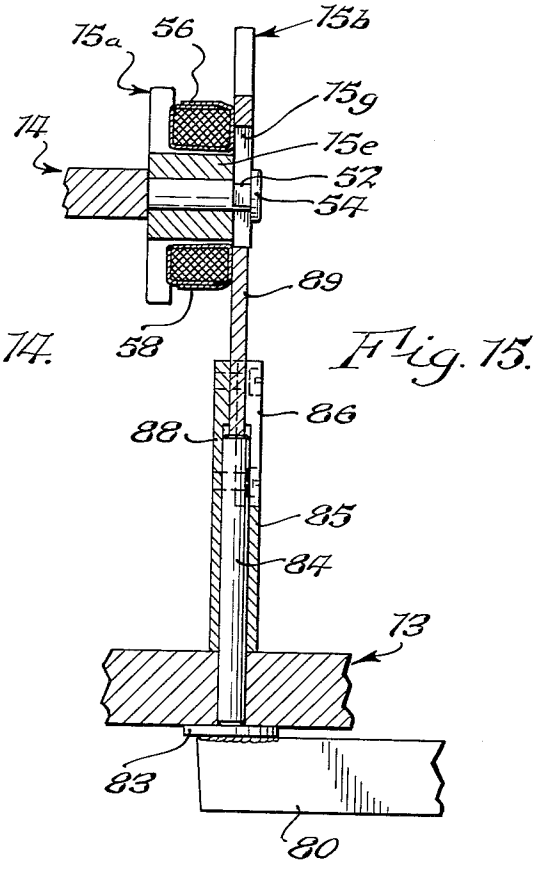


Fig. 15.

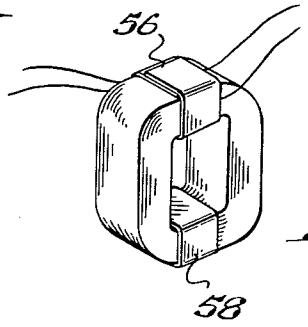


Fig. 16.

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COIL WINDING MACHINE

Filed July 24, 1951 8 Sheets-Sheet 7

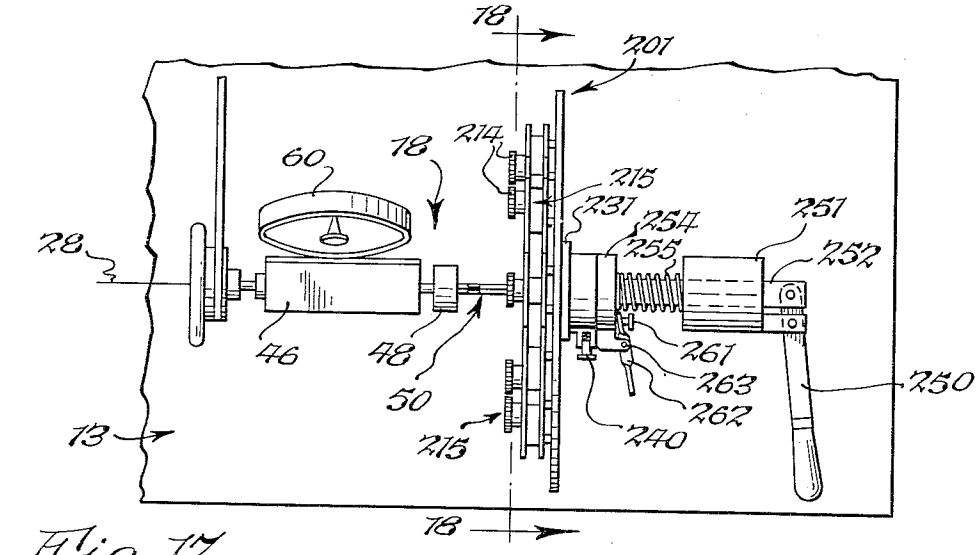


Fig. 17.

