Aug. 2, 1966 F. H. CARMAN ETAL 3,263,309

METHOD OF WINDING A LOOP CONTAINING COIL

Filed April 20, 1959 2 Sheets-Sheet 1

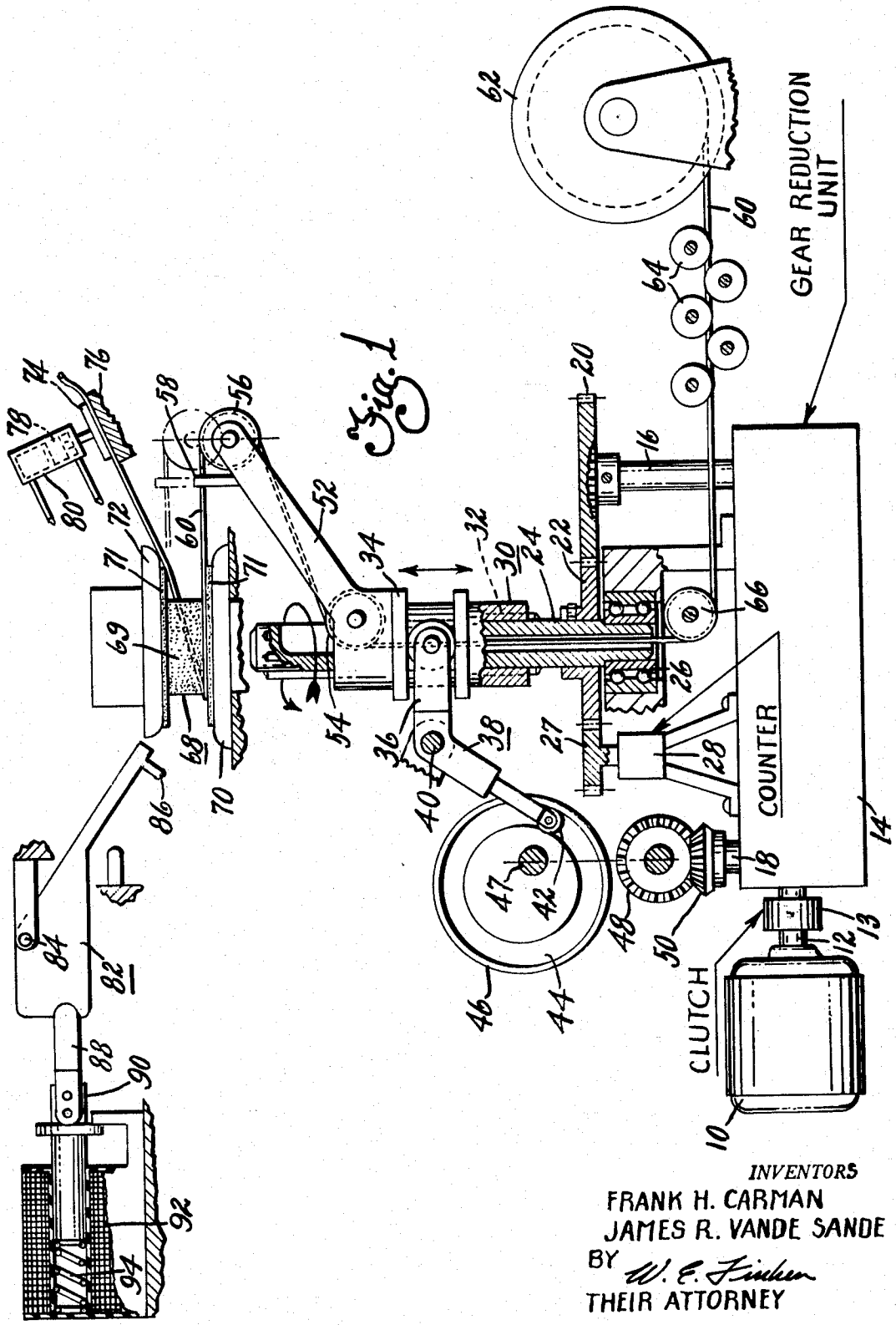


Fig. 1

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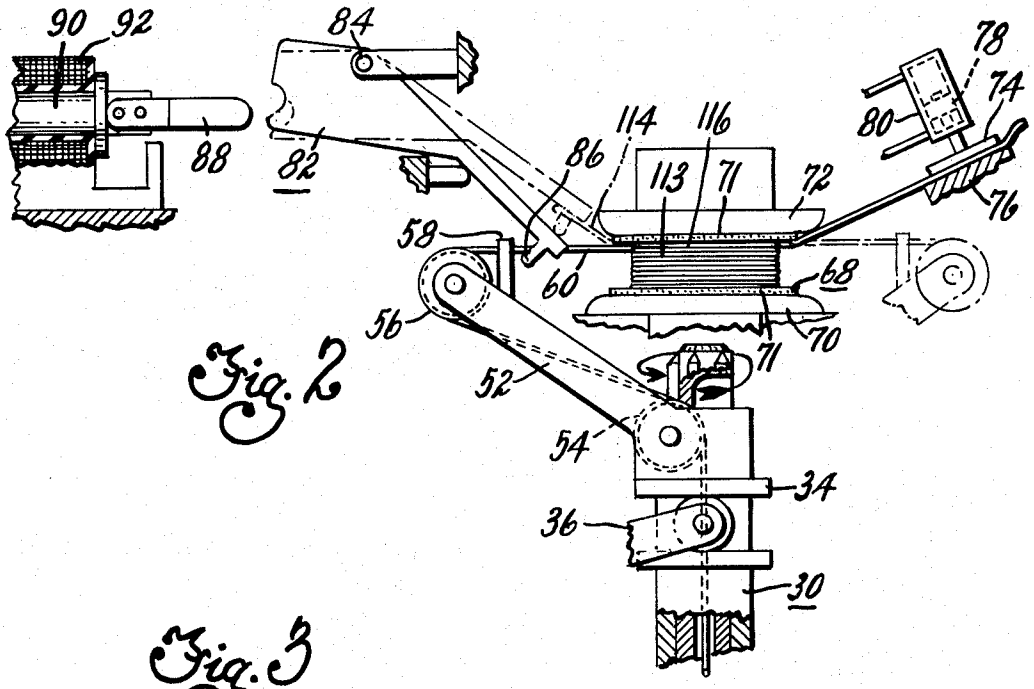
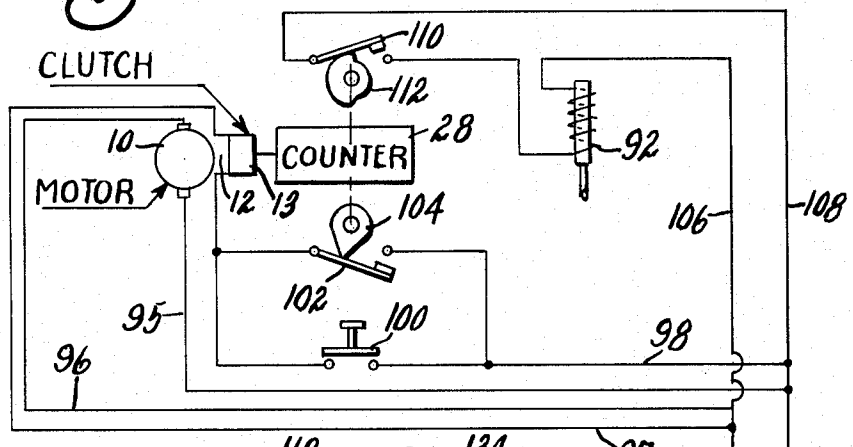


Fig. 2

Fig. 3



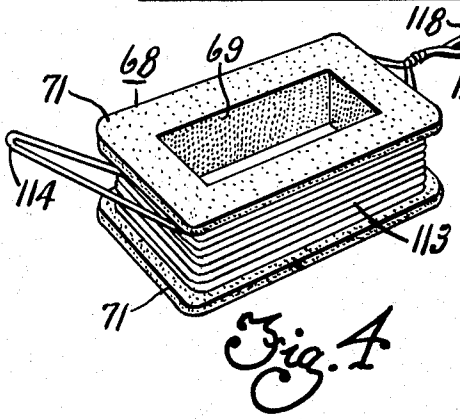


Fig. 4

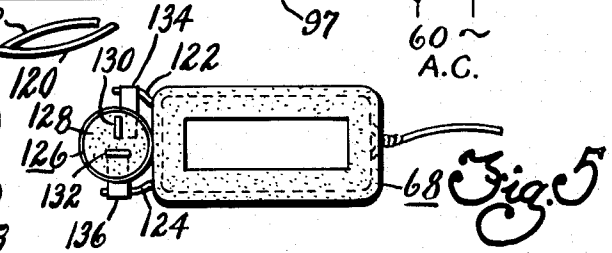


Fig. 5

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METHOD OF WINDING A LOOP CONTAINING COIL

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2 Claims. (Cl. 29—155.57)

This invention pertains to coils for electrical apparatus, and particularly to a center tapped coil and a method of making the same.

