

Feb. 20, 1951

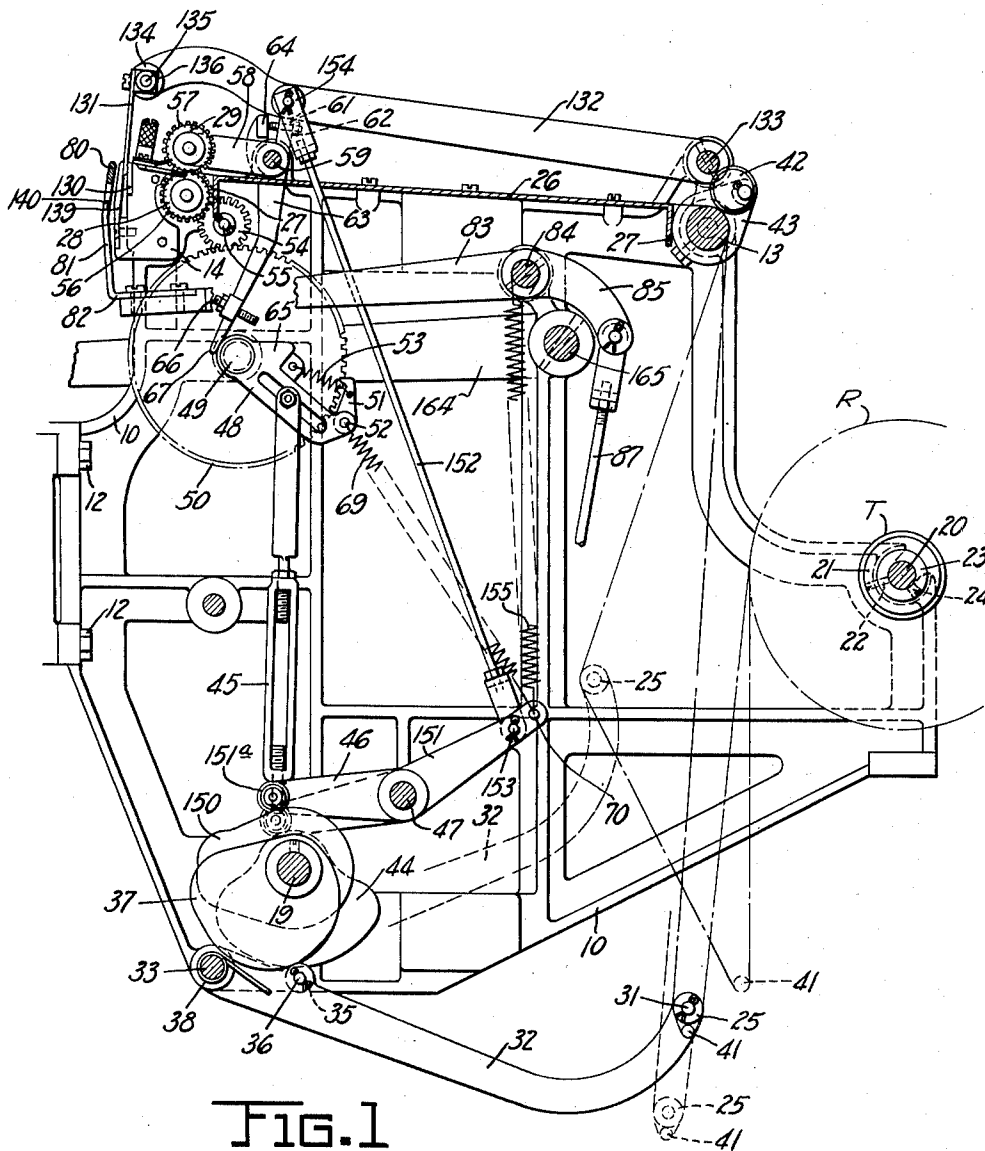
J. E. BOSH ET AL

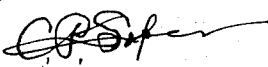
2,542,303

WINDING MACHINE

Filed May 31, 1946

9 Sheets-Sheet 1



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WINDING MACHINE

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9 Sheets-Sheet 2

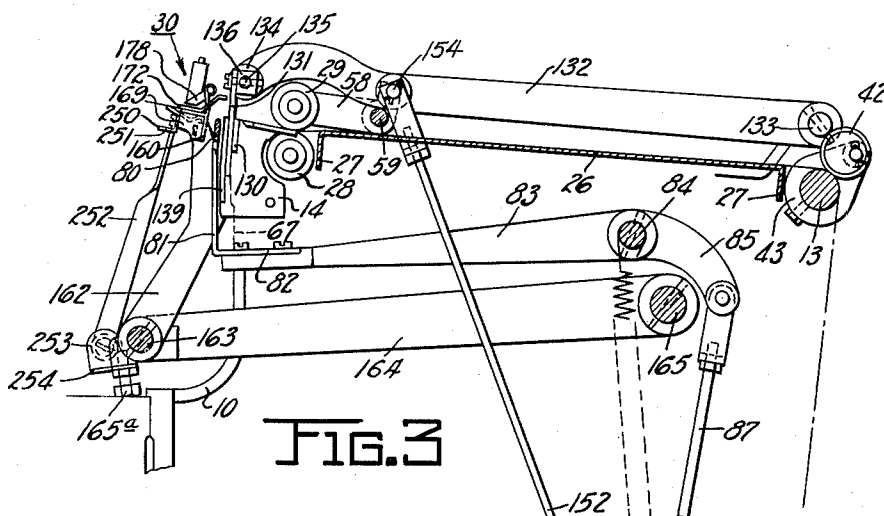


FIG. 3

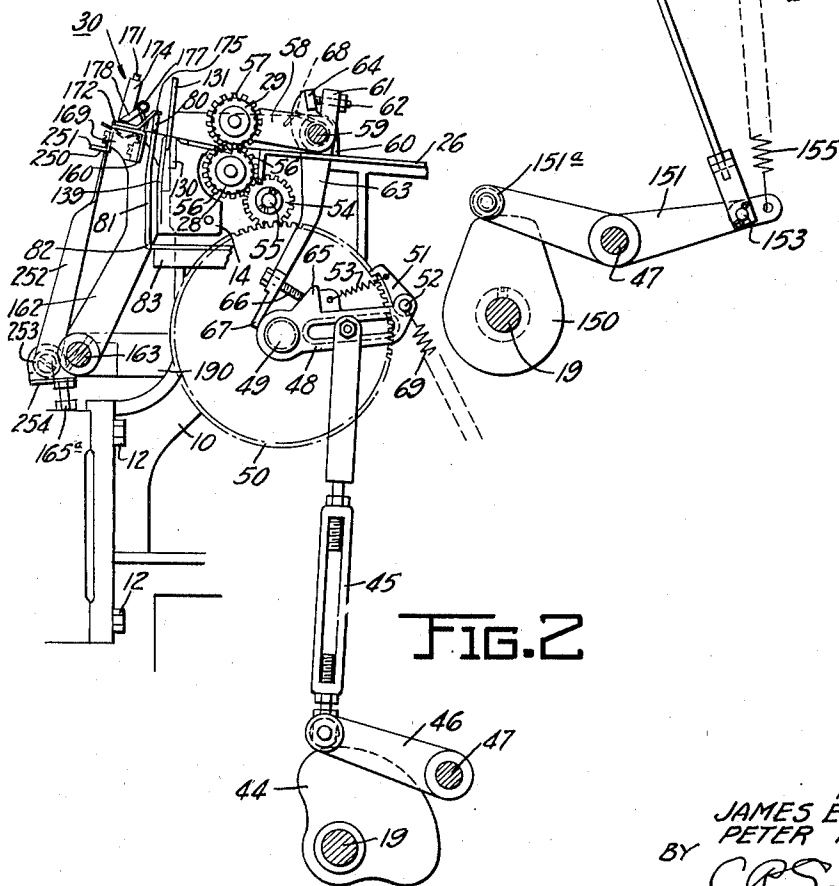


FIG. 2

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9 Sheets-Sheet 3

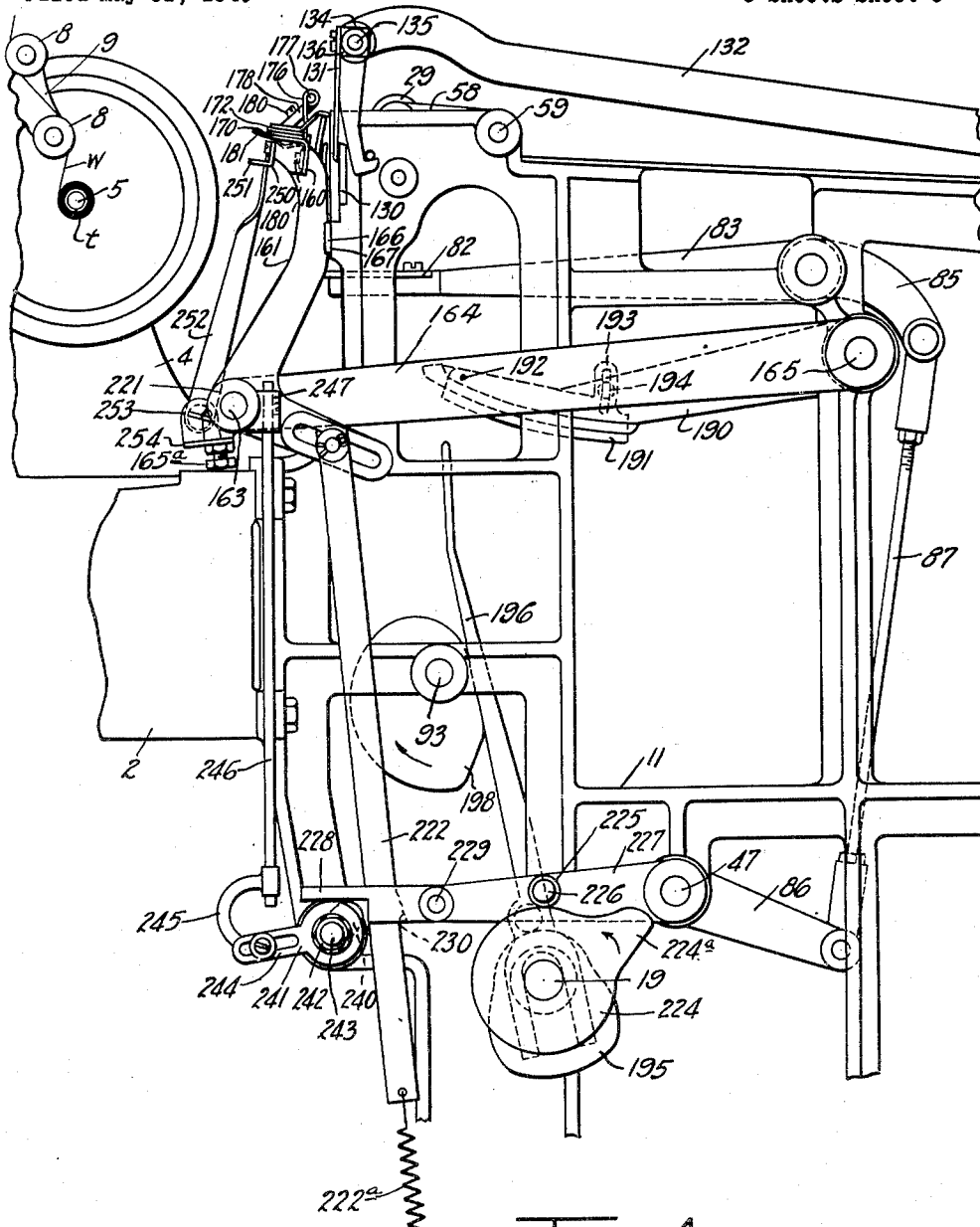


FIG. 4

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9 Sheets-Sheet 4

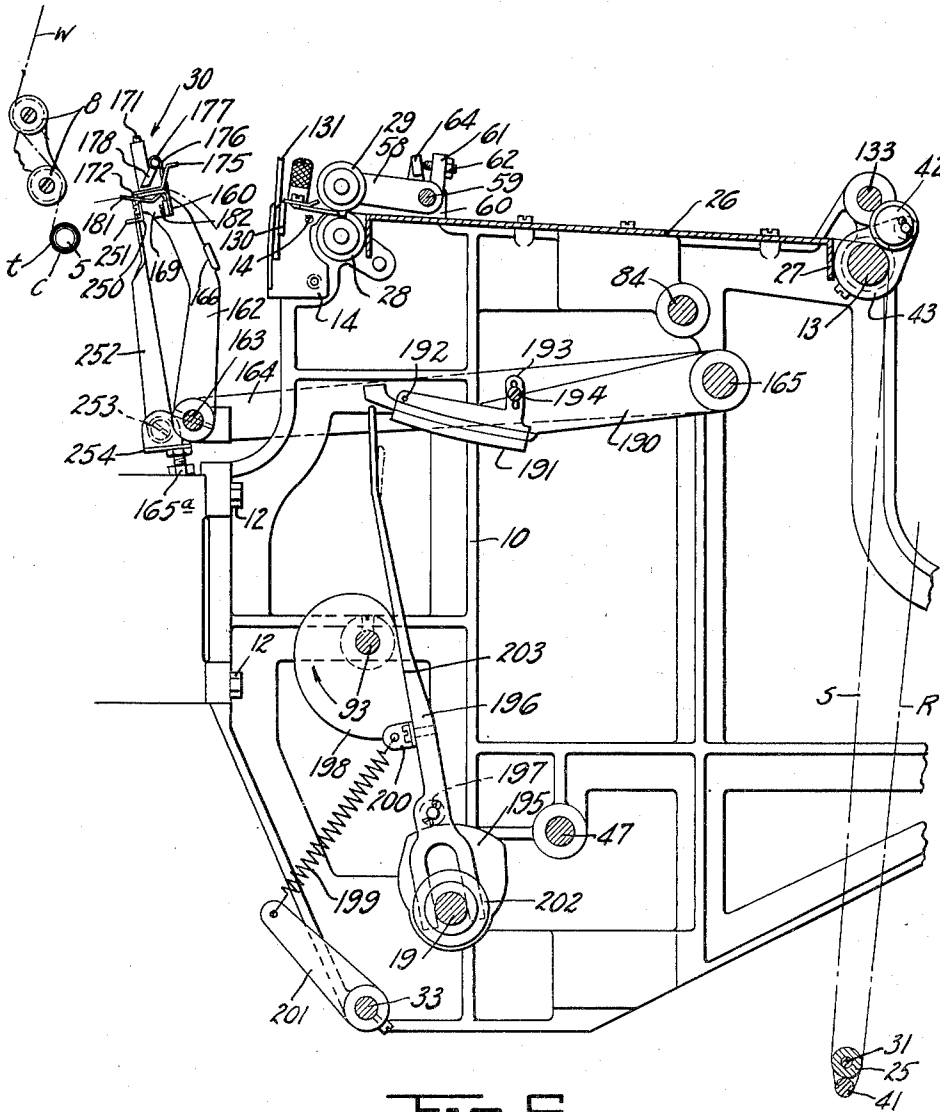


FIG. 5

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9 Sheets-Sheet 5

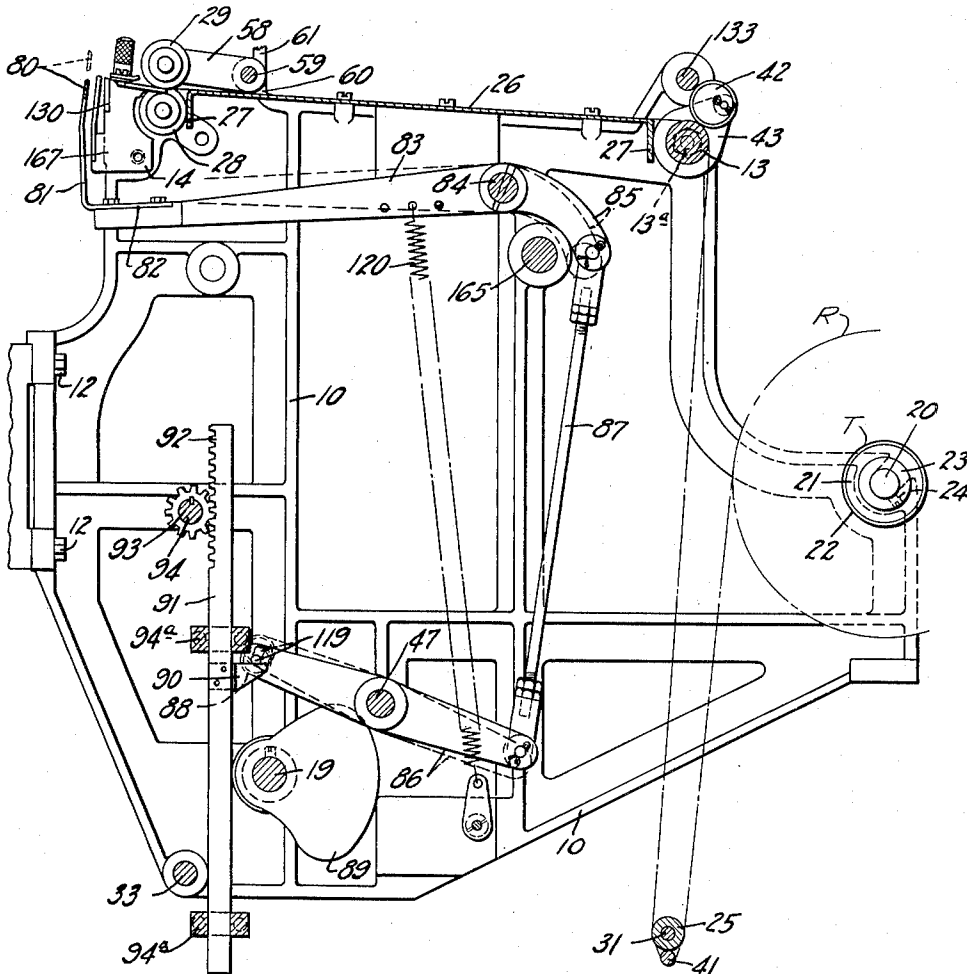


FIG. 6

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9 Sheets-Sheet 6

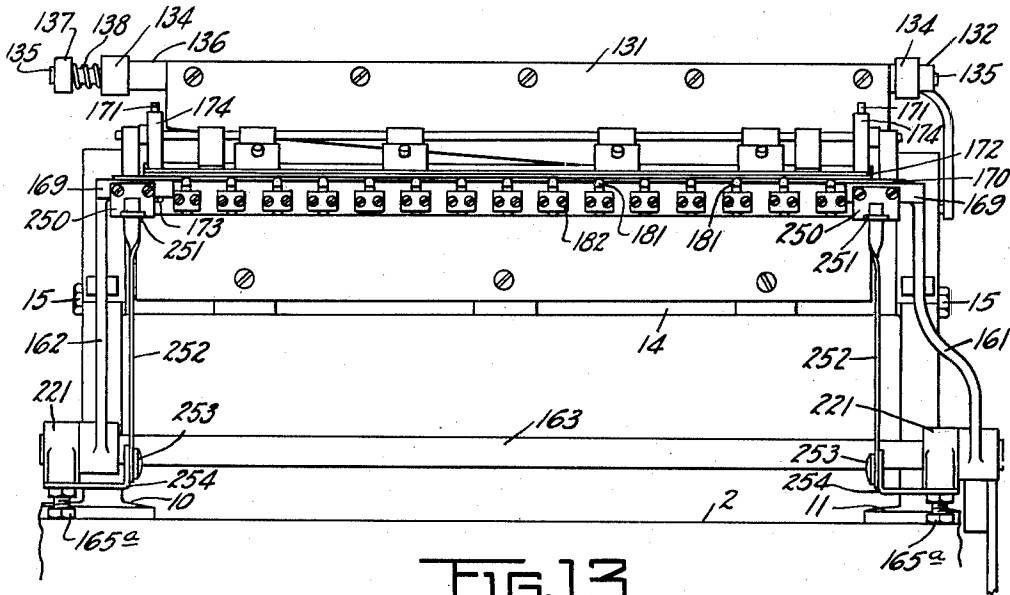


FIG. 13

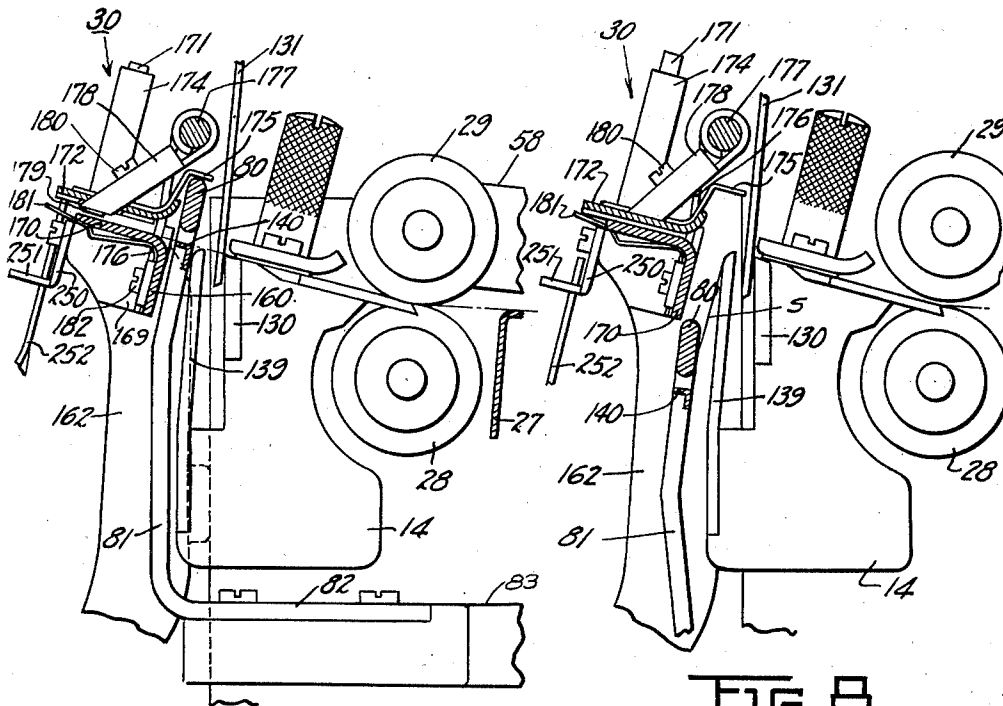


FIG. 7

FIG. 8

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9 Sheets-Sheet 7

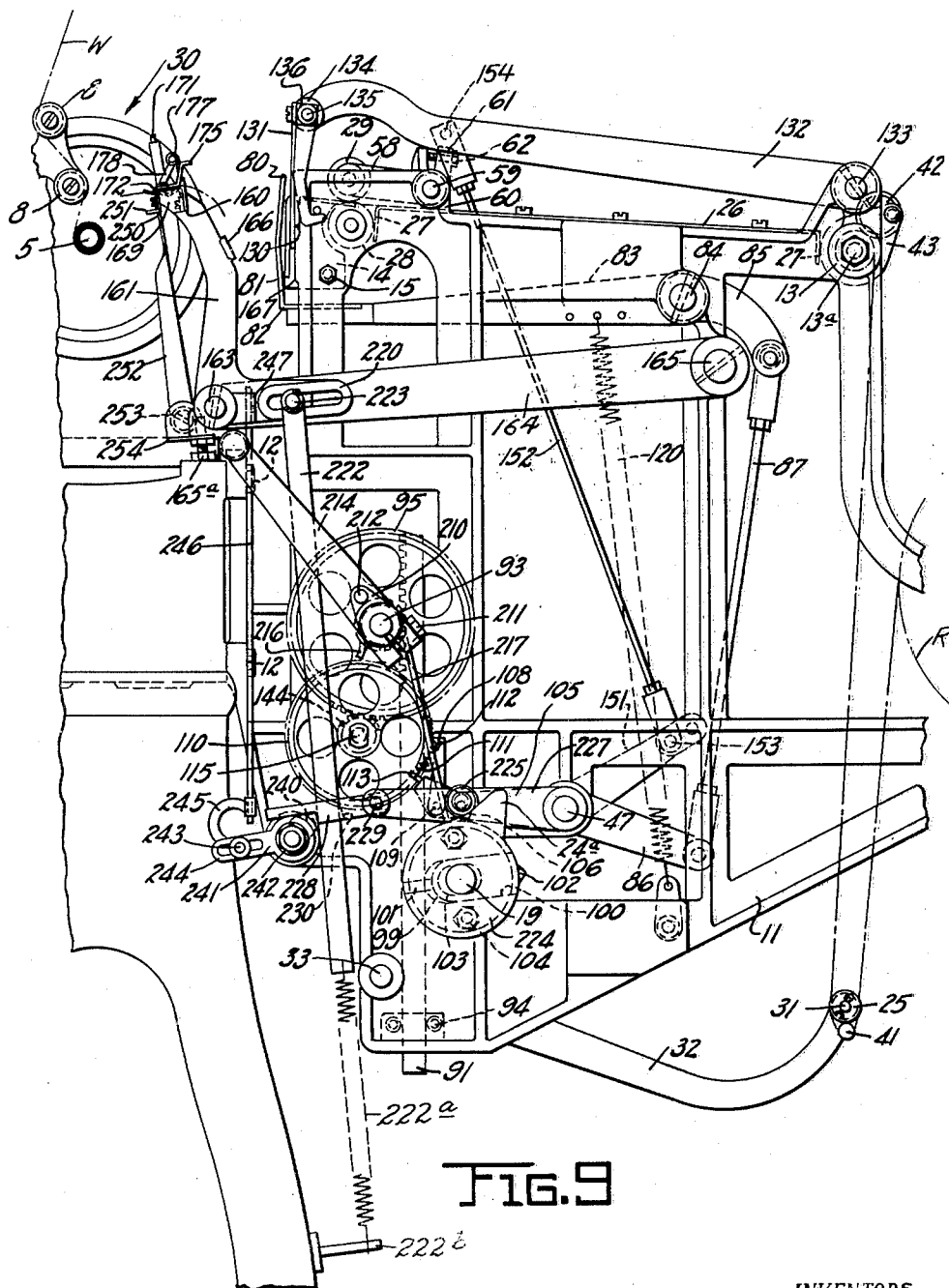


FIG. 9