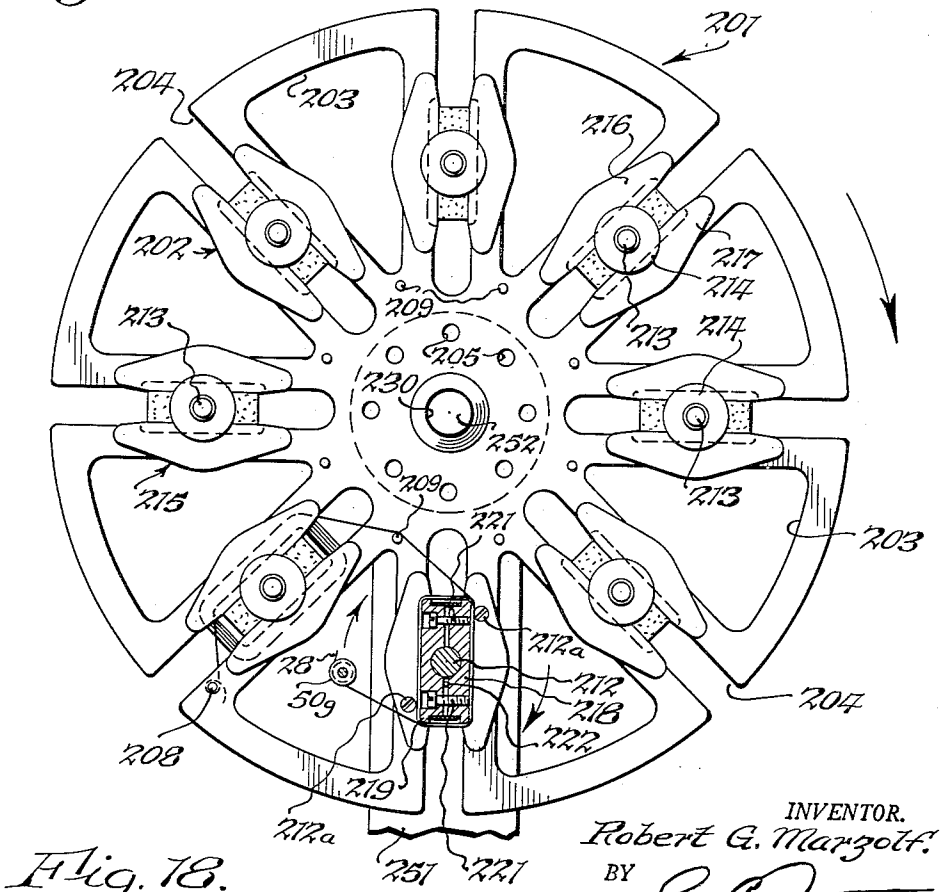


Fig. 18.

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COIL WINDING MACHINE

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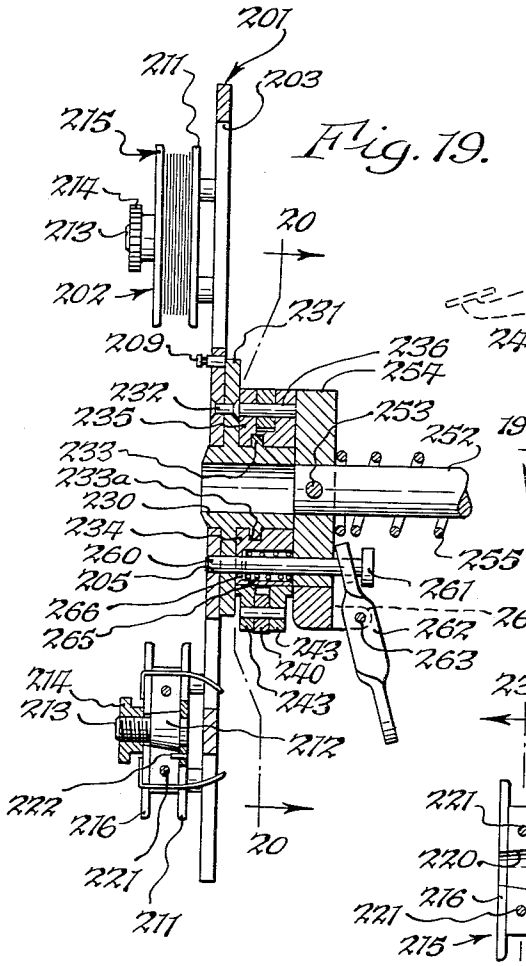


Fig. 19.

