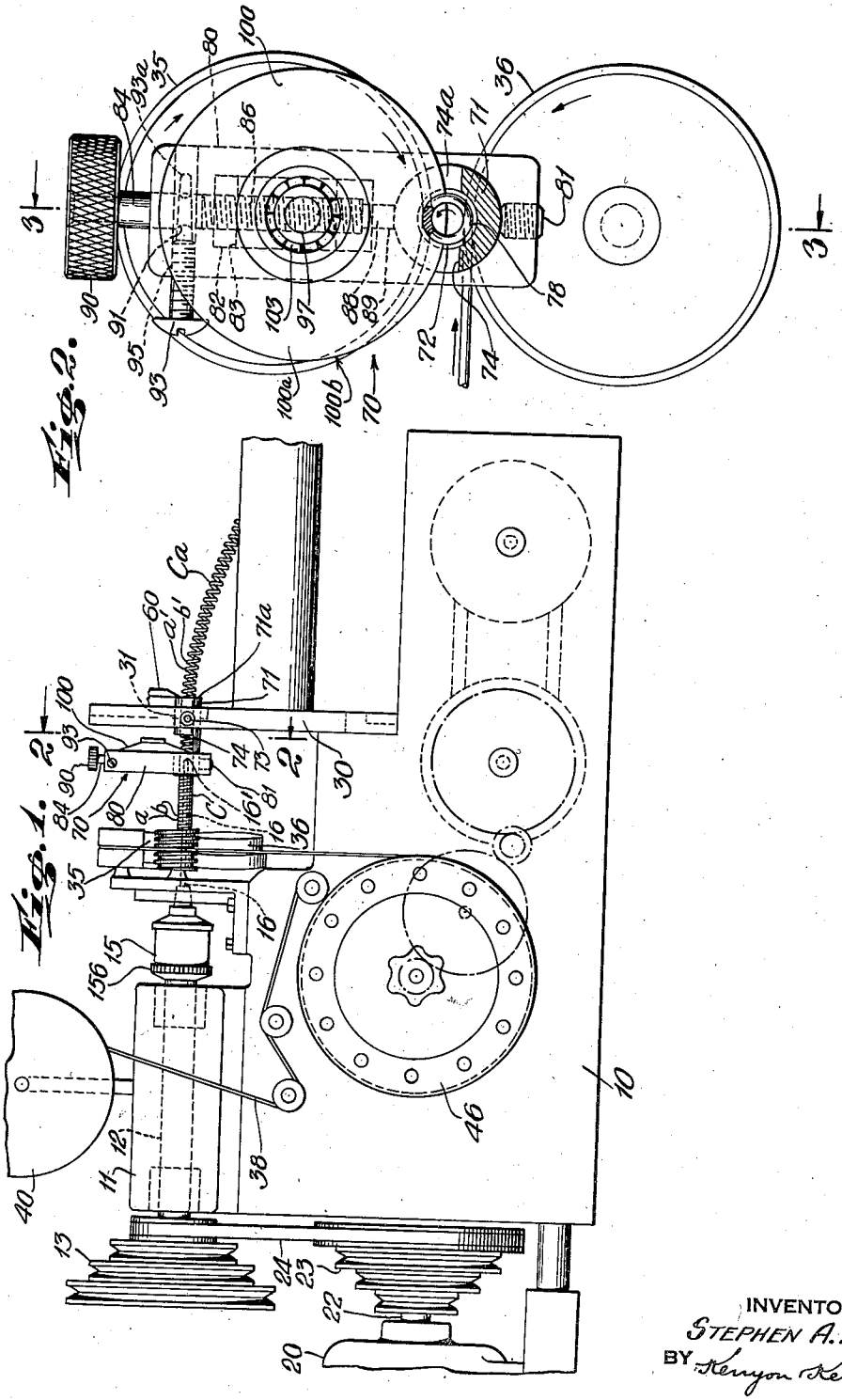
Oct. 21, 1941. S. A. PLATT 2,260,054

TURN SPACING DEVICE FOR COILS

Filed Oct. 2, 1940 3 Sheets-Sheet 1



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TURN SPACING DEVICE FOR COILS