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9 Sheets-Sheet 8

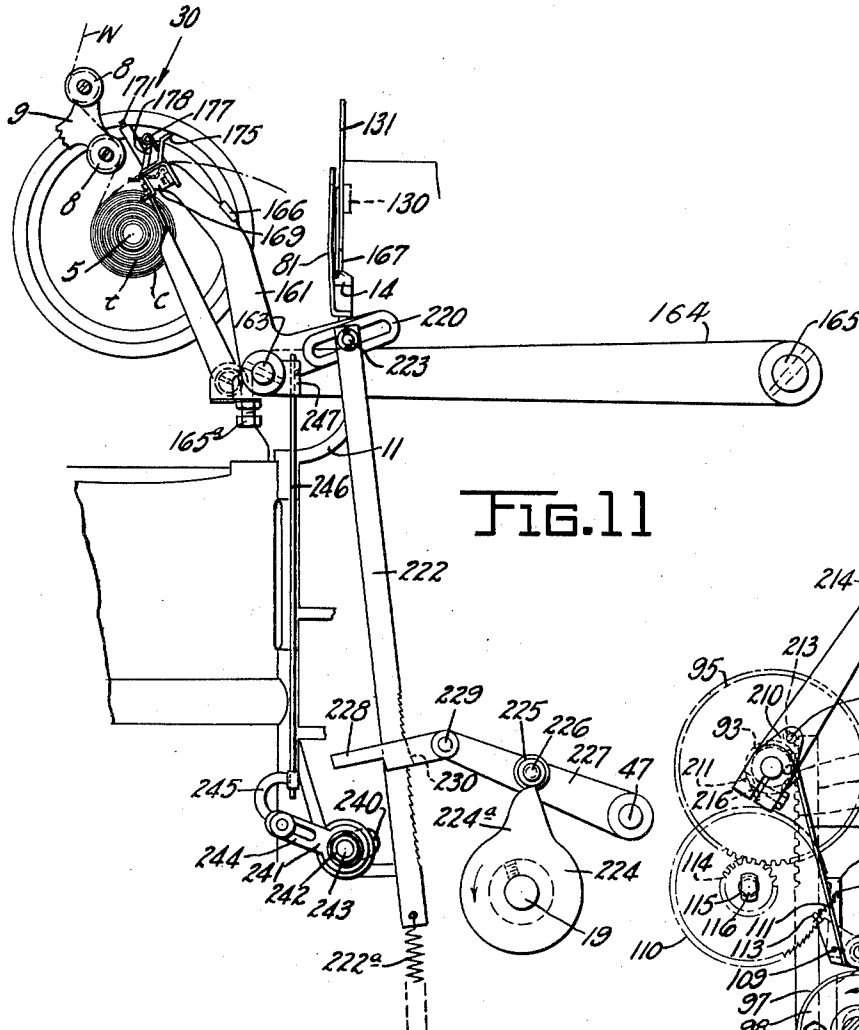


FIG. 11

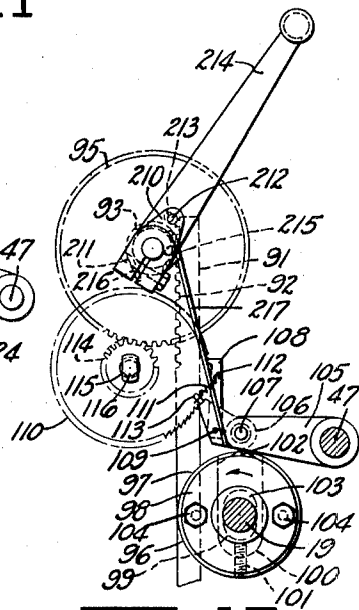


FIG. 10

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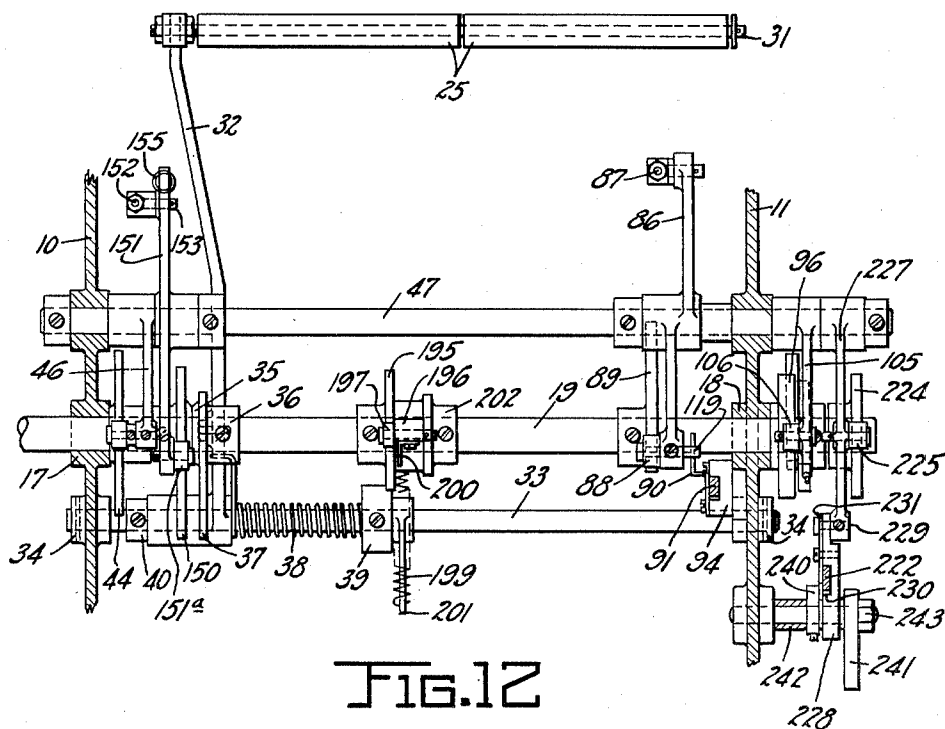


FIG. 12

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UNITED STATES PATENT OFFICE

2,542,303

WINDING MACHINE

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Application May 31, 1946, Serial No. 673,428

31 Claims. (Cl. 242-10)

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This invention relates to improvements in winding machines, and has particular reference to machines for inserting insulation material or separation layers in layer wound coils.

In the manufacture of layer wound coils it is the practice to employ automatic machinery which will wind a layer of strand or wire upon a mandrel or an arbor and then cause at proper intervals a layer of sheet or insulating material to be inserted between successive layers wound on the same arbor. Such automatic machinery is generally provided with means for feeding the sheet material, means for measuring the sheet in accordance with increasing diameter of the coil being wound, means for severing the measuring sheet, and means for inserting or delivering the measured and severed sheet to the winding at proper intervals.

The use of very thin sheet material for insulation, in order to obtain coils having good magnetic properties consistent with a minimum amount of space, has presented difficulties in handling not found in other sheet insulating material. Very thin sheet material, such as cellulose acetate having thicknesses ranging from 0.0005" to 0.001" have been unusually hard to handle. One of the main reasons underlying this difficulty has been the failure of the machines of the prior art to release the measured and severed sheet in the sheet serving operation just prior to the engagement thereof by the coil as it is being wound.

Another difficulty attendant upon the machines of the art has been the failure to support thin sheets adequately throughout both their length and width, both kinds of support being necessary both during the severing operation and the serving operation.