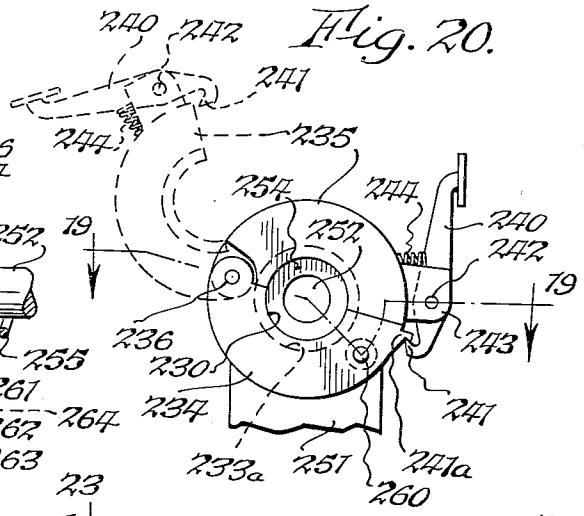


Fig. 20.

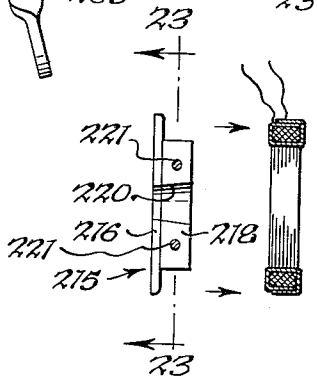


Fig. 22.

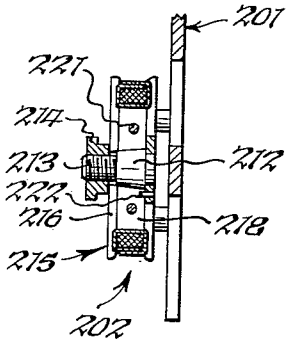


Fig. 21.

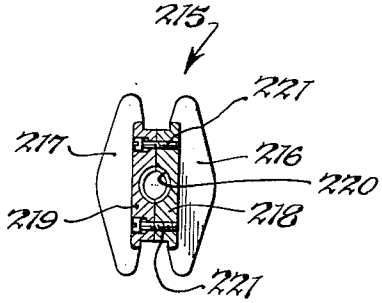


Fig. 23.

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United States Patent Office

2,712,836

Patented July 12, 1955

2,712,836

COIL WINDING MACHINE

Robert G. Marzolf, Snyder, N. Y.

Application July 24, 1951, Serial No. 238,311

12 Claims. (Cl. 140—92.1)

This invention relates to coil-winding machines, particularly adapted for use in the winding of coils for electrical motors, although not limited to such use.

It is an object of this invention to provide improved arrangements for starting the winding of the coils, completing such winding, and removing the finished coils from the machine, with a minimum of labor.

It is a further object of this invention to provide an improved machine for winding strings of connected coils, each coil of which may consist of two or more electrically separate windings, in order to facilitate mounting of such coils in motor frames, and to minimize the time and labor required for their connection, and reduce the possibility of incorrect connection.

It is still a further object of this invention to provide a machine of the class described which is relatively simple and economical to construct, and which requires little maintenance.