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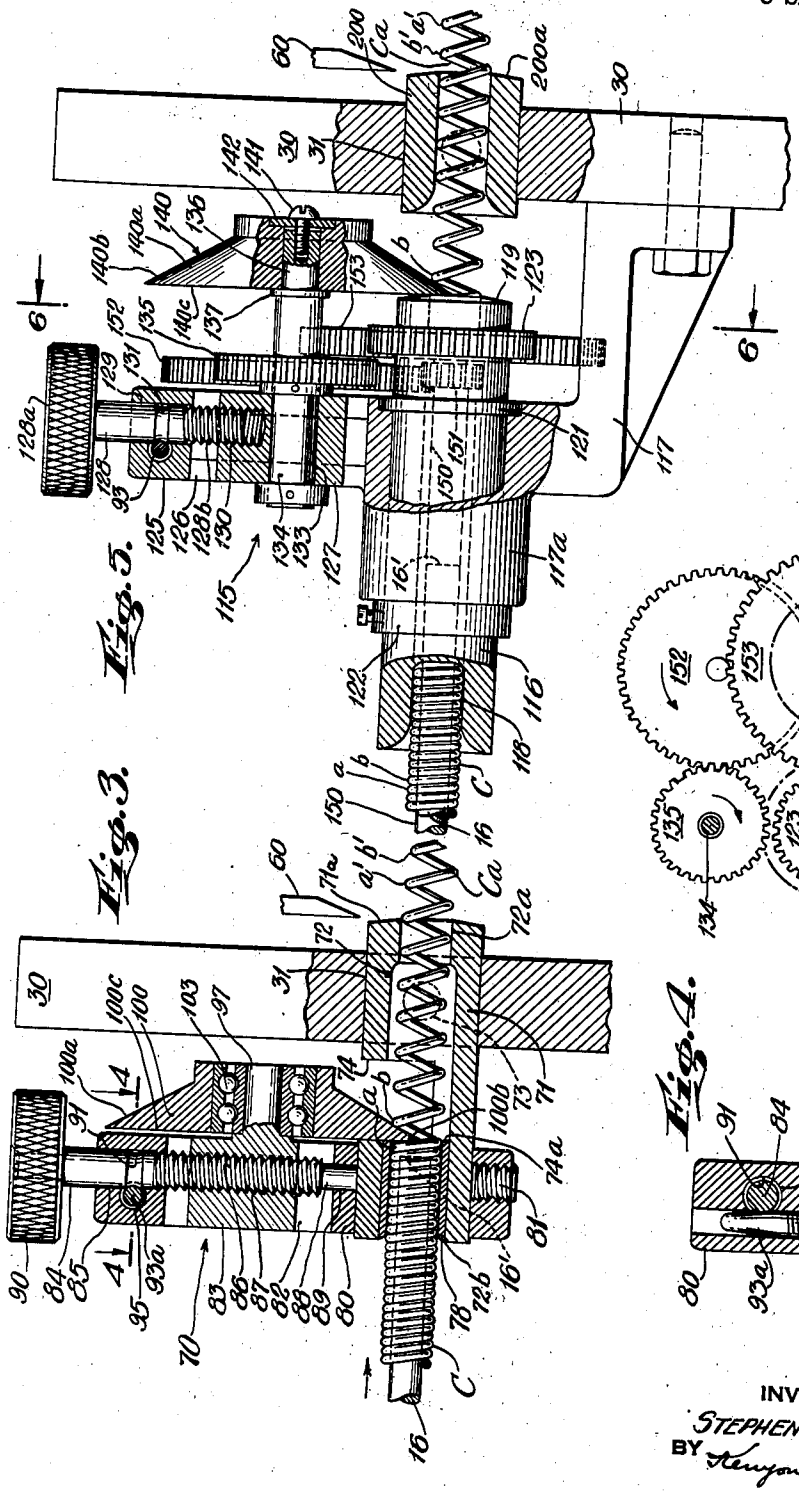


Fig. 3.

Fig. 5.

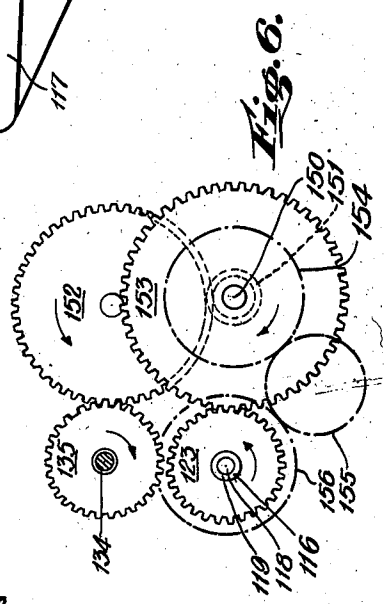


Fig. 6.