In the winding of coils it is obvious that the diameter thereof is increasing at intervals during the winding operation, and this requires that the sheet serving mechanism be suitably varying in its movement to take care of such increments in diameter, or else the serving mechanism will not function properly with the winding operation.

In the winding of coils the changes in diameter vary as the thickness of the strand to be wound and also as the thickness of the sheet material separating each layer. In the machines of the prior art it has been the practice to raise the sheet serving mechanism to allow for the increasing diameter between each sheet serving cycle, but it has not been possible heretofore readily to change the sheet serving mechanism to allow for differences in both wire or strand size nor for the thickness of the sheet material.

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With the foregoing considerations in mind it is an object of this invention to provide a winding machine having a sheet measuring and a sheet serving mechanism which can be used with extremely thin materials.

Another object is to provide in a winding machine means for supporting sheet material during both the sheet severing and the sheet serving operations.

A yet further object is to provide means for varying the movement of the sheet serving mechanism in accordance with the increase in diameter of a coil being wound.

Still another object is to provide in a winding machine of the class described means for readily adjusting the sheet serving mechanism in order that the machine may readily be accommodated to the winding of coils of a different diameter, different wire sizes, and different thicknesses of sheet insulating material, and combinations of two or more of the foregoing variables.

Further objects of the invention are set forth in the following specification which describes a preferred embodiment of the invention, by way of example as illustrated by the accompanying drawings, in which:

Figure 1 is a side elevation of a portion of a winding machine, showing the sheet serving means thereof partly in section and illustrating the drawing-off, feeding and cutting mechanisms for the sheet material, and showing the positions of the correlated elements thereof during the delivery of the paper to the winding;

Figure 2 is a part sectional view similar to Figure 1 showing the position of the feed rolls immediately following the feeding of the sheet material into the delivery shelf and illustrating the manner in which the feed rolls are separated to permit the measuring bar to draw an additional length of paper therebetween;

Figure 3 is a similar part sectional view showing the cutting-off mechanism which operates to sever the strip of paper immediately following the measuring operation;

Figure 4 is a part sectional view showing the sheet serving mechanism with means for varying the movement thereof in accordance with the increase in diameter of the coil being wound;

Figure 5 is a similar part sectional view of the sheet serving mechanism showing the position of the feed elevating means at the start of the winding of the coils;

Figure 6 is a similar part sectional view illustrating the sheet measuring means for controlling the length of the sheet fed into the coils;

Figure 7 is an enlarged detail view of a portion

of the sheet serving means, a portion of the sheet measuring means, a portion of the sheet severing means, and a portion of the sheet releasing means which co-operates with the sheet serving means;

Figure 8 is an enlarged sectional view similar to Figure 7 showing the sheet measuring means at the end of the measuring movement;

Figure 9 is an end view of the sheet serving mechanism showing the delivery mechanism in operative position during the transfer of the sheet to the coils being wound;

Figure 10 is a side view of the elevation control mechanism shown in the opposite position shown in Figure 9;

Figure 11 is an end view of the sheet serving mechanism shown in position to effect delivery of the sheet to the coils, the sheet releasing means being shown in co-operation with the sheet serving means;

Figure 12 is a detailed plan view of the cam shaft and various cams and levers for actuating the different mechanisms; and

Figure 13 is a detailed front view of the sheet serving means, the sheet releasing means and the cutting-off mechanism.

For convenience of description the invention will be described by dividing the complete machine in convenient units, such as the coil winding mechanism in general, the sheet supply means, strip or sheet feeding mechanism, sheet measuring means, sheet serving means, and means for controlling the sheet serving means.

Referring now particularly to Figures 4, 5 and 9, the machine to which the present invention is applied is substantially of the character disclosed in Le Boeuf Patent No. 2,029,577, Machine for Winding Electrical Coils, issued February 4, 1936, and comprises a bed or table 2 supported by legs 3 adapted to rest on the floor. The table 2 supports a headstock 4 which carries the journals for a winding spindle, not shown, which supports a mandrel or arbor 5 having thereon a tube *t* around which is wound a coil C, suitable means not shown, being provided to drive the arbor 5 to wind the coil C. A supply of strand material or wire *w* passes over a wire guide 8, 8 supported on a reciprocating cross-head 9, the reciprocation of the crosshead 9 being longitudinal of the axis of the arbor 5 to provide during the reciprocation thereof and the rotation of the mandrel 5, a coil upon the mandrel 5. It is obvious that a plurality of guides 8, 8 may be provided on the crosshead 9 whereby a plurality of coils may be wound simultaneously.

The complete mechanism for inserting sheets of insulating material into the coil or coils being wound comprises a complete unit adapted for attachment to the rearward side of the coil winding machine. Referring particularly to Figures 1, 4, 5 and 9, the mechanism is supported on a pair of frame members or brackets 10 and 11 which are bolted to the table or bed 2 by means of cap bolts 12 threaded into the table 2. The frame members 10 and 11 furnish supports or bearings for the various shafts of the mechanism later to be described. Extending between the frame members 10 and 11 at their upward rearward end is a strut or tie rod 13 which is secured to the members 10 and 11 by means of cap bolts 13a which pass through holes in the members 10 and 11 and are threaded into the strut or tie rod 13. Referring particularly to Figures 1, 2, 3, 5 and 9, the frame members 10 and 11 are also braced at their forward end by means of a strut

or paper guide member 14, the latter being secured between the members 10 and 11 by means of cap bolts 15 passing through holes in the frames 10 and 11 and threaded into the strut 14.

As previously stated, and with particular reference to Figure 12, the frame members 10 and 11 constitute bearings for various shafts of the mechanism, and as herein shown, provides bearings or journals 17 and 18 for a rotatable cam shaft 19 which provides the main driving element for the several mechanisms hereinbefore referred to, and which is driven by the same mechanism which drives the arbor 5 through a train of gearing, not shown. The details of the gearing which drives both the cam shaft 19 and the winding mandrel or arbor 5 is described with detail in Le Boeuf Patent No. 2,029,577 referred to hereinbefore. Suffice it to say, however, the cam shaft 19 makes one complete revolution during the complete traverse of the carriage or cross-head 9 in either direction.

Means are provided for supplying a sheet of insulating material to be inserted into the coil C at proper intervals, and to this end, as seen with reference to Figure 1, a roll R of sheet cellulose acetate or other insulating material is rotatably mounted on a rod 20 removably supported on the frames 10 and 11. As is shown, the central tube T upon which the sheet material is rolled is preferably supported on each end by means of a pair of frusto-conically shaped members 21 which may be suitably positioned with the roll R and thereafter locked into place upon the rod 20 by means of set screws 22. The rod 20 may have provided at each end thereof for proper longitudinal positioning thereof a collar 23 which may be locked into place by set screws 24.

The end of the paper strip S is drawn from the roll R and passed around movable rollers 25, and thence up and over the tie rod 13. The strip is then drawn over a plate-like shelf 26 which spans the frame members 10 and 11 and is fastened thereto in any convenient manner. Preferably, the plate 26 has end portions 27 bent downward at right angles to provide smooth corners so that the sheet material may not be torn or otherwise damaged during its travel thereacross. From the plate or shelf 26 the paper passes between a pair of feed rollers 28 and 29 which feed the paper on to a delivery shelf or sheet serving means indicated generally by the ordinal 30 in a manner as will be later explained.

Means are provided for drawing a portion of sheet material from the roll R during a part of the cycle of operations of the machine, and to this end, see Figures 1 and 12, the rollers 25 are rotatably mounted on a rod 31 secured to the end of a rockable supply lever 32 which is pivoted upon a rod 33 extending between the side frames 10 and 11 and secured at each end in bosses located at each frame by means of pins 34, see Figure 12. A cam follower 35 projecting from the supply lever 32 and secured thereto by means of a pin 36 is adapted to co-operate with a cam 37 fast with the cam shaft 19. The supply lever with its cam follower 35 is constantly urged into contact with the cam 37 by means of a helical spring 38 around the rod 33, one end of which is secured to the lever 32, the other end being secured to a collar 39 fastened to the rod 33. The spring 38 also serves to make the lever 32 abut a collar 40 secured to the rod 33.

The supply control cam 37 and the lever 32

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actuated thereby is shown by the initial position in Figure 1; with the parts in this relationship the rollers 25 are depressed to approximately $\frac{3}{4}$ of a complete working stroke. During this stroke the rollers 25 engage the loop of sheet material S and move downwardly to draw a length of sheet material from the roll R. When the arm 32 is in its lowermost position as illustrated by the dotted line in Figure 1 the loop of sheet material is completely formed, and further rotative movement of the cam 31 permits the follower 35 and the lever 32 to move upwardly to their uppermost inoperative position as indicated by the dash lines in this view. While in this position the loop of paper S is free to be drawn upwardly by the feed rolls 28 and 29 in the manner as later explained. In order to provide a small amount of tension of the suspended length of sheet material a weight 41 in the form of a cylindrical rod may be placed within the loop.

Means are provided to prevent the strip S from being drawn rearwardly across the plate 26 on the strut 13, and to this end, and mounted upon the strut 13 are a pair of weighted grippers in the form of discs 42 mounted eccentrically upon arms 43 which may be loosened and adjusted along the strut 13. Preferably the peripheries of the disc 42 are provided with rubber or other friction material to provide frictional resistance to the paper strip passing thereunder. The arms 43 together with the discs 42 may be adjusted in position along the strut 13 for proper relationship with sheet material of different widths.

As has been described generally, the strip S is moved across the table 26 to be moved into proper position with the sheet serving means 30, the sheet measuring means and the sheet severing means, and comprises in part the pair of opposed rollers 28 and 29. Referring particularly to Figures 1, 2, 7 and 8, said means comprises a cam 44 fast upon the shaft 19 and deriving its motion therefrom, which co-operates with a cam follower 45 secured to an arm 46 which is pivotably connected to a fulcrum rod 47 which spans the frame members 10 and 11 and is journaled therein. The substantial translative movement of the cam follower 45 causes the rollers 28 and 29 to be rotated, and as will be seen from Figure 2, the cam follower 45 co-operates with a slotted arm 48 pivoted on a stud 49 supported by the frame 10 which also supports a gear 50. The slotted arm 48 carries at the end thereof a pawl 51 pivoted at 52 and adapted to engage with the teeth of the gear 50. A spring 53 maintains the end of the pawl 51 in engagement with the teeth with the gear 50, one end of the spring 53 being hooked to the pawl 52 and the other end being hooked to the arm 48. The gear 50 co-operates with an idler gear 54 journaled on a stud 55 in the frame 10 and the idler gear 54 meshes with gear 56 driving roller 28, gear 56 in turn meshing with gear 57 to drive roller 29. Roller 28 together with its driving gear 56 is suitably journaled in frame members 10 and 11.