The features of novelty which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its fundamental principles and as to its particular and preferred embodiments, will best be understood by reference to the specifications and accompanying drawing, in which,

Fig. 1 is a side elevation of a machine in accordance with one embodiment of my invention;

Fig. 2 is a top plan view thereof;

Fig. 3 is a diagrammatic illustration of a string of connected coils, each with two windings, as made on the machine;

Fig. 4 is a section on lines 4—4 of Fig. 2;

Fig. 5 is a section on lines 5—5 of Fig. 4;

Fig. 6 is a detail view, partly in section, of a wire thrower or flyer employed in the machine;

Fig. 7 is a view on lines 7—7 of Fig. 6;

Fig. 8 is a view on lines 8—8 of Fig. 6;

Fig. 9 is a perspective view of the rear coil form;

Fig. 10 is a similar view of the front coil form;

Fig. 11 is a section on lines 11—11 of Fig. 2;

Fig. 12 is a section on lines 12—12 of Fig. 11;

Fig. 13 is a section on lines 13—13 of Fig. 12;

Fig. 14 is a section on lines 14—14 of Fig. 2;

Fig. 15 is a section on lines 15—15 of Fig. 14;

Fig. 16 is a perspective view of a finished coil;

Fig. 17 is a top plan view of a modified form of my invention;

Fig. 18 is a section on lines 18—18 of Fig. 17;

Fig. 19 is a section on lines 19—19 of Fig. 20;

Fig. 20 is a section on lines 20—20 of Fig. 19;

Fig. 21 is a detail section showing a completed coil in position;

Fig. 22 is a similar view showing removal of the coil, and

Fig. 23 is a section on lines 23—23 of Fig. 22.

Referring first to the embodiment of the invention shown in Figs. 1–16, the machine comprises a base 11, from which rises pedestal 12, carrying table 13. Mounted

on the table for indexing rotation about a vertical axis is turret 14, in this instance arranged to carry eight coil forms 15 mounted on the periphery of the turret, each with its axis horizontal. Secured to the turret for producing indexing, or step-by-step rotation, is the turret drive lever 16. In the embodiment shown, this is manually operated, but other mechanisms, well known in the art, power driven, if desired, may be employed to index the turret.

As many winding stations may be provided as there are desired separate windings on each coil. In this instance, I have shown two, 18 and 20, one being a duplicate of the other, so that only one need be described in detail. Mounted below the table is the motor 22, driving the winder at station 18 through belt 24, for example. Motor 22 is started and stopped, and its speed controlled, by rheostat 26 which may be mounted on the side of pedestal 12 in position to be operated by the knee of the operator at station 18. Such rheostats and their construction and connection are well known and are therefore not described in detail.

Wire 28 is fed from spool 30 in container 32, passes up through an opening 34 in base plate 36 of bracket 38 mounted on table extension 13*a* and over pulley 40 mounted at the upper end of said bracket. Preferably two turns of wires are taken over pulley 40, and the wire then passes axially down the hollow center 44 of the flyer or winder shaft 42 mounted in bearings in housing 46. The forward end of shaft 42 carries chuck 48 which has an off-center opening to receive arm 50*a* of flier or winding arm 50 extending diagonally outward and toward turret 14 (see Fig. 6). Flier arm 50*a* is retained in chuck 48 by any suitable means, such as set screws 48*a*. Winding arm 50 also carries feed arms 50*b*, 50*c*, and 50*d*, each having a pulley, 50*e*, 50*f*, and 50*g*, over which the wire passes in turn (Fig. 6). As the winding arm 50 rotates, carried by shaft 42, driven in turn by pulley 25 secured thereto, and driven by belt 24 from motor 22, the outer end of arm 50 moves in a circular path around coil form 15, and (the end of wire 28 being attached) the wire 28 is wound about the coil form.

The coil form 15, in this embodiment of the invention, comprises a pair of H plates, back plate 15*a*, and cooperating front plate 15*b*. The legs of the H of back plate 15*a* may have counterbored openings 15*c* by which plate 15*a* may be secured to turret 14 by suitable bolts 15*d*, and back plate may have a central boss 15*e*, rectangular in shape (for rectangular coils) tapered and polished to facilitate removal of the finished coil. The face of boss 15*e* may have squared stud 52 and clamp boss 54 to receive and hold front plate 15*b*, with a sliding fit, and both front and rear plates are provided with registering tape-receiving slots 15*f*, and front plate 15*b* has also stud receiving slot 15*g*, to permit sliding front plate 15*b* vertically downwardly on stud 52. In preparation for winding a coil, adhesive tape strip 56 and 58 may be laid in slots 15*f*, with their ends temporarily pressed on turret 14 and clamp boss 54 (see Fig. 6). After completion of the coil winding, the projecting ends of tape strips 56 and 58 are wound around the respective portions of the coil and pressed down, to secure the coil (see Figs. 15 and 16). Front plate 15*b* may then be lifted off and the coil removed from the form. This action, however, ordinarily does not occur until the turret has indexed the coil to position 6, where the ejector mechanism is mounted.