Fig. 4.

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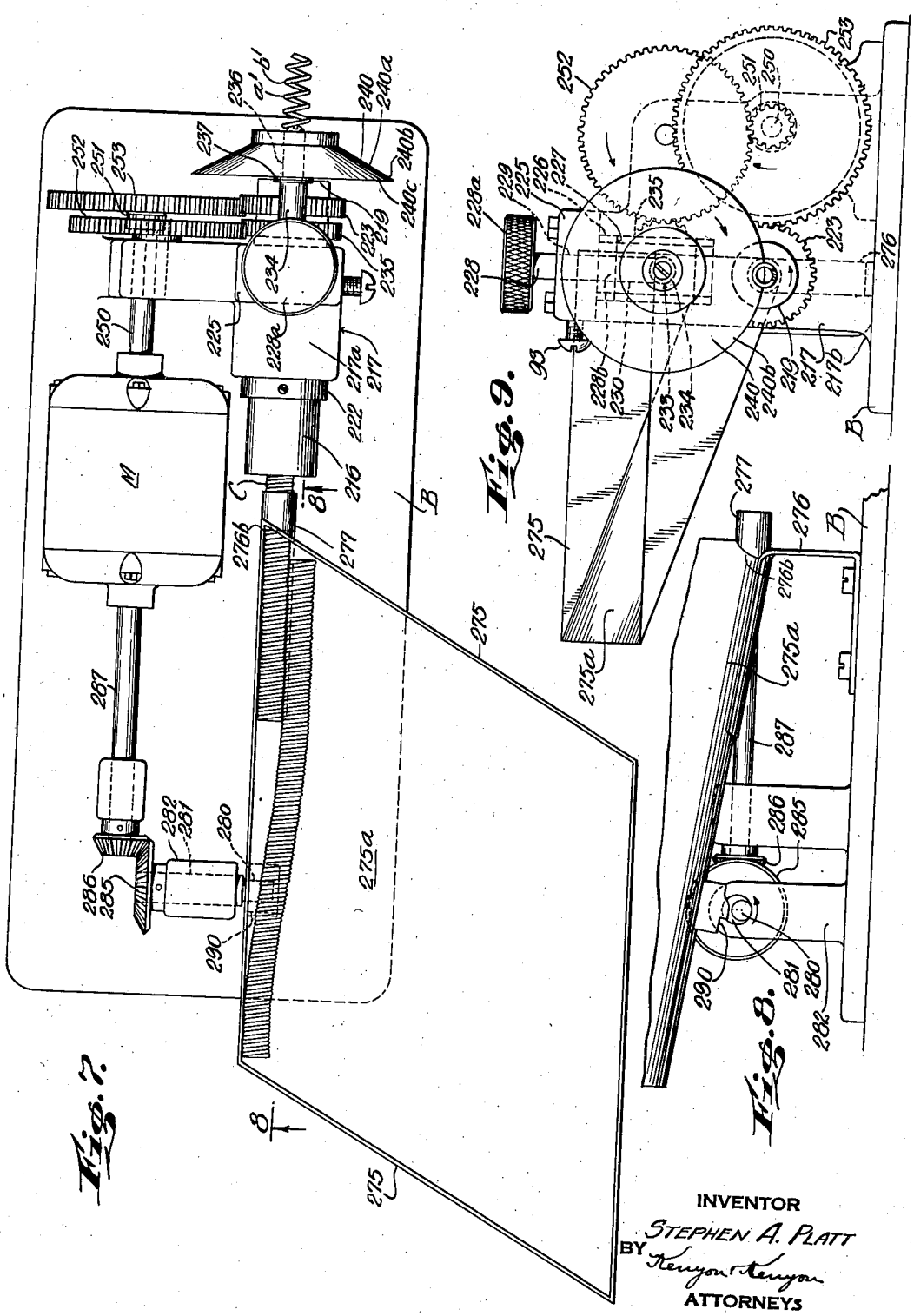


Fig. 7.

Fig. 9.

Fig. 8.

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2,260,054

TURN SPACING DEVICE FOR COILS

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Application October 2, 1940, Serial No. 359,335

12 Claims. (Cl. 153—64)

The present invention relates to automatic coil winding machinery, and more particularly to a device adapted to uniformly and regularly space the individual turns of closely wound coils.