Means are provided for permitting the top roller 29 to be swung out of contact with the lower roller 28 when it is desired to feed an additional length of sheet material to the sheet serving means. To this end the upper roller 29 and its driving gear 57 are supported on an arm 58 fast upon a shaft 59, which is journaled in a bearing 60 mounted on frame members 10 and 11. One of the arms, see Figure 2, is provided with an upstanding lug 61 through which is threaded an adjustable limiting screw 62. A lifter

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lever 63 pivoted on the shaft 59 is formed with a lug 64 adapted to engage the end of the screw 62 to rock the arm 58 to raise the top roller 29 away from the lower roller 28 upon rotation of the cam 44, which through the cam follower 45 imparts rotation to the arm 48 to cause an angular shoulder 65 to rock the arm 63 about shoulder 59, arm 63 having an adjustable connection to the angular shoulder 65 by means of the threaded member 66. The end 67 of the arm 63 normally rests against the hub of the arm 48 when the connection 66 is out of contact with the angular shoulder 65, and the arm 58 is normally biased in a direction whereby the roll 29 makes contact with the roll 28 by means of a coil spring 68. A spring 69 is provided to tend to swing the arm 48 downwardly to maintain the cam follower 45 in contact with the cam 44, one end of the spring 69 being anchored at the pivot 52, the other end being anchored at the frame 10 at 70, see Figure 1.

Means are provided for measuring the sheet material which has previously been moved into the sheet serving means by the action of the feed rollers 28 and 29, the sheet measuring means being also operable to maintain the sheet serving means 30 in sheet receiving position, at the same time the sheet measuring means providing for support both longitudinally and transversely of the sheet material, and the sheet measuring means thereafter moving to maintain the sheet serving means in sheet holding position for subsequent severing of the sheet material prior to the sheet serving operation. As will be seen with reference to Figures 3, 6, 7, 8 and 12, the sheet measuring means comprises a horizontally extending bar or rod 80 which is positioned forward of the paper-guide or strut 14. The length of the loop is governed by the circumference of the coil or coils being wound at the time the sheet is to be served thereto. As the circumference of the coil constantly increases in length with the growth of the winding, the length of the insulation strip must increase accordingly.

Referring particularly to Figure 6, the measuring bar 80 is formed integrally with legs 81 having laterally extending feet 82 which are secured to a pair of measuring levers 83 which are each pivoted on frames 10 and 11 at 84. The lever 83 has a rearwardly extending portion 85, hingedly connected to a lever 86 pivoted upon fulcrum rod 47 by means of an adjustable connector 87. Means are provided for rocking the lever 86 about its axis 47 to cause the downward or measuring movement of the measuring bar 80 at proper intervals, and to this end the lever 86 has mounted at the other end thereof a cam follower 88 which at times is in contact with a cam 89 fast upon cam shaft 19. Since the amount of downward movement of the cam follower 88 determines the amount of downward movement of the measuring bar 80, means must be provided to limit such downward movement in accordance with the length of the sheet to be measured, severed and later served. To this end the cam follower 88 is supported on a pin 110, the extension of which is caused to rest against a stop or gauge finger 90 mounted upon a gauge bar 91 which is provided at one end with a rack 92 which meshes with a pinion 93 fast upon a shaft 94. A spring 120 connected at one end to the lever 83 and to the other end on the frame 10 causes the extension normally to rest on the stop 96. The gauge bar 91 may be conveniently supported by guides 94, see Figures 6 and 12, secured to the frame 11. The pinion 93 is periodically rotated a small amount to lower the rack

91 with the gauge finger 90 to cause the measuring bar 80 to be lowered in an increasing amount, and as will be seen with reference to Figures 9, 10, the shaft 93 projects beyond the frame member 11 and carries adjacent its bearing in the frame 11 a spur gear 95 secured thereto. Means are provided for driving the spur gear 95 intermittently with its attendant pinion 93, see Figure 6, and as shown with particular reference to Figure 10, the cam shaft 19 has mounted thereon an adjustable cam 96 consisting of an annulus 97, a hub 98, and a slidably adjustable cam block 99 mounted therebetween. The annulus 97 surrounds the end of the cam shaft 19 abutting the side of a bearing on the frame 11 and is provided with a diametrically extending slot 100 in its face. The slot 100 extends only part way across the annulus so that provision is made for a radial set screw 101 at one end thereof. The cam block 99 is adapted to be slid radially in the slot 100 of the annulus 97 whereby its pointed end 102 may be projected beyond the periphery of the annulus 97. The block 99 has a slot 103 through which the shaft 19 extends to provide for this adjustment. A pair of bolts 104 are provided to draw the annulus 97 and the hub 98 together, and the block 99 will be securely clamped therebetween in its adjusted position.

The cam 96 co-operates with a lever 105 pivoted on the fulcrum shaft 47, the lever 105 having thereon a cam follower 106 carried on a pin 107. The lever 105 has mounted thereon a pawl 108 which is pivoted to the lever at 109, the pawl 108 has mounted thereon a pawl 108 which is pivoted to the lever at 109, the pawl 108 being lightly biased to engage the teeth of a spur gear 110 by means of a spring 111 which is hooked at 112 to the free end of the pawl and at its other end to a pin 113 on the free end of the lever 105.

It will thus be seen that the rotation of the cam 96 upon the shaft 19 will give intermittent rotation to the spur gear 110 which has fast thereto a small spur 114, spur gears 110 and 114 being mounted upon a stub shaft 115 secured in the frame 11 and provided with a head as at 116. The small spur gear 114 meshes with the spur gear 95 fast on the shaft 93.

It will thus be seen that as the pinion 94 on the shaft 93 is intermittently rotated a small amount the gauge bar 91 will be lowered a corresponding amount thereby lowering the gauge finger 90, and the measuring bar 80 to increase the downward movement of measuring bar 80 in accordance with coils of increasing diameter.

Means are provided for cutting the sheet material to form a sheet of proper dimensions for insertion between the layers of the winding, said means comprising a pair of knives one stationary and the other movable. Referring particularly to Figures 1, 7, 8 and 9, the forward side of the paper guide member or strut 14 is recessed along its length to receive a lower or stationary knife blade 130 which is fastened against the strut 14 by a plurality of screws, not shown. The upper edge of the blade 130 is beveled to provide a shearing edge forming a continuation of the upper inclined surface of the paper guide or strut 14. An upper or movable knife blade 131, which co-operates with the lower or stationary knife blade 130, is pivotally mounted between the forward end of a pair of arms or levers 132, see Figure 1, and provided with a lower inclined edge. The arms 132 are pivoted upon a shaft 133, the shaft 133 being supported in hubs or bearings at the top of the

frame members 10 and 11. Referring now to Figure 13 the forward end of the levers 132 are provided with hubs 134 for receiving the reduced cylindrical ends or trunnions 135 of a knife supporting bar 136. The bar 136 is of rectangular cross section and the blade 131 is secured to its flat forward face by means of suitable screws as shown. The knife 131 moves in an arcuate path and it is necessary that its cutting edge be maintained in contact with the sharpened edge of the lower knife 130. For this purpose the left hand trunnion 135 is extended beyond its bearing 134 and at its extremity is a fixed collar 137 acted upon by a spring 138, which is coiled around the trunnion 135 between the collar 137 and the bearing 134 with its ends secured to each of these elements, whereby the bar 136 tends to be rocked in a direction to maintain the lower inclined cutting edge of knife 131 in contact with the lower knife 130.

Referring to Figures 7 and 8 the knife 131 is arranged to slide downwardly between the knife 130 and a sheet guide plate 139 secured to the forward face of the paper guide or strut 14. The guide plate 139 supports the paper strip in advance of the fixed knife 130, and the paper strip is further supported in advance of the fixed knife 130 during times when the sheet is fed into the serving means 30, when the measuring bar 80 is in its uppermost position, by means of a small angle 140 which is supported at its ends on the legs 81 in any convenient manner. It will thus be seen that the sheet material is supported at a plurality of points when it is fed into the sheet serving means indicated generally by the ordinal 30.

Means are provided for moving the knife 131 downwardly in the sheet serving operation during a portion of the cycle, and to this end, as shown in Figures 1 and 3, the arms 132 which support the upper movable blade 131 are caused to pivot about the axis 133 by means of a cam 150 secured to the main cam shaft 19, cam 150 being in contact with a cam follower roll 151a mounted at one end of a knife operating lever 151 pivoted upon fulcrum rod 47, the other end of the lever 151 being hingedly connected to a rod or link 152 at 153. The other end of the rod 152 is hingedly connected at 154 to the knife operating lever 132. A spring 155 constantly urges the cam follower 151a into contact with the cam 150, said spring being secured at one end to the lever 151, and secured at the other end to the shaft 84. Referring now to Figure 1, the cam follower 151a is shown in its lowermost position with the rearward end of the lever 151 rocked upwardly and the arms 132 supporting the upper knife 131 in elevated position. As the cam 150 rotates substantially one hundred and eighty degrees its eccentric contour forces the follower 151a upwardly and the rearward arm of the lever 151 is rocked downwardly against the action of the spring 155. During this movement of the lever 151 the arms 132 are lowered to carry the upper knife 131 downwardly across the fixed knife 130 in a manner as later more fully explained. However, the strip severing operation takes place immediately following the measuring operation, and the inclined cutting edge of the knife 131 makes contact with the cutting edge of the lower knife 130 and cuts the strip S with a shearing action to provide a sheet of predetermined size which is held in and transferred to the coil or coils being wound by the operation of the sheet serving means 30 next to be described.

Means are provided for securely holding the sheet material after the sheet has been fed thereto during the sheet feeding operation, the sheet being held during the measuring and severing operation, and the sheet serving means being thereafter operated to serve the measured and severed sheet and to release the measured and severed sheet just prior to the engagement thereof by the coil or coils being wound. The sheet serving means 30 is positioned in front of the knives and the measuring bar 89, and as shown with particular reference to Figures 4, 5, 9 and 13, the sheet serving means comprises a horizontally extending angle iron rest or platen 160 supported at its ends by elbow shaped levers 161 and 162 which have their hubs fixedly secured to a horizontal shaft 163 extending between the forward ends of a pair of relatively long arms 164. The arms 164 are fast on a shaft 165 which is journaled in the frame members 10 and 11, the shaft 165 being adapted to be rotated in its bearings by elevating means as later described, whereby the sheet serving means 30 is lifted to the height necessary for effecting delivery of the measured and severed sheet in proper relation or position to the periphery of the coil being wound, the lifting of the sheet serving means 30 at the same time causing varying movement of the sheet serving operation thereof in accordance with the distance from the center of rotation of the coil being wound to the periphery of the coil being wound.

During the inoperative stroke of the elevating means the ends of the arms 164 rest upon the top of the bed 2 of the winding machine as shown in Figures 2, 3 and 4. Secured in the bosses at the ends of the arms 164 are bolts 165a arranged with their heads adapted to rest on the top of the bed 2, the bolts 165a being adapted to be adjusted to regulate the lowermost position of the arms 164 whereby the initial position of the sheet serving means 30 with respect to the coil or coils being wound may be adjusted. The sheet serving means 30 is normally maintained in close proximity with the measuring bar 89 by means later to be described. To limit the rearward movement of the said serving means or shelf 30, lugs 166 are provided on the sides of the levers 161 and 162 and are adapted to bear against the finished faces 167 on the frames 10 and 11, see Figure 9.

As shown in Figures 7, 8 and 13, the levers 161 and 162 have inwardly projecting ledges 169 to which an angularly shaped rest or platen 170 is secured. Rising from the top of the ledges 169 are a pair of guide pins 171 upon which a tension plate 172 is adapted to slide when the sheet material is to be inserted into the delivery shelf 30 during the sheet feeding operation, and when the delivery shelf 30 is moving into the sheet serving position. The guide pins 171 are shouldered and the shoulders thereon bear against platen 170, the end of the pin 171 being threaded and securing the platen 170 to the ledges 169 by means of nuts 173 threaded to the pins 171, see Figure 13.