Turn counter 60 is suitably geared to flyer shaft 42, to show the number of turns applied in winding.

To provide for level winding, the entire flyer assembly is mounted for sliding movement axially toward and away from coil form 15, as shown by the arrows in Fig. 1.

For this purpose, base block **62** has an opening **63** to receive feed lever 64 (Figs. 2, 4 and 5), pivoted on pin **65** for swinging movement in a horizontal plane, and urged in a counter-clockwise direction by plunger **66** riding on spring **67** in receiving opening **68** in base block **62**, closed by retaining screw **69**. Base block **62** has a wide, shallow groove **71** to receive flange plate **72** secured to the base of flyer carrier housing **46**, in which flyer shaft **42** is journalled, and retainer plates **73** are secured to base block **62** on opposite sides and serve to retain flange plate **72** and flier carrier **46** on base block **62** while permitting it to slide axially. Pin **74**, mounted in flyer carrier **46**, extends downwardly through flange plate **71** and the upper part of base block **62**, and through longitudinal slot **64***a* in feed lever **64** and terminates in a slot (not shown) in the lower portion of base block **62**.

From the foregoing, it will be understood that as the feed lever is swung back and forth, pivoting on pin **65**, pin **74** in slot **64***a* is moved back and forth in a linear path, carrying with it the flyer carrier and flier, distributing the wire of the winding in a level manner. It will be understood that any well known automatic feed mechanism may be employed for the purpose, instead of the manual means shown, but for simplicity and economy of machine construction and maintenance, I prefer the manual mechanism shown. The machine operator finds it a simple matter to work the feed lever as the coil is being wound. A second winding mechanism, like that already described, is shown at index station 3, and, if used, is manned by another operator. The manner of use of the two winding mechanisms will now be described.

As the winding at station **1** is completed, the operator stops motor **22**, preparatory to indexing the turret one step, performs the indexing operation, bringing an empty and taped coil form to flyer **50**, and the next coil is started by starting the motor. No break has been made in the wire, so the last turn on the first coil leads to the first turn of the next coil. On completion of the first winding of the second coil, the motor at station **1** is again stopped, the turret indexed, and the third coil started. The second indexing has now carried the first coil to station **3**, and the operator at this station puts on the second winding, surrounding the first winding. The indexing continues until coils reach station **6**, where they are ejected. This method of winding the coils is diagrammatically shown in Fig. 3.

To facilitate ejection, ejector lever **80** is provided, pivoted at **81** in bracket **82** mounted under the table **13**, and has pusher head **83**, engaging and raising ejector plunger **84** carried in opening in table **13** and the ejector housing consisting of lower front plate **85**, rear plate **88**, and upper front plates **86** and **87**, the housing forming a vertical track for plunger **84** and rectangular ejector plate **89** carried by the plunger.

As the turret indexes a coil to station **6**, the top of ejector plate **89** lies directly under front coil form plate **15***b*. The operator at this station pushes down on ejector lever **80**, and plate **89** engages and pushes up front coil form **15***b* to clear boss **54**, as shown in Figs. 14 and 15, whereupon the operator may lift it off, and then restores lever **80** to initial position, dropping plate **89** out of the way, so that the coil can be removed from back coil form **15***a*. The operator then replaces front form **15***b*, applies the tape strips to the form as already mentioned, and the form is ready to receive another winding.

The turret **14** is mounted on turret shaft **90** (and may be shrunk on) within hollow column **91**, and its weight is carried on thrust bearings **92** riding in grooves **92***a* on the under side of turret **14** and the upper surface of column **91**. Bearings **94** and **95** may also be provided, fitting correspondingly shaped recesses at the upper and lower ends of column **91**, which may be secured to table **13** by bolts **93**.