In my at one-time co-pending application, Serial Number 290,397, filed August 9, 1939 (now U. S. Patent No. 2,227,602, issued Jan. 7, 1941), and, also, my presently co-pending application Serial Number 354,474, filed August 28, 1940, I have described automatic coil winding machinery designed to produce very uniform electrical resistance coils of predetermined lengths.

Coils manufactured by the machines therein described are what are termed closely wound coils; that is, the adjacent turns thereof are substantially contiguous. Before such coils can be actually used in manufacturing of electrical heating units, the individual turns must be properly spaced from each other. Heretofore, it has been the practice to stretch the individual coils manually to provide this required spacing. Such practice, however, is open to numerous objections. Unequal spacing of the turns in hand stretched coils with consequent hot spots in the electrical heating units often results. Also, spoilage and waste frequently occur if the coils are stretched by hand.

While gauges and guides have been provided heretofore for the assistance of the operator in determining the extent of the stretch for each closely wound coil, the personal equation has often resulted in inaccuracy and in defective electrical heating units. To reduce such results to a minimum, a common practice has been to have skilled workers space the individual turns in the coils by hand at the coil winding factory. But the shipment of these coils with spaced turns has been extremely unsatisfactory because of the fact that even carefully stretched coils become deformed or otherwise damaged during transit. As a result, manufacturers requiring accurate coils have more and more resorted to the practice of ordering the coils shipped to them in closely wound form and have then had them stretched manually in situ just prior to use, preferring to bear the loss on coils improperly stretched by their own workmen. But this stretching has all the disadvantages herein above pointed out, and, in fact, is worse because factory hands engaged in high speed production of electrical units do not have the time necessary to carefully stretch the coils to meet any given set of requirements.

The turn spacing devices or attachments constituting the subject-matter of the present invention are designed particularly to afford a means of very accurately and automatically spacing the individual turns of closely wound coils either at the place of original coil manufacture or in situ by the manufacturers of electrical resistance units.

An object of this invention is to produce a turn spacing attachment which may be applied to existing coil winding machinery and which will serve to uniformly, accurately and automatically space the individual turns of closely wound coils produced by the machine and place such coils in condition for immediate use in electrical units.

A further object of this invention is to provide a turn spacing attachment which may be conveniently and quickly attached to existing coil winding machinery of the type described in my aforementioned applications and to other types of coil winding machinery producing closely wound coils.

Still another object of my invention is to produce an automatic coil turn spacing device for use by an electrical manufacturer which may be conveniently located wherever necessary in the assembly line of production for the production of spaced turn coils from closely wound coils previously purchased.

Yet another object of this invention is the production of the equipment to meet the foregoing objects which may be readily manufactured and produced at low cost.

To the accomplishment of the foregoing and such other objects as may hereinafter appear, this invention consists in the construction and arrangement of parts hereinafter described, and then sought to be defined in the appended claims, reference being had to the accompanying drawings forming a part hereof and which show, merely for the purposes of illustrative disclosure, preferred embodiments of the invention, it being expressly understood, however, that various changes may be made in practice within the scope of the claims without digressing from the inventive idea.

In the drawings, in which similar reference characters denote corresponding parts:

Figure 1 is a front elevational view of a coil winding machine of the type described in my aforementioned copending applications to which one form of my novel turn spacing device has been applied;

Fig. 2 is an enlarged fragmentary sectional

view taken along the line 2—2 of Fig. 1 illustrating details of said device and viewed in the direction of the arrows;

Fig. 3 is a vertical section of the turn spacing attachment taken along line 3—3 of Fig. 2 and also viewed in the direction of the arrows;

Fig. 4 is a transverse section taken along line 4—4 of Fig. 3, also viewed in the direction of the arrows;

Fig. 5 is a view similar to Fig. 3 of a modified form of power-driven turn spacing attachment;

Fig. 6 is a diagrammatic illustration of the gearing associated with the device shown in Fig. 5 and viewed from the right along the line 6—6 thereof;

Fig. 7 is a top plan view of a turn spacing device adapted for convenient location along an assembly line at the point of use of electrical resistance units so that the operator at such point may conveniently provide himself with coils having uniformly spaced turns of predetermined length from closely wound coils furnished to him;

Fig. 8 is a vertical sectional view taken along line 8—8 of Fig. 7 and viewed in the direction of the arrows; and

Fig. 9 is a side elevational view viewed from the right of Fig. 7 of the device shown therein.