In the manufacture of split series reversible motors having only one wound pole, a center tapped coil can conveniently be used. A motor of this type is disclosed in copending application Serial No. 680,238 filed August 26, 1957, now U. S. Patent No. 3,045,137, in the name of Simmons et al. and assigned to the assignee of this invention. The present invention relates to a unique center tapped field coil wherein a loop is formed in an intermediate turn of the coil in such a manner that the succeeding turns of wire securely retain the loop in assembled relation with the coil. In addition, the present invention contemplates a unique method of winding center tapped coils from a continuous length of wire by withdrawing a loop from an intermediate turn near the center of the coil. Accordingly, among our objects are the provision of an improved center tapped coil construction; the further provision of a coil construction having a looped intermediate turn which is securely held in assembled relation by successive overlying turns; the further provision of a method of making a tapped coil from a continuous length of wire; and the still further provision of the method of winding a coil wherein a loop is withdrawn from an intermediate turn.

The aforementioned and other objects are accomplished in the present invention by winding substantially half of the total number of turns on a bobbin, withdrawing a loop from an intermediate turn, and then winding the remaining turns on the bobbin from a continuous length of wire. Specifically, the completed coil construction includes a bobbin having a loop withdrawn from an intermediate turn of a predetermined number of turns wound thereon from a continuous length of insulated wire. The ends of the continuous length of wire extend from one side of the bobbin. These ends can be twisted together, bared of insulation and electrically connected so as to form a common ground connection for the two portions of the center tapped coil. The loop of the center turn is severed and the bared ends thereof are electrically connected to a terminal assembly.

In winding the tapped coil, a bobbin is placed on a stationary winding head. The end of the wire from the coil, constituting a start lead, is clamped in a fixture. A power operated flyer type winding arm is rotated about the winding head and bobbin and simultaneously reciprocated to evenly distribute the turns on the bobbin. After substantially half of the total number of turns are wound on the bobbin, a hook is extended between the winding arm and the bobbin so that a portion of the next turn is wound about the hook. The hook is automatically moved out of the path of the succeeding turns by the wire tension so that the remaining turns are again evenly distributed on the bobbin by the flyer type winding arm. Movement of the winding arm is automatically arrested after a predetermined number of turns are wound on the bobbin. The wound coil is thereafter removed from the winding head and the end lead is severed.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings,

wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

FIGURE 1 is a schematic view, partly in section and partly in elevation, illustrating apparatus for carrying out the coil winding method of this invention.

FIGURE 2 is a fragmentary view, partly in section and partly in elevation, illustrating the manner in which a loop is withdrawn from an intermediate turn of the coil during the winding operation.

FIGURE 3 is a schematic diagram of an electrical circuit for controlling the winding apparatus used in carrying out the coil winding method of this invention.

FIGURE 4 is a perspective view of a center tapped coil constructed according to this invention.

FIGURE 5 is a plan view in elevation of the completed coil construction with a terminal block attached thereto.

With particular reference to FIGURE 1, apparatus for carrying out the coil winding method of this invention is schematically shown including an electric motor **10** having a shaft **12** drivingly connected with the input side of an electrically operated clutch **13**. The output side of the clutch **13** is drivingly connected to a gear reduction unit **14** having two output shafts **16** and **18**. The output shaft **16** has a gear **20** connected thereto meshing with a gear **22**. The gear **22** is drivingly connected to an upstanding hollow shaft **24** supported by bearings **26**. The gear **22** also meshes with a gear **27** which drives a counter **28** that can be selectively adjusted to determine the number of turns to be wound on the coil.