Shaft **90** has a downwardly projecting portion **90***a* of

reduced diameter, and a still further reduced end portion **90***b*, carrying retaining collar **96** held by set screw **96***a*. Bearings **102** may surround shaft portion **90***a* within table **13**. Below bearings **102** I provide flanged drive collar **98**, pinned to shaft **90***a* by pin **101**, having a series of index notches **98***a* around the periphery of the collar flange **98***b*. Above flange **98***b* I provide a stationary collar **99**, bolted to the table, and having one indexing notch only, as at **99***a*. Below collar **98** there is provided a bearing **98***c* and rotatable on bearing **98***c* the turret drive lever **97**, arranged to swing back and forth in a short arc as in Fig. 12.

The outer end of lever **16** carries a vertically extending hollow handle **103**, and within handle **103** there is release rod **104**, carrying at its upper end release button **105**.

The lower end of rod **104** bears on bell crank lever **106** pivoted at **107** and connected to arm **108**, pivoted at its forward end at **112** to latch **109**, sliding between guides **110** and having vertical extension **111**. The latch is urged into the indexing notch **98***a* by spring **113** bearing against stop **114**. Rotation of the turret in one direction only is permitted by pawl **118** riding in index notches **98***a*, pivoted at **119**, and spring pressed into notches **98***a* by spring **120** fulcrumed on pin **121**.

To index the turret, the operator takes handle **103**, presses the release button **105**, and swings lever **76** counter-clockwise as in Fig. 12 until latch **109** engages the next indexing notch. Returning the lever to initial position will now rotate the turret to the next indexed position. It will be seen from Fig. 13, that latch **109** does not go all the way into notch **98***a*, being stopped by engagement of the forward side of vertical extension **111** with the outer surface of collar **99**. When the turret reaches the index position, the upper extension **111** registers with index notch **99***a* in stationary collar **99**, and the latch then moves all the way forward, locking the turret in position. Excessive movement of lever **16** is prevented by the configuration of the edge of the table, as will be seen from Fig. 2.

To count the coils, suitable counting mechanism **122** may be provided, having counteractuating arm **123** engaged and moved by pins **124**, one for each coil form. The space between coil forms may be covered by downwardly and inwardly projecting shields **125**.

In the operation of the embodiment of the machine so far described, four persons are employed; two winders, one taper, and one demounter.

In the embodiment of the invention shown in Figs. 17–23, table **13** is provided with a rotor or coil form wheel **201**, mounted for rotation on a horizontal axis on pedestal **251**. The wheel is removable in a manner to be described, and to reduce its weight is provided with a multiplicity of triangular cut-outs **203** and radial slots **204**, and carries a number of coil forms **202**, symmetrically mounted around the axis. In the embodiment herein described, eight forms are shown, but a larger or smaller number may be provided.

Indexing holes **205** may be formed for locking the wheel **201** at each indexing position, and wire winding mechanism **18**, similar to that shown in Figs. 1–16 may be employed. In this instance, however, instead of mounting the wire feed mechanism for movement toward and away from the coil form wheel, for level winding, the coil form wheel is made movable toward and away from the winding mechanism, in a manner to be described.

A pin **208** is provided near the periphery of wheel **201** near one coil form, to which the end of the wire may be fastened when starting to wind coils, and a number of grooved pins **209**, one for each coil form, are positioned symmetrically around wheel **201** radially inward from the coil forms and between them to receive and support the wire where it passes from one coil to the next, as will be seen from Fig. 18.

Each form may be made up of a generally H-shaped

back plate **211**, secured to wheel **201** by bolts **212***a* (Fig. 18), carrying a projecting central tapered stud **212**, terminating in threaded portion **213** to receive clamp nut **214**. The front coil form plate **215** is likewise generally H-shaped and is made up of two portions **216** and **217**, having inwardly projecting central portions **218** and **219**, having central tapered hole **220** to fit stud **212**. The two portions **216** and **217** are secured together in any suitable manner, as by bolts **221**. To assure assembly of the front and back plates in correct position, the back plate may carry locating pin **222**, fitting into the space between the two halves of the front plate (see Fig. 18). When the front plate is removed from the back plate, the two halves may be pressed into contact, as in Fig. 23. To assure the clearance space between the two halves of the front plate when bolted together, the bolt holes may be stopped so that the bolts cannot bring the two halves into contact.