The tension plate 172, mounted to slide upon the upright pins 171 by means of sleeves 174 therearound, comprises a sheet metal strip with its rearward side flared upwardly. This flared portion of the tension plate 172 together with the rearward rounded portion of the platen 170 provides a re-entrant opening or mouth for receiving the forward edge of the sheet as it feeds from the rolls 28 and 29.

Secured to the rearward side of the tension plate 172 are a pair of fingers 175 which are bent upwardly and rearwardly so that their ends are adapted to engage with the top of the measuring bar 89 as the latter is raised, to lift the tension plate 172 to permit the sheet to be fed thereunder, see Figure 7. The sheet is fed across the platen 170 by the feed rolls 28 and 29 and the measuring bar 89 then descends to perform the measuring operation by forming a loop in the sheet in the manner as previously described. To the end that the sheet is properly gripped on the delivery shelf 30 during the measuring operation to prevent retrogressive movement thereof, a pair of sheet metal fingers 176, see Figures 7 and 8, are attached to the forward side of the platen 170, and reach upwardly above the tension plate 172. The upper extremities of the fingers 176 are formed into a loop to support a horizontal rod 177 which supports a plurality of gripper fingers 178 which pass through an opening in the tension plate 172, and which have in the ends thereof a rubber detent 179 for gripping the sheet material. The detent 179 may be retained inside the finger 178 by means of a bolt 180. The platen 170 is preferably covered with felt or similar material, which with the rubber detent 179 securely grips the sheet material. As shown with reference to Figures 7 and 8 when the delivery shelf 30 is in position for the sheet feeding operation the tension plate 172 is lifted by the action of the measuring bar 89, at the same time lifting the finger 178 and the detents 179 out of contact with the platen 170, to permit the sheet material to be slid forwardly thereacross. With reference to Figure 8, when the measuring bar 89 has moved downwardly to form a loop in the sheet material the tension plate 172 is in contact with the platen 170 and the fingers 178 are released whereby the detents 179 are in contact with the sheet material to prevent its being drawn rearwardly by the action of the descending measuring bar 89.

As seen with reference to Figures 7, 8 and 13 the lower platen 170 has secured thereto, a plurality of thin flexible fingers 181 which support the sheet material throughout its length while it is being retained in the sheet serving means 30, the fingers 181 insuring that the strand being wound on the coil form may evenly grip the forward end of the measured and severed sheet. The fingers 181 may be secured to the platen 170 in any convenient manner as by the screws 182 shown in Figure 13.

The sheet material which has been measured and severed in the manner as previously explained is delivered into the coils for insertion between the layers thereof by a forward swinging of the sheet serving means or delivery shelf 30 to the position shown in Figure 11. The forward projecting edge of the sheet is delivered to the upper surface of the coil being wound and is drawn thereinto by the strand or wire *w*. In order that the sheet may be fed to overlie the top of the coil as it increases in diameter it is necessary that the delivery shelf 30 be progressively elevated during the progress of the winding. The elevating movement of the delivery shelf 30 must be in proportion to the diameter of the coil, its total extent being substantially equal to the thickness of a strand of wire plus that of the previously inserted sheet plus the diameter of the coil being wound. In the use of extremely thin sheet materials between layers of strands in a coil, the gripping of the sheet

material between strands must be free and without any gripping action by the sheet serving means. To this end means must be provided for releasing the sheet held by the delivery shelf 30, just prior to its being gripped by the strand or strands being wound.

The elevating means for the delivery shelf 30 and the control therefor is described with reference to Figures 4 and 5. The shaft 165 carrying the arms 164 has also fixed thereon a cam arm 190 provided with a cam face 191 which may be angularly adjusted in its position with reference to the arm 190, since one end of the cam face is pivoted at 192 and is provided with a slot 193 spaced from the pivot 192 so that the face may be rotated about the pivot 192 and secured into position by means of a bolt 194 threaded into the arm 190. A cam 195 fast upon the shaft 19 co-operates with a lifter member 196 having a cam follower 197 secured thereto which follows the contour of the cam 195, the contour of the cam 195 being such that a substantially vertical reciprocating motion is given to the lifter member 196. The lifter member 196 is positioned against the side of the cam 195 and held against lateral displacement by means of a collar 202 fast on the cam shaft 19. The lifter member 196 is constantly urged into contact with an elevation control cam 198 by means of a spring 199 secured at 200 to the lifter member 196, the other end of the spring 199 being connected to a member 201 which may be pivotally adjusted about the rod 33 spanning the frame members 10 and 11. The upper end of the lifter member 196 is adapted to engage against the cam face 191 of the elevation arm 190 to rock its shaft 155 to raise the arms 164. In this manner the levers 161 and 162 carrying the delivery shelf 30 are bodily raised to the position necessary to effect delivery of the sheet to the coils, see Figures 4 and 11. The forward edge of the lifter member 196 engages against the face of the elevation control cam 198 which is fast upon the shaft 93, previously described as carrying the pinion gear 94, see Figure 6.

At the start of the winding operation the coil C is relatively small in diameter and the elevation of the delivery shelf 30 is unnecessary to effect proper transfer of the sheet to the coils. Accordingly, the cam 198 is provided with a flat face 203 along which the lifter 196 slides with the control cam 198 in the position shown in Figure 5. The lifter member 196 will be reciprocated substantially vertically by the rotating cam 195 with its upper end moving from the position shown by dash lines to that illustrated by the full lines. Under this action the lifter member 196 does not engage the cam face 191 with the arm 190 and consequently no elevation of the delivery shelf takes place.

However, as the coils start to build up, the control cam 198 is slowly rotated in a clockwise direction as seen in Figure 5 and its eccentric contour gradually swings the lifter member 196 rearwardly against the action of the spring 199. As the lifter member 196 continues to be reciprocated by the cam 195 its upper end engages the cam face 191 on the member 190 to raise the latter and also the delivery shelf 30. During a complete operation the control cam 198 is intermittently rotated to a slight extent and at each turning movement thereof it moves the lifter 196 longitudinally on the inclined cam face 191 of the arm 190, thereby causing the lifter 196 to engage the cam face 191 at points progressively rearward on the cam face 191.

As was described with particular reference to Figure 10 the cam shaft 93 was periodically rotated by a ratchet and pawl arrangement driven by a main cam shaft 19. When the machine is first placed into operation the control cam 198 must be placed in the initial position seen in Figure 5 with its flat surface 203 in contact with the lifter member 196. At the same time the gauge finger 90, see Figure 6, must be raised to render the measuring bar 80 inoperative during the same portion of the operation of the entire mechanism. Referring particularly to Figure 10, the shaft 93 extends beyond the hub of the gear 95 and upon its end is an arm 210 secured thereto by a bolt 211 passing through its split hub. The arm 210 carries a pin or stud 212, the inner end of which passes through an enlarged circular hole 213 of a crank handle 214. The crank handle 214 is loosely mounted on the shaft 93 between the arm 210 and the hub of the gear 95, the hub of the crank 214 being provided with a circumferential groove 215 engaged by an upper hooked end 216 of a pawl release rod 217. The hook 216 of the rod 217 frictionally engages the groove 215 to resist the turning movement of the rod 217 on the hub of the crank 214.

The lower end of the rod 217 is positioned between the pin 113 projecting from the top of the pawl 108, and the pivot 109 of the pawl, and during the winding operation the rod 217 rests against the pivot 109 as shown in Figure 10. The hub of the crank 214 has a spring, not shown, coiled about the hub thereof which tends to rotate the crank to hold the rod 217 in the position as above described. The turning movement of the crank 214 is limited by the pin 212 engaging the side of the enlarged hole 213 therein.

After the completion of one or a series of coils the machine is adjusted for another winding operation by turning the crank 214 in a counter-clockwise direction until it strikes the rearward edge of the bed 2, see Figure 9. At the first movement of the crank in this direction its hub is rotated on the shaft 93 against the tension of the spring around the hub of the crank 214 until the side of its hole 213 makes contact with the pin 212. During this initial movement of the crank, the rod 217 is rocked to cause its lower end to contact with pin 112 on the pawl 108 whereby the pin is disengaged from the teeth of the ratchet wheel 110. Under this movement the rod 217 brings up the end of the follower pin 107 which serves as a stop therefor. After the pawl 108 has been released from the ratchet wheel 110, continued movement of the crank 214 turns the arm 210, through the medium of the pin 212, thereby to rotate the shaft 93. The turning of the shaft 93 causes the gears 95 and 114 to return the ratchet wheel 110 to its first or starting position. As the crank 214 strikes the bed 2 it is released by the operator and the spring around the hub of the crank then acts to turn it back slightly as limited by the engagement of the pin 212 with the opposite side of the hole 213, at which juncture the lower end of the rod 217 releases the pawl 108 to allow it again to engage the teeth of the ratchet wheel 110. By the foregoing operation, the shaft 93 is rotated until the stop or finger 90 is raised to its uppermost position, and the cam 198 is rotated to the position shown in Figure 5, which positions of stop 90 and cam 198 is for the start of the coil winding operation.

Means are provided for effecting delivery by the sheet serving means of a measured and severed

sheet to the coil or coils being wound, and to this end the levers 161 and 162 are rocked about an axis to carry the sheet serving means 30 forwardly to the position shown in Figure 11. As shown in Figures 9 and 11, the lever 161 is constructed with a slotted arm 220 projecting rearwardly from a hub 221 upon which the lever 161 pivots. Pivoting of the arm 161 is accomplished by a vertical bar 222 which has a sliding linkage to the arm 220 at 223. Means are provided for imparting interval movement to the bar 222 by means of a delivery cam 224 secured to the main cam shaft 19. As shown in Figures 4 and 11, the delivery cam 224 is provided with a lobe 224a which co-operates with a roll follower 225 mounted upon a pin or stud 226, which in turn is mounted upon a lever 227 pivoted on the fulcrum rod 47. The bar 222 has secured thereto a return spring 222a which is anchored on the frame 3 at 222b, see Figure 9. At the forward end of the lever 227 is mounted a dog 228 which is hingedly connected thereto at 229. The dog 228 is formed with an angular slot 230, the sides of which straddle the bar 222, the latter being held in the slot by a sheet metal plate 231 secured to the side of the dog 228. The slot 230 of the dog 228 is slightly wider than the bar 222 whereby the latter is permitted to slide freely therein as the levers 161 and 162 are raised with the arms 190.

Means are provided for limiting or varying the amount of pivoting of the levers 161 and 162 about the pivot 221 in accordance with the diameter of the coil being wound. To accomplish this there is provided means for adjusting the position where the dog 228 makes engagement with the bar 222, the position being varied by the amount the sheet serving mechanism 30 is lifted from the bed 2 by the amount of swing of the arm 190 and the position of a cam which varies the position of engagement of the dog 228 on the bar 222. As shown in Figure 4, there is provided a cam 240 which is held between an arm 241 and a collar 242 by means of a bolt 243 which supports the cam 240 between the arm 241 and the collar 242 the cam being secured in position by means of a set screw engaging the bolt 243, the bolt 243 being journaled in the frame 11. The arm 240 has a slot 244 therein in which a connector member 245 is adapted to slide as the longitudinal motion of the member 245 imparts rotation to the arm 241. The member 245 is connected to a rod 246 which is connected to a collar 247 pivotably mounted on the shaft 163.