A reciprocable shuttle **30** has a straight spline connection, as indicated by numeral **32**, with the shaft **24** so as to rotate therewith while being capable of axial movement relative thereto. The shuttle **30** includes a collar section **34** which receives the end of a yoke **36** formed on one end of a bellcrank **38** having an intermediate fixed pivot **40**. The other end of the bellcrank **38** carries a cam follower roller **42** that is received by a groove **44** in a rotatable cam **46**. The cam **46** is drivingly connected to a shaft **47** driven by a bevel gear **48** that meshes with a bevel gear **50** driven by the shaft **18**. The cam **46** is driven in timed relation with rotation of the shaft **24** so as to reciprocate the shuttle **30**, and thereby evenly distribute the turns of wire on the coil bobbin in a manner well known in the art.

A winding arm **52** is attached to the shuttle **30**, the winding arm supporting a pair of pulleys **54** and **56** and having an upstanding eyelet **58**. A continuous length of insulated wire **60** is unwound from a reel **62**, passed between a plurality of tensioning rollers **64** and over the periphery of a guide pulley **66**. The wire **60** extends through the hollow shaft **24**, over the guide pulley **54** and around the guide pulley **56**. The wire **60** also extends through the eyelet **58**.

A bobbin **68** is supported on a two-part winding head comprising a stationary lower part **70** and a movable upper part **72**. The bobbin **68** is composed of insulating material and includes a hollow core **69** having a flange **71** at each end. The upper part **72** of the winding head is movable to facilitate insertion of the bobbin **68** and removal of the completed coil. However, during the winding operation the upper part **72** of the winding head is maintained in assembled relation with the lower part **70**.

The end of the wire **60** is securely held by a clamp **74**. The end of the wire **60** is placed between the clamp **74** and a stationary support **76**, and the clamp **74** can conveniently be connected to the rod of a reciprocable piston **78** disposed within a cylinder **80**. The piston **78** can be subjected to differential air pressure in op-

posite directions to clamp and release the end of the wire **60**.

A bellcrank **82** having an intermediate pivot **84**, has a hooked end **86** located adjacent the winding head. The bellcrank **82** is normally maintained in the position shown in FIGURE 1 by a locking link **88** so that the hooked end **86** is located out of the path of the wire being wound on the bobbin **68**. The locking link **88** is attached to a solenoid plunger **90** mounted for movement within a solenoid coil **92**. When the coil **92** is deenergized, a spring **94** maintains the plunger **90** and the locking lever **88** in the position depicted in FIGURE 1. When the solenoid coil **92** is energized, the plunger **90** moves to the left, as viewed in FIGURE 1, thereby permitting pivotal movement of the bellcrank **82** by gravity so that the hooked end **86** will be positioned between the winding head and the path of the outer end of the winding arm as it is rotated thereabout.

With reference to FIGURE 3, the motor **10** can be energized from a source of 60 cycle alternating current through wires **95** and **96**. The electrically operated clutch **13** can be energized through wires **97** and **98**. A manually operated push button switch **100** is connected in circuit with the clutch **13**, the switch **100** being shunted by a switch **102** actuated by a cam **104**. The cam **104** is driven by the counter **28**. The push button switch **100** is momentarily closed to initiate the winding operation and the switch **102** controlled by the cam **104** automatically deenergizes the clutch **13** after the desired number of turns have been wound on the bobbin **68**. The solenoid coil **92** can be energized from the 60 cycle alternating current source through wires **106** and **108** as controlled by a switch **110** actuated by a cam **112**. The cam **112** is likewise driven by the counter **28** so as to facilitate closure of the switch **110** as an intermediate turn is being wound on the bobbin. The solenoid coil **92**, thereafter, remains energized until the end of the winding cycle, since the switch **110** remains closed.