The coil form wheel is arranged to be quickly demounted from the machine when desired, usually after all of the coil forms have been wound. For this purpose, a hollow central hub **230** is secured to wheel **201**, as by rivets **232** engaging the wheel and circular flange **231** carried by hub **230**. Hub **230** also has a smaller circular flange **233**, bevelled at 45° on its back-side, fitting a registering groove **233***a* in the bearings **234** and **235**. The lower half bearing **234** is stationary, while the upper half bearing **235** is pivoted as at **236** for swinging movement, to open position, shown in dotted lines in Fig. 20, and is releasably held in closed position by latch **240** having hook **241** engaging keeper **241***a* on lower bearing **234**. Latch **240** is pivotally mounted at **242** between ears **243** carried on upper bearing **235**, and is spring pressed in a clockwise direction by spring **244**.

For level winding, the form wheel may be shifted axially, by feed lever **250** pivoted on pedestal **251** mounted on table **13** and connected to sliding shaft **252** which is pinned by pin **253** to butt plate **254**. The lower half bearing **234** is securely mounted by any suitable fastening means to the butt plate **254** and the spring **255** urges butt plate **254** and bearings **234** and **235** to the left as in Figs. 17 and 19. By pressing more or less on lever **250** the form wheel **201** is moved axially to distribute the winding turns axially as desired.

Looking at indexed positions is accomplished by index pin **260** passing through indexing holes **205** in wheel **201**, flange **231**, lower bearing **234**, and butt plate **254**, having enlarged head **261** engaged on its front side by bifurcated lever **262** pivoted at **263** on ears **264** of butt plate **254**. Pin **260** is biased to locking position by spring **265** surrounding pin **260** in an opening in lower bearing **234**, and engaging, at one end, butt plate **254**, and at the other, pin **266** in index pin **260**.

To wind coils having more than one winding, a plurality of winding stations may be provided as shown in Figs. 1–16, but this is not necessary, as one winding may be applied during one rotation of the coil form wheel, and a second winding on top of the first during a second rotation, a third during a third rotation, and so on. If the wire is not broken or cut, all windings are in series, with only two ends of wire. With the machine of Figs. 1–16, on the other hand, all first windings are in series, with four ends of wire.

In the foregoing specification I have explained the principles of my invention and the best mode in which I have contemplated applying those principles, so as to distinguish my invention from other inventions; and I have particularly pointed out and distinctly claimed the part, improvement, or combination which I claim as my invention or discovery.

While I have shown and described certain preferred embodiments of my invention, it will be understood that modifications and changes may be made without departing from the spirit and scope thereof, as will be clear to those skilled in the art.

I claim:

1. In a coil winding machine, a base, a rotary member mounted thereon, means for rotating said member step by step to a plurality of predetermined stop positions, a plurality of coil forms mounted on said rotary member, each of said coil forms comprising a coil retaining plate detachable from said coil form by sliding movement in a direction perpendicular to the longitudinal axis of the said coil form, a winding mechanism positioned adjacent a first one of said stop positions and in winding registry with successive ones of said coil forms as said forms are successively rotated to said first stop position, and an ejector mechanism positioned adjacent a second one of said stop positions, said ejector mechanism comprising an ejector plate positioned to be coplanar with each of said retaining plates as said forms are successively rotated to said second stop position, and means for selectively moving said ejection plate into forcible contact with successive ones of said retaining plates at said second stop position.