Referring now to the drawings and first to Fig. 1, 10 denotes generally a coil winding machine frame of the type disclosed in my said co-pending applications. This frame is provided with a bearing flange 11 which rotatably supports on suitable bearings the journal portion of an axle or shaft 12 which protrudes from each end of the flange 11. One end of the shaft has keyed to it the stepped driving pulley wheel 13. The opposite end of the shaft 12 is constructed to receive any standard form of chuck 15, that illustrated being a well-known key-tightening type. This chuck 15 is adapted to receive and support horizontally by one of its ends a winding mandrel 16 upon which the wire is wound into coil form.

Suitable driving means for rotating the shaft 12 is provided. In the embodiment shown, this includes the motor 20 whose rotor shaft 22 has a stepped pulley wheel 23 fixed thereto. A driving belt 24 passed around the two pulley wheels 23 and 13 serves to couple the motor and chuck-bearing axle or shaft 12, so that the motor drives the mandrel 16. Variability of speed is obtained by shifting the belt from step to step of the pulley wheels 13 and 23.

The frame 10 forwardly has an upwardly extending vertical flange 30 which has a bore 31 in axial alignment with the shaft 12 and the mandrel 16.

The rolls 35 and 36 (Fig. 2), of resilient material such as rubber having a high coefficient of friction, which co-operate with the mandrel 16 in winding the coil, as described in my said Patent Number 2,227,602, are supported from the frame 10 at diametrically opposite points with respect to said mandrel. These rolls are movable toward and away from each other and the mandrel 16. They may be locked in any desired spaced position with respect to each other and the mandrel. Likewise, the two rolls are normally biased with respect to each other and with respect to the mandrel axis and this bias may be varied at will. The rolls together with the mandrel serve to produce accurately wound coils with close turns which move off the mandrel end 16' as described in my aforementioned patent and presently co-pending application.

Wire 38 for forming the coils is fed suitably to the mandrel 16 from a spool 40 and coiled thereon in a manner described in either one of my aforementioned patent and presently co-pending application or in any other desirable manner.

The wire 38 in its passage to the aforesaid bite is lubricated suitably, for example, in the manner described in my aforementioned patent and presently copending application.

The wire 38 is also suitably tensioned as it passes from the spool to the mandrel 16. This tensioning is accomplished herein, for example, through the agency of the metering wheel 46 in the manner described in my aforementioned patent and presently co-pending application.

Rotation of the metering wheel caused by the passage of wire 38 around it is used to control an automatic cut-off mechanism illustrated diagrammatically by the knife blade 60 operated periodically in a manner described in either of my aforementioned patent and presently co-pending application or in any other suitable manner.

The wire coil C formed on the mandrel 16 as described in my aforementioned patent and presently co-pending application has predetermined pitch and closely spaced turns *a*, *b*. This coil during its formation rotates and moves outwardly along the mandrel towards its exit end 16'. The turn spacing attachments illustrated in Figs. 1–6 inclusive of this application are intended to be mounted in such manner as to operate upon the coil turns *a*, *b* of the rotating coil C, leaving the exit end 16' of the mandrel 16.

In Figs. 1–4 inclusive, the turn spacing attachment 70 comprises a combination guide and cut-off tube or sleeve 71 (Fig. 3). This sleeve has in one portion a longitudinally extending bore 72 of larger diameter than that of the coil formed on the mandrel 16 and a second portion 72*a* of reduced diameter at its exit end, preferably substantially equal to that of the coil after spacing. The guide sleeve 71 is adapted to be supported in the bore 31 of the flange 30 of the machine frame 10, being removably fixed in place in said flange by set screw 73 (Fig. 1) or in any other convenient manner. The exit end of the sleeve is cambered at 71*a* to co-operate with the intermittently operated knife blade 60 for cutting off predetermined coil section lengths from the spaced turn coil emerging from the tube 71. The other end of the tube 71 projects from the flange 30 toward the mandrel 16 whose end 16' projects into the bore 72 for a short distance. Intermediate its ends, the tube or sleeve 71 is provided with a transverse recess or kerf 74 extending into the bore 72 in the manner shown for a purpose to be presently described. Since the bore 72 is of larger diameter than that of the coil C, an adapter sleeve 78 of finished hardened steel or other wear-resisting material is adapted to be borne in the bore 72 between its inlet end 72*b* and the straight side 74*a* of the kerf 74. This adapter sleeve has an internal diameter substantially equal to that of the external diameter of the coil C entering the bore 72.