Referring to FIGURES 1 through 3, the steps involved in winding the unique center tapped coil construction of the present invention are as follows: A bobbin **68** is placed over the stationary part **70** of the winding head and the movable part **72** of the winding head is thereafter clamped to the stationary part **70**. The end of the wire **60** from the previous coil is securely held by the clamp **74**. The push button switch **100** is momentarily closed to energize the clutch **13** thereby imparting simultaneous rotary and reciprocating movement to the flyer type winding arm **52**. The wire **60** is wound about the core of the bobbin **68** and evenly distributed thereon as shown in FIGURE 2 to form a coil **113**. As soon as substantially half of the total number of turns have been wound on the bobbin **68**, the cam **112** permits closure of switch **110** thereby energizing the solenoid coil **92**. When the solenoid coil **92** is energized, the bellcrank rotates in the clockwise direction by gravity to the full line position shown in FIGURE 2 wherein the hooked end **86** is positioned between the outer end of the winding arm **52** and the winding ahead, as shown in FIGURE 2, so that the wire **60** is wound thereabout. As the wire is wound over the hooked end **86**, the wire tension acting on the bellcrank **82** during continued rotation of the winding arm **52** effects counterclockwise rotation of the bellcrank to the phantom position indicated in FIGURE 2. This movement of the bellcrank **82** is sufficient to withdraw the hooked end **86** out of the path of successive turns of the wire **60** and forms a loop **114** in the intermediate turn **116**.

As the hooked end **86** of the bellcrank is withdrawn from the full line position of FIGURE 2 to the phantom line position of FIGURE 2, the portion of the intermediate turn **116** adjacent the left hand end of the bobbin is pulled upwardly into engagement with the upper flange **71** of the bobbin. Accordingly, during continued rotation and reciprocation of the winding arm **52** the withdrawn loop **114** will not interfere with winding of the succeeding turns. In addition, the loop **114** is securely retained in assembled relation with the coil since the remaining half of the turns are wound over the center turn **116**.

After the desired total number of turns have been wound about the bobbin **68**, the cam **104** actuates the switch **102** to denergize the clutch **13** thereby arresting movement of the winding arm **52**. At the same time the cam **112** opens the switch **110** to deenergize the solenoid **92**. At this point, the movable part of the winding head **72** is disengaged from the stationary part **70** facilitating removal of the completed coil. At the same time, the clamp **74** is released, and the wire **60** is again positioned between the clamp **74** and the stationary support **76**. The wire **60** is then severed, after which the clamp **74** can again be moved into engagement with the stationary support **76** to securely hold the end of the wire **60**.

With particular reference to FIGURE 4, when the bobbin **68** having the coil **113** wound thereabout is removed from the winding head, the end leads **118** and **120** of the coil can be twisted together. Thereafter, one of the wires **118** or **120** can be severed, and the wires **118** and **120** electrically connected by any suitable means, such as welding. The welding operation removes the insulation from the wire. The loop **114** can then be severed to form coil leads **122** and **124** of the center tapped coil. Since ends **122** and **124** are securely held in assembled relation with the bobbin by the outer turns of the coil **113**, these wires can support a terminal assembly **126**. The terminal assembly **126** includes an insulating housing **128** having a pair of spade terminals **130** and **132** and a pair of terminal lugs **134** and **136**. The terminal lugs **134** and **136** are crimped over and welded to the ends of the wires **122** and **124** to produce the finished coil construction shown in FIGURE 5.

From the foregoing it is manifest that the lead wires of the coil constructed according to this invention do not have to be taped in place since the first and last coil turns are mechanically and electrically connected to form the common ground lead for the center tapped coil. In addition, the leads for the two coil sections are securely held in position by the overlying turns and can conveniently support the terminal assembly. Moreover, by practicing the welding method of this invention, center tapped coils can be economically manufactured.

While the embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. The method of winding a center tapped coil having a predetermined number of turns on a bobbin from a continuous length of insulated wire, the bobbin having a core with a flange at each end, comprising the steps of, winding substantially half of said predetermined number of turns on said bobbin, extending a hook into the path of movement of said wire to wind one turn near the center about the hook, automatically retracting the hook out of the path of movement of said wire due to wire tension to form a loop by pulling one side of said one turn into engagement with one of the flanges on said core, and then winding the remainder of said predetermined number of turns on said bobbin over said one turn to securely retain the loop in assembled relation with the coil.

2. The method of withdrawing a loop from an intermediate turn of a coil wound on a bobbin by a flyer type rotary winding arm, comprising the steps of, extending a hook between the bobbin and the path of movement of the winding arm when the arm is winding an intermediate turn on the bobbin so that a portion of the intermediate turn is wound about the hook, and automatically retracting the hook out of the path of movement of said winding arm due to wire tension to form a loop on said intermediate turn, so that during completion of the winding the intermediate turn will be securely held in position by the overlying turns.

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