2. In a coil winding machine, a base, a rotor mounted thereon for step by step rotation to a plurality of stop positions, coil forms mounted around the periphery of said rotor with their axes extending horizontally, said forms each comprising a back plate affixed to said rotor and a front plate removable from said coil form by sliding movement perpendicular to the coil form axis, a winding mechanism positioned adjacent a first one of said stop positions and in winding registry with successive of said coil forms at said first stop position, and an ejector mechanism adjacent a second of said stop positions, said ejector mechanism including a member selectively movable into forcible engagement with each of said front plates as each of said coil forms are successively moved to said second stop position thereby selectively to slide each of said front plates in a direction perpendicular to its respective coil form axis.

3. The combination claimed in claim 2 in which said front plate is removable by vertical movement, the said movable member of said ejector mechanism being mounted for vertical movement.

4. The combination of claim 2 in which said winding mechanism comprises a flier arm selectively rotatable about each of said coil forms at said first stop position in succession, and means for reciprocating said flier arm with respect to the longitudinal axis of a coil form at said first stop position to level-wind each coil at said stop position.

5. The combination of claim 2 including a further winding mechanism adjacent a third one of said stop positions, whereby plural coils may be wound upon a given coil form by moving said form from said first to said third stop positions.

6. In a coil winding machine, a rotor mounted thereon for step by step rotation, coil forms mounted on said rotor, a first winding mechanism positioned in winding registry with a coil form for stop positions of said rotor, a second winding mechanism operable independently of said first winding mechanism and positioned in winding registry with another coil form for stop positions of said rotor, said coil forms each comprising a back plate affixed to said rotor and a front plate detachable from said coil form by sliding movement in a predetermined direction perpendicular to the longitudinal axis of the coil form, and ejector means spaced from both said first and second winding mechanisms and adjacent said rotor, said ejector means including a force transmitting member selectively moveable into engagement with the front plate of each of said coils after said coils have passed said second winding mechanism, and means for moving said force transmitting member in said predetermined direction thereby to detach the front plate from each of said coil forms successively after winding thereon has been terminated.

7. In a coil winding machine, a supporting structure, a rotary member rotatably mounted on said supporting

structure, a plurality of coil forms mounted on said rotary member, means for indexing said rotary member and the coil forms thereon in a step by step motion to a plurality of stop positions, a first winding mechanism mounted on said supporting structure adjacent one of said stop positions and in winding registry with each of said coil forms in succession, and a second winding mechanism operable independently of said first winding mechanism, said second winding mechanism being mounted on said supporting structure adjacent a further stop position of said rotor and coil forms.

8. The combination of claim 7 in which said rotary member has a substantially vertical axis of rotation with respect to said supporting structure, said coil forms being mounted on said rotary member with their axes horizontal, each of said winding mechanisms comprising a flier arm for feeding wire, means for rotating said flier arm around the horizontal axes of said coil forms, and means for reciprocating said flier arm in a direction substantially parallel to the horizontal axes of said coil forms.

9. The combination of claim 7 in which said coil forms each include a coil retaining plate selectively detachable by sliding movement in a predetermined direction perpendicular to the coil form axis, and ejector means mounted on said supporting structure adjacent a still further of said stop positions, said ejector means including a force transmitting member selectively movable in said predetermined direction to engage selectively each of said retaining plates at said further stop position.

10. A form for winding coils comprising a first retaining flange, an elongated central projection affixed to said first flange and substantially perpendicular thereto, said central projection having a squared stud affixed thereto at the terminus thereof removed from said first flange, and a second retaining flange substantially parallel to said first flange, said second flange defining an open ended rectangular slot near the center thereof and so dimensioned as to slide on said squared stud only in a direction substantially perpendicular to the longitudinal axis of said central projection.

11. The coil form of claim 10 in which said central projection defines an elongated depression substantially parallel to the longitudinal axis of said central projection for the reception of a tape strip.

12. The form of claim 11 in which each of said first and second retaining flanges are shaped in the form of an H, the legs of said H-shaped flanges being substantially parallel to one another, said central projection being substantially rectangular in cross section and said elongated depression comprising a pair of recesses opposingly disposed along said central projection and between the legs of each H, whereby a pair of tape strips may be respectively placed in said recesses and each of said tape strips may extend past said retaining flanges between the legs thereof.

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