A slide frame 80 is suitably supported on the guide sleeve or member 71 and adjustably fixed thereto at 81. This slide frame is adapted to extend at a right angle from the sleeve 71 and has a straight-sided slot 82. A slide block 83, whose over-all length is less than that of the slot 82, is slidably supported in the slot by the adjustment bolt 84. This bolt extends through a bore 85 in the frame and has a threaded portion 86 engaging in a threaded bore 87 of the

slide block. At its lower end 88, the bolt is reduced in diameter and rotatably borne in a recess 89 in the slide frame 80. A manipulating knob 90 on the bolt 84 serves conveniently for rotation of the latter to effect longitudinal displacement of the block 83 in the slot 82. An annular groove is provided on the bolt at 91 and a wedging pin 93 having a tapered end 93a adapted to engage in the groove 91 is threadedly supported in a bore 95 in the slide frame 80. This pin serves both to prevent longitudinal displacement of the bolt 84 and as a setting device for fixing the bolt 84 in any adjusted position of rotation.

A laterally extending flange or shaft 97 is provided on the slide block 83. A spacing or wedging wheel 100 is rotatably supported on this flange 97, suitable ball bearings 103 being provided to permit free rotation of the roller. This wheel 100 has a conical flange 100a flaring outwardly toward the slide block 83 and terminating in a sharp circumferential edge 100b adjacent the slide block 83. The flat end surface 100c faces the flat side 74a of the kerf 74 in tube 72 and is closely spaced relative thereto, only sufficient clearance being allowed to permit free rotation of the wheel 100.

This wheel, being carried on the flange 97, is movable as a unit with the latter in a direction transverse to the bore 72. As a result, its edge 100b is movable (under control of knob 90) into the kerf 74 to any desired depth in a direction at right angles to the axis of the bore 72 and the wheel acts as a rotatable wedge.

The turn spacing device is operated as follows:

The closely-wound coil C on the mandrel 16 is rotating with the latter as it moves off the end 16' thereof. The edge 100b of the spacing roller engages wedge-like between two adjacent turns *a*, *b* of the coil as the latter moves past the straight edge 74a of the kerf 74. Since turn *a* next adjacent the other closely spaced turns behind the edge 74a cannot move either forwardly or backwardly at the instant of contact, the balancing of forces at the point of contact forces the turn *b* forwardly spacing it from turn *a*. The extent of spacing produced depends upon the adjusted depth to which edge 100b projects into the kerf 74 and upon the angle of taper of the flange 100a. Since the coil rotates as it passes the edge 100b, it, in effect, screws itself out past said edge, and each leading turn *b* is continually spaced from the turn *a* directly behind. Since the wire is deformable, each turn retains its spacing relative to the other turns. The result is that the coil Ca leaving the cambered exit end 71a of the tube 71 has its adjacent turns *a'*, *b'* in uniform spaced relationship. The spacing depends upon the adjustment of the wheel 100. The emerging coil Ca may be severed into predetermined lengths by intermittent operation of the knife blade 60 controlled, for example, in the manner described in my aforementioned copending applications or in any other suitable way.

Wheel 100 is freely rotatable to reduce or eliminate entirely any wear of or marring of the coil turns during spacing and also to reduce wear on the faces of the wheel functioning during such spacing.

When it is desired to provide spacing between turns of larger coils or to eliminate substantially all possibility of marking or marring of the wire constituting the coil turns during the spacing thereof, a power-driven turn spacing attachment may be employed.

Figs. 5 and 6 illustrate one form of such power-driven turn spacer adapted particularly for attachment to a coil winding machine like that of Fig. 1 in lieu of the turn spacing device of Figs. 2–4 inclusive.

The power driven turn spacer 115 shown in Fig. 5 comprises an elongated horizontally extending tube or sleeve 116 of hardened steel or other suitable material supported horizontally and rotatably journaled in a bearing 117a of a bracket 117 which is suitably supported at 117b by the flange 30 of the machine frame. The tube 116 is supported in such manner that its horizontal bore 118 is in axial alignment with the opening 31 in the flange 30 with its end 119 spaced from said opening and with the end 16' of the mandrel projecting a substantial distance into the bore from the opposite end of the tube. This sleeve or tube 116 while rotatable in the bearing 117a of the bracket 117, is fixed suitably against longitudinal displacement as by the annular flange 121 thereon and by the adjustable collar 122. An annular external gear 123 is fixedly supported on the sleeve for a purpose to be presently described.