It will be remembered that the lifter member 196 is not operable to lift the arms 190 except as the cam 193 has rotated to cause the engagement of the lifter member 196 with the cam face 191 to lift the arms 190 and the sheet serving mechanism 30. However, when the arms 190 are lifted to compensate for increasing diameter of the coil being wound the lifting of the arms 190 will simultaneously lift the rod 246 to rotate the cam 240. Immediately the arm 190 is lifted the lobe 224a of the cam 224 will lift the lever 227, and will cause the dog 228 pivoted on the end thereof to lift the bar 222 to pivot the sheet serving mechanism with its measured and severed sheet into position whereby the strand being wound will engage the forward end of the measured and severed sheet. It will be seen that the change of angular position of the cam 240 will change the point at which the dog 228 will engage in the bar 222 thereby varying the amount of swing in the forward or sheet serving direction of the sheet serving means 30. By suitable adjustment of the

position of the cam 240 between the arm 241 and the collar 243 the amount of swing of the levers 161 and 162 may be suitably varied. With the cam 240 turned to the left position, or counter-clockwise at the start as seen in Figure 4, the dog 228 will be lifted a small increment each time the levers 190 are lifted a small increment, and the position of engagement of the dog 228 on the bar 222 will be lifted to cause the dog 228 to engage the bar at a higher point thereon, so that when the cam lobe 224a lifts the lever 227, the amount of swing of the levers 161 and 162 will be lessened as the coil being wound increases in diameter.

With the cam 240 in the position in Figure 4, the increment in the amount of lift of the arms 190 will rotate the cam 240 further to the right to lower the dog 228, thereby causing it to engage the bar 222 at a lower point, and upon actuation of the lobe 224a of the cam 224 the amount of swing of the sheet serving means 30 will be accordingly increased. According to the thickness of the paper employed and the thickness of the strand being wound, the amount of swing of the sheet serving means may be suitably varied according to desired operating conditions.

Means are provided for releasing the measured and severed sheet held between the platen 170 and the tension plate 172 as the sheet serving means 30 moves to the sheet serving position to the coil being wound. To this end, the inwardly projecting ledges 169 have secured thereto sheet metal angles 250, the substantial horizontal legs of which are slotted at 251 to receive a pair of fingers 252 which are pivotally connected at 253 to a sheet metal member 254 which is held in place on the hub 221 by means of the adjusting screws 165a. The end of the finger 252 is adapted to raise with respect to the arms 161 and 162 upon the pivoting thereof about the shaft 163, whereby the end of the fingers 252 are operable to lift the tension plate 172 from the platen 170, when the sheet serving means 30 moves to the sheet serving position, to insure that the measured and severed sheet is held but loosely in the sheet serving means 30 when the measured and severed sheet is engaged by the strand being wound. With the foregoing arrangement and with the use of extremely thin separation sheets, there is no possibility of distorting or tearing or otherwise mishandling the measured and severed sheet which is served to the coil being wound.

The operation of the mechanism thus far described is as follows:

The functioning of the various mechanisms of the machine has already been explained in the description of the co-operating elements, and the method of operation of the complete apparatus will be explained as it relates to the sequence of operations necessary to supply insulation or sheet material to the coils being wound.

A supply of wire or any strand or strands to be wound is provided by mounting spools, not herein shown, in convenient position above the winding arbor 3. The strands of wire are drawn from the spools under any convenient device for regulating the proper tension of the strand, and the ends of the strands are attached in any convenient manner to a tube 4 secured to the arbor 5 in proper position to start the winding.

A roll of sheet material, such as very thin cellulose acetate is supplied for delivery to the sheet feeding means, see Figure 1, with the forward edge of the strip drawn from the roll R, first around the supply rollers 25, and then over the

tie rod 13. The strip S is then drawn across the plate 26 and entered between the feed rolls 28 and 29, the upper roll 29 being lifted manually for this purpose. As has been explained, the winding arbor 5 is driven by any convenient power means, and the crosshead 9, which travels axially of the arbor 5 is so arranged that it makes one complete revolution of the cam shaft 19 for a full traverse of the crosshead 9 in either direction. The details of this mechanism are fully described in Le Boeuf Patent No. 2,029,577, referred to previously.

Assuming that the strand *w* has traversed along the tube *t* mounted on arbor 5 by the guides 3, 8, and the latter have very nearly reached their ends of the reciprocating movement, the various mechanism embodied in the paper serving apparatus will assume the position as illustrated in Figures 1, 5, 6 and 9. At this point the delivery of a measured sheet to the coil C taking place, being approximately one-half completed, while the sheet material is being drawn from the roll R by the rollers 25 actuated by the supply cam 37. The feed rolls 28 and 29 are inoperative with the paper strip therebetween, and the measuring bar 80 is being raised from its lowermost position under the action of the measuring cam 39. The upper knife 131 has severed the sheet material to form a sheet and is now in raised or inoperative position while the fingers 178 are depressed to grip the sheet to the platen 170 of the sheet serving means 30. The elevation control mechanism has not yet indexed the control cam 198 around to a sufficient extent to affect the lifting of the sheet serving means 30 under the action of the elevation cam 195, see especially Figure 5 of the drawings.

As above stated the delivery mechanism is inoperative at this point and the severed sheet of paper is being transferred to the coils. During this sheet transfer operation the sheet releasing means co-operating with the sheet serving means 30 is operating to lift the tension plate 172 from the platen 170, see Figures 5, 9 and 11. Meanwhile, the delivery bar 222, see Figure 11, is being raised by the dog 228 which is temporarily connected therewith, the arm 227 and the dog 228 being moved by the delivery cam 224 in the manner as before explained. As the winding operation progresses and the wire guides 3, 8 reach the end of their traverse, the delivery shelf 30 assumes a position in close proximity to the coil C whereby the forward edge of the measured and severed sheet will be deposited on the upper surface of the coils under the strand *w* leading thereto, as shown in Figure 11. The forward edge of the sheet is thus caused to be gripped and held by the strand as the traverse of the guides 3, 8 is reversed. Thereafter the rotation of the coils on the mandrel 5 draws the sheet from the delivery shelf 30 and as it feeds into the coils it supplies a separation layer between the completed layers and strands and the next succeeding strand deposited thereon.

Assuming that the first measured and severed sheet has been transferred to the coils and a new cycle of operation is about to start, the drawing off of the sheet material from the roll R will be considered as the first operation in the cycle. To effect this the rollers 25, see Figures 1 and 12, are moved downwardly under the action of the cam 37 to draw from the roll R an ample supply of sheet material S. During the descent of the rollers 25 the eccentrically mounted rubber discs 42 act with a wedging effect to bind the sheet

material against the rod 13 to prevent it from being drawn back from the plate 26.

After a sufficient length of sheet material has been drawn from the roll R, the rollers 25 descend to the position illustrated by the dash lines in Figure 1. During this return movement the feed cam 44, see Figure 2, is rotated to raise the cam follower 44 to swing the arm 48 upwardly whereby its pawl 51 acts to rotate the gear 50 through a part of a complete revolution. Through the gear train 50, 54, 56 and 57, the rolls 28 and 29 are rotated in opposite directions to feed the sheet S therebetween. It will be seen with reference to Figures 2 and 7 that as the sheet S is fed forwardly by the feed rolls 28 and 29 the measuring bar 80 is in raised position and the tension plate 172 is elevated whereby the sheet material will pass thereunder. As will be seen with reference to Figure 7, the measuring bar 80 is provided with an angle 140, the substantial horizontal leg of which furnishes additional support for the sheet as it is being fed across the platen 170. As the arm 48 reaches its upper extent of movement its abutment or angular shoulder strikes the contact screw 66 on the lifter member 63, thereby turning the latter on its axis 59. The lug 64 on the member 59 then contacts the adjusting screw 62 in the lug 61 to lift the top roll 29 out of engagement with the lower roll 28 to permit the strip S to be drawn therebetween by the measuring bar 80.

Immediately the upper feed roll 29 is raised the measuring operation takes place, and referring to Figure 6, the measuring bar 80 is held in raised position by means of the cam 89. As the cam 89 rotates, the cam follower 88 follows its contour, until the pin 119, upon which the cam follower 88 is supported strikes the gauge finger 90 on the gauge bar 91. Coincident with the upward movement of the follower 88 the measuring bar is lowered. The tension plate is thus released whereby its associated tension fingers 178 act to grip the sheet against the platen 170 to prevent retrogressive movement thereof. As before explained the measuring bar 80 has no downward movement at the first traverse of the strand because the gauge finger 90 is in uppermost position to prevent such movement. However, during progressive traverse, the gauge finger is lowered at a uniform rate to allow the measuring bar 80 to descend to a constantly increasing extent.

As the measuring bar descends it engages the sheet material and drives it downward to form a loop therein, the length of the loop being governed by the diameter of the coils being wound. When winding strands of large diameter, the circumference or perimeter increases rapidly while coils wound of the fine strands increase in size very slowly. For this reason the throw of the control cam 96 is adjusted in the manner as before explained so that the indexing of the shaft 93 may be regulated as required.

After the measuring operation is completed the feed rolls actuating mechanism, shown in Figure 2, returns to inoperative position and the top roller 29 is again lowered against the lower roll 28. During this latter movement the upper knife 131 descends to cut the measured sheet to form a measured and severed sheet which is held on the sheet serving means 30 for transfer to the coils. The knife 131 is moved downwardly under the action of the cam 159, see Figure 3, which through the link connection 152 rocks the arms 132. The lower sharpened edge of the knife is held against the cutting edge of the stationary knife 130 by means previously described to cause it to act

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with a shearing effect to sever the strip S resting across the edge of the knife 130. As the operation is completed the mechanism acts to raise the sheet serving means 30 in a position to transfer the sheet to the coil C. Referring to Figure 5, the elevation of the delivery shelf 30 is lifted by means of the lifter member 196 which is raised by the cam 195. As before explained the lifter member 196 makes contact with the cam face 191 on the arm 190 to raise the latter and thereby rock the longer arms 164 carrying the sheet serving means or delivery shelf 30.

When winding the first few layers of coils, if a relatively fine strand is being used it is not necessary to elevate the delivery shelf 30 since the position of the sheet is initially adjusted in proper relation to the top of the coils by means of the adjusting screws 165a carried on the forward end of the arms 164 and resting against the top of the bed 2. After the first few layers of paper have been wound into the coils, the delivery shelf must be periodically raised to insure that the sheet will properly overlie the top of the coils for the purpose as before explained. The lifter member 196 is, therefore, not caused to contact the cam face 191 of the arm 190 of the first few windings, but as the coils increase in size the lifter member 196 is eventually moved into position to strike the cam face 191. As previously explained, this positioning of the lifter member 196 is accomplished by gradually rocking it on its pivot pin under the action of the control cam 198. The cam 198 is fast upon the shaft 93 carrying the pinion 94 for operating the measuring gauge finger 90, see Figure 6. As the finger 90 is progressively lowered to compensate for the increase in size in coil C, the cam 198 is slowly rotated to rock the lifter member 196 to the right, whereby the delivery shelf 30 is gradually lifted. The extent of shifting movement of the lifter member 196 depends upon the size of the strand being wound, being variable by the adjustment of the index cam 96 for the ratchet mechanism shown in Figure 10. This adjustment also regulates the change in position of the gauge finger 90.