The bracket 117 has a vertically extending slide frame 125 integrally formed with it or permanently attached thereto. This slide frame has a vertically extending straight-sided slot 126 closed at its top and bottom and adapted to receive a slide block 127 of smaller over-all length than said slot. A manipulating bolt 128 having a manipulating knob 128a and extending through a bore 129 in the frame wall and having a threaded portion 128b engaging in a threaded bore 130 in the slide block 127 serves to move the block into any adjusted vertical position in the slot. The bolt 128, like bolt 84, has an annular groove or recess 131 in which a setting screw or bolt 93 (like that previously described in connection with the first modification [Fig. 4]) operates to prevent longitudinal displacement of the bolt and as a setting screw for fixing the manipulating bolt 128 in any adjusted position.

The slide block 127 has a horizontally extending bore or shaft bearing 133, in which a shaft 134 is rotatably borne. This shaft is suitably fixed against displacement in its axial direction and provided with a driving gear 135 suitably keyed or otherwise fixed thereto. A portion 136 of reduced diameter and a shoulder flange 137 on the shaft serve to receive and position a turn spacing or wedging wheel 140. The latter is suitably locked to the shaft as by the locking bolt 141 and washer 142.

This spacing or wedging wheel, like that (100) of the first modification, has a conical flange 140a flaring outwardly toward slide block 127 and terminating in a sharp circumferential edge 140b. The flat end surface 140c faces the outlet end 119 of the tube 116 and is closely spaced relative thereto, only sufficient clearance being allowed to permit free rotation of the wheel 140 with respect to said tube.

Both the gear 123 for rotating tube 116 and the gear 135 for rotating the shaft 134 and wheel 140 thereon may be suitably driven from a common source. One form of such common drive may be conveniently arranged in connection with the chuck 15. To this end, in the embodiment shown, a drive shaft 150 extending parallel to the shaft 12 (Figs. 1 and 6) and suitably supported in bearings and brackets (not shown)

from the machine frame is provided. This shaft has a gear 151 keyed thereto which meshes with a suitably supported idler gear 152. The idler gear 152 also meshes with gear 135 on shaft 134 so that rotation of shaft 150 imparts rotation to the gear 135 and consequently shaft 134 and spacing or wedging wheel 140.

The shaft 150 also has a second gear 153 keyed or otherwise fixed thereto which meshes directly with the gear 123 on the sleeve 116 so that drive of shaft 150 directly rotates the sleeve 116.

The shaft 150 has a third gear 154 keyed or otherwise fixed thereto. This gear meshes with a suitably supported idler gear 155 which in turn meshes with a gear 156 keyed or otherwise fixed to the driven chuck 15. Thus rotation of the chuck 15 serves to drive shaft 150 and in consequence to rotate both the sleeve 116 and the spacing or wedging wheel 140.

The gearing ratios are so selected that preferably the sleeve 116 rotates at exactly the speed of rotation of the rotating coil C leaving the mandrel 16. Also the surface speeds of the contacting portions of the spacing or wedging wheel 140 and the coil turns are made substantially equal, motion being arranged to be in the same direction so that there is no relative rotational motion between the contacting portions.

In this modification as in the previous modification, the wedging effect of the spacing or wedging wheel 140 may be varied by manipulation of the bolt 128 to move the slide block transversely of the bore and consequently vary the depth of penetration of edge 140*b* of the wheel between adjacent coil turns. This depth of penetration and the angle of bevel of the flange 140*a* determine the extent of spacing between turns, i. e., the pitch of the spaced coil.

Since the hardened sleeve 116 through which the closely wound coil is progressing rotates at the exact speed of revolution of the coil inside it, the live rotating turns of the closely wound coil emerging from the sleeve 116 travel at the same speed in R. P. M. as the tube. The spacing wheel also travels at its proper dividing speed, i. e., it has a speed of rotation such that its surfaces contacting the turns of the wire have a surface speed equal to the surface speed of the contacting portions of the turns of the rotating coil. As a result, all mechanical parts are traveling in timed relationship with respect to the rotation of the wire coil. Since this relationship is such that no relative rotary motion between parts exists, the coil screws itself out past the edge of the wedging wheel in the manner described with respect to the first modification without any possibility of marking or marring of the wire as its turns are spaced. The elimination of such marring or marking is very important because the electrical characteristics of the coil change markedly if markings or marrings are present. The result is that the coils with spaced turns produced by this device are notably uniform and highly accurate and free of defects such as those noted.

The spaced turns of coil pass from the guide tube or sleeve 116 to a receiving tube 200 suitably carried in the opening 31 of the flange 30. This receiving tube may be cambered at 200*a* to co-operate with the cutoff knife 60 to sever predetermined lengths of spaced turn coil.