As has been explained with reference to Figures 4 and 5, the cam face 191 may also be adjusted in position to vary the amount of lift of the sheet serving means 30 depending upon the thickness of the strand being wound and the thickness of the sheet material employed.

Immediately the delivery shelf 30 has been elevated it is rocked forwardly to transfer the measured and severed sheet to the coil C. As will be seen with reference to Figures 5 and 9, the fingers 252 are operating with the forward movement of the delivery shelf 30 to lift the tension bar 172 from contact with the platen 170, and simultaneously lifts the fingers 178 out of contact with the measured and severed sheet whereby the strand being wound may readily engage the measured and severed sheet without binding. As before explained, the transfer or sheet delivery is effected by means of the cam actuated dog 228, shown in Figure 11, which engages the delivery bar 222. At this point in the cycle of operations the delivery cam 224 turns to the position illustrated in Figure 11 and the dog 228, having gripped the bar 222, lifts the latter to rock the levers 161 and 162.

It will also be seen with reference to Figures 4 and 11 that the raising of the arms 190 simultaneously lifts the rod 246 to rock the cam 240 whereby the position of the dog 228 is adjusted

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with reference to the delivery bar 222 to vary the amount of swing of the levers 161 and 162 according to the diameter of the coil being wound.

As has been explained previously the delivery operation is very rapid so that the delivery shelf 30 may be returned to position to receive an additional supply of sheet material to be severed from the strip S. As the shelf 30 is returned to its initial position the paper supply mechanism completes the operation of drawing a supply of sheet material from the roll R while the measuring bar 80 is raised to allow the strip to be fed thereunder. The tension fingers 178 are raised simultaneously with the bar 80 to permit the strip to be fed unto the platen 170, and the angle connected to the delivery bar 80 provides an additional surface over which the sheet material may move and be supported. At this point the pawl 108 is actuated by the cam 96, see Figure 10, to index the elevation control cam 198 and position the gauge finger 90, whereby to reset the various mechanisms in position to start a new cycle of operations in the manner explained hereinabove.

The various operations above explained are repeated during the winding of the coils until a predetermined number of turns of strand or wire have been wound. Automatically actuated means, not herein shown, then act to arrest the operation of the machine. The coils may then be removed from the machine with the mandrel 5 and another mandrel placed in the headstock 4, see Figure 4. After the strands *w* have been attached to the mandrel 5 or to the tube *t*, the sheet serving apparatus is reset by drawing the crank handle 214 forwardly to the position shown in Figure 9. The crank handle 214 is then caused to actuate the mechanism before described to reset the measuring bar 80 and the lifter bar 196 in the first position for winding another set of coils.

It will be apparent from the foregoing description that the present invention applies sheets for separation or insulating material to coils being wound at the completion of each layer of winding. At the same time providing means for insuring that the separation layers may be freely inserted between each layer without any binding and with proper placing of the separation sheet. The sheet serving means operated by the mechanism is also provided with means for varying the amount of stroke thereof in accordance with the changing of diameter of the coils being wound. The sheet serving means thus operates with accuracy and precision, properly inserting the sheets of insulation material into the coils without crinkling and skewing, whereby perfectly wound coils are produced.

While the invention has been described and illustrated in a preferred embodiment thereof, it is to be distinctly understood that various modifications may be made therein without departing from the spirit or scope of the invention except as defined in terms of the claims here appended.

We claim:

1. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle; the combination therewith of means for moving said sheet serving means in a curvilinear path into position to deliver a sheet to said coil, means for intervally raising the sheet serving

6. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle; the combination therewith of means for moving said sheet serving means in a curvilinear path into position to deliver a sheet to said coil, reciprocable means for intervally raising the sheet serving means prior to its position

10. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound on said spindle, means for feeding sheet material to said sheet serving means, means for measuring and severing the sheet material fed to said sheet serving means, means for pivoting said sheet serving means about an axis into position to deliver a measured and severed sheet to said coil, means for intervally raising the sheet serving means prior to its position for delivery, and means co-operating with the means for raising the sheet serving means in accordance with the increase in diameter of said coil for chang-

ing the range of movement of said sheet serving means.

11. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle, means for feeding sheet material to said sheet serving means, means for measuring and severing the sheet material fed to said sheet serving means, means for moving said sheet serving means in a curvilinear path into position to deliver a measured and severed sheet to said coil, reciprocable means for intervally raising the sheet serving means prior to its position for delivery, and means co-operating with the means for raising the sheet serving means in accordance with the increase in diameter of said coil for changing the range of movement of said sheet serving means.

12. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle, means for feeding sheet material to said sheet serving means, means for measuring and severing the sheet material fed to said sheet serving means, means for pivoting said sheet serving means about an axis into position to deliver a measured and severed sheet to said coil, reciprocable means for intervally raising the sheet serving means prior to its position for delivery, and means co-operating with the means for raising the sheet serving means in accordance with the increase in diameter of said coil for changing the range of movement of said sheet serving means.

13. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle; the combination thereof with means for moving said sheet serving means into position to deliver a sheet to said coil, means for intervally raising the sheet serving means prior to its position for delivery, means co-operating with the first said means for changing the sheet delivery position of said sheet serving means in accordance with the increasing diameter of said coil, and means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

14. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle; the combination thereof with means for moving said sheet serving means into position to deliver a sheet to said coil, reciprocable means for intervally raising the sheet serving means prior to its position for delivery, means co-operating with the first said means for changing the sheet delivery position of said sheet serving means in accordance with the increasing diameter of said coil, and means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

15. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being

wound upon said spindle; the combination thereof with means for pivoting said sheet serving means about an axis into position to deliver a sheet to said coil, means for intervally raising the sheet serving means prior to its position for delivery, means co-operating with the first said means for changing the sheet delivery position of said sheet serving means in accordance with the increasing diameter of said coil, and means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

16. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle; the combination thereof with means for pivoting said sheet serving means about an axis into position to deliver a sheet to said coil, reciprocable means for intervally raising the sheet serving means prior to its position for delivery, means co-operating with the first said means for changing the sheet delivery position of said sheet serving means in accordance with the increasing diameter of said coil, and means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

17. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle; the combination thereof with means for moving said sheet serving means into position to deliver a sheet to said coil, means for intervally raising the sheet serving means prior to its position for delivery, automatic means for progressively increasing the range of action of said second means in accordance with increase in diameter of said coil, means co-operating with said second means in accordance with the increase in diameter of said coil, for changing the range of movement of said sheet serving means, and means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

18. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle; the combination thereof with means for moving said sheet serving means into position to deliver a sheet to said coil, reciprocable means for intervally raising the sheet serving means prior to its position for delivery, automatic means for progressively increasing the range of action of said second means in accordance with increase in diameter of said coil for changing the range of movement of said sheet serving means, and means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

19. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle; the combination thereof with means for pivoting said sheet serving means about an axis into position to deliver a sheet to said coil, means for intervally raising the sheet serving means prior to its position for delivery, automatic means for progressively in-

creasing the range of action of said second means in accordance with increase in diameter of said coil, means co-operating with said second means in accordance with the increase in diameter of said coil for changing the range of movement of said sheet serving means, and means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

20. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound upon said spindle; the combination therewith of means for pivoting said sheet serving means about an axis into position to deliver a sheet to said coil, reciprocable means for intervally raising the sheet serving means prior to its position for delivery, automatic means for progressively increasing the range of action of said second means in accordance with increase in diameter of said coil, means co-operating with said second means in accordance with the increase in diameter of said coil for changing the range of movement of said sheet serving means, and means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

21. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound on said spindle, means for feeding sheet material to said sheet serving means, means for measuring and severing the sheet material fed to said sheet serving means, means for moving said sheet serving means into position to deliver a measured and severed sheet to said coil, means for intervally raising the sheet serving means prior to its position for delivery, means co-operating with the means for raising the sheet serving means in accordance with the increase in diameter of said coil for changing the range of movement of said sheet serving means, and means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

22. In a coil winding machine wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound on said spindle; the combination therewith of means for moving said sheet serving means into position to deliver a sheet to said coil, means for intervally raising the sheet serving means prior to its position for delivery, and means acting upon said sheet serving means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

23. In a coil winding machine wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound on said spindle; the combination therewith of means for pivoting said sheet serving means about an axis into position to deliver a sheet to said coil, means for intervally raising the sheet serving means prior to its position for delivery, and means acting upon said sheet serving means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

24. In a coil winding machine wherein a rotating spindle co-operates with a strand travelling

axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound on said spindle; the combination therewith of means for moving said sheet serving means into position to deliver a sheet to said coil, reciprocable means for intervally raising the sheet serving means prior to its position for delivery, and means acting upon said sheet serving means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

25. In a coil winding machine wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound on said spindle; the combination therewith of means for pivoting said sheet serving means about an axis into position to deliver a sheet to said coil, reciprocable means for intervally raising the sheet serving means prior to its position for delivery, and means acting upon said sheet serving means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

26. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound on said spindle, means for feeding sheet material to said sheet serving means for measuring and severing the sheet material fed to said sheet serving means, means for moving said sheet serving means into position to deliver a measured and severed sheet to said coil, and means acting upon the sheet serving means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

27. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a coil being wound on said spindle, means for feeding sheet material to said sheet serving means for measuring and severing the sheet material fed to said sheet serving means, means for pivoting said sheet serving means about an axis into position to deliver a measured and severed sheet to said coil, and means acting upon the sheet serving means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

28. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a sheet between successive layers of a strand being wound on said spindle; the combination therewith of means for moving said sheet serving means into position to deliver a sheet to said coil, means for intervally raising the sheet serving means prior to its position for delivery, automatic means for progressively increasing the range of action of said second means in accordance with the increase in diameter of said coil, and means acting upon said sheet serving means for releasing the sheet being served prior to the engagement thereof by the strand being wound.

29. In a coil winding machine wherein a rotating spindle co-operates with a strand travelling axially of said spindle and wherein sheet serving means intervally inserts a measured and severed sheet into said coil; the combination therewith of a lever for raising said sheet serving

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means in accordance with increase in diameter of a coil being wound, a reciprocable member, means for reciprocating said member, a cam face on said lever, a cam for displacing the reciprocable member progressively to increase the amount of lift of said lever, and means for adjusting said cam face for different sheet thicknesses and strand sizes.

30. In a coil winding machine of the type wherein a rotating spindle co-operates with a strand travelling axially of the spindle and wherein sheet serving means intervally inserts a measured and severed sheet into said coil; the combination therewith of means for feeding sheet material into said sheet serving means, a shelf across which said sheet is fed, means for measuring said sheet, means for severing said sheet, and means on said sheet measuring means forming a continuation of said shelf for supporting the sheet during sheet feeding.

31. In a coil winding machine, the combination of means for winding a strand, means for feeding sheet material, sheet serving means including a

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delivery shelf and clamping means co-operating therewith for receiving and holding the fed sheet, means for measuring said sheet, means for severing said sheet, means on said delivery shelf comprising a plurality of thin fingers for supporting the forward end of the sheet, and means for releasing the clamping means while the sheet serving means is moving to sheet serving position whereby the strand being wound may readily engage said sheet.

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