The turn spacing attachments which have been hereinbefore described are designed most particularly for use by a coil manufacturer. As has been previously mentioned in this specification, many manufacturers of electrical heating equipment prefer to order closely-wound electrical resistance coils such as those produced by the machine shown in Fig. 1 or by machines such as those described in my aforementioned copending applications. It becomes necessary, therefore, to provide a turn spacing device which may be conveniently used by such a manufacturer in the assembly line of production to space properly the turns of the closely wound coils just prior to their insertion into electrical equipment. The modification disclosed in Figs. 7–9 inclusive is designed particularly to meet such requirement.

The turn spacer disclosed in these figures is very similar to that shown in Figs. 5 and 6 and comprises an elongated horizontally extended hardened steel tube or sleeve 216 supported horizontally and rotatably journaled in a bearing 217*a* of a bracket 217 which is suitably supported at 217*b* by a base B of any suitable type. This sleeve or tube 216 while rotatable in the bearing 217*a* of the bracket 217 is fixed suitably against longitudinal displacement as, for example, by the adjustable collar 222 and an annular flange (not shown) similar to the annular flange 121 of the modification of the Fig. 5. An annular external gear 223 is fixedly supported from the sleeve 216 for a purpose to be presently described.

The bracket 217 has a vertically extended slide frame 225 either integrally formed with it or permanently attached thereto. This slide frame has a vertically extending straight sided slot 226 closed at its bottom and adapted to receive a slide block 227 of smaller over-all length than said slot. A manipulating bolt 228 having a manipulating knob 228*a* and extending through a bore 229 in the frame wall and having a threaded portion 228*b* engaging in a threaded bore 230 in the slide block 227 serves to move the block into any adjusted vertical position in the slot. The bolt 228, like bolts 84 and 128, has an annular groove or recess (not shown) in which a setting screw or bolt 93 (like that previously described in connection with the two modifications) operates to prevent longitudinal displacement of the bolt and as a setting screw for fixing the manipulating bolt 228 in any adjusted position.

The slide block 227 has a horizontally extended bore or shaft bearing 233 in which a shaft 234 is rotatably borne. This shaft is suitably fixed against displacement in its axial direction and provided with a driving gear 235 suitably keyed or otherwise fixed thereto. A portion 236 of reduced diameter and a shoulder flange 237 on the shaft serve to receive and position a turn spacing or wedging wheel 240. This wheel is suitably locked to the shaft 234 in the same way as the wedging wheel 140 of the previous modification.

This spacing wheel like those of the first two modifications has a conical flange 240*a* flaring outwardly toward the slide block 227 and terminated in a sharp circumferential edge 240*b*. The flat end surface 240*c* faces the outlet end 219 of the tube 216 and is closely spaced relatively to the tube, only sufficient clearance being allowed to permit free rotation of the wheel 240 with respect to said tube.

Both the gear 223 for rotating the tube 216 and the gear 235 for rotating the shaft 234 and the wheel 240 thereon may be suitably driven from a common source. In the embodiment

shown, this driving means comprises a driving motor M suitably supported from the base B and having a drive shaft 250. This shaft has a gear 251 keyed thereto which meshes with a suitably supported idler gear 252. The idler gear 252 also meshes with the gear 235 so that rotation of shaft 250 imparts rotation to the gear 235 and consequently shaft 234 and the spacing or wedging wheel 240. The shaft 250 also has a second gear 253 keyed or otherwise fixed thereto which meshes directly with the gear 223 on the sleeve 216 so that drive of shaft 250 directly rotates the sleeve 216.

Means are provided for automatically feeding the closely wound predetermined length of coil to this spacing attachment. To this end, a chute or slide 275 inclined to the horizontal is provided and suitably supported on the base B by the bracket 276. The bottom face 275*a* of this chute is inclined to the horizontal both in the direction perpendicular to the axis of the bore of the tube 216 and also inclined to the horizontal in a direction along the line of the axis of the tube 216. At its lowermost corner 276*b*, this chute is provided with a tubular outlet 277 which is so positioned as to lie concentric with and directly in front of the inlet opening of the tube 216. The bore of the tubular outlet 277 is so admeasured as to permit the closely wound coil segments to move therethrough and into the mouth of the tubular sleeve 216. These coil segments may be pushed by hand from the chute 275 into the turn spacing attachment or and preferably should be fed automatically thereto from the said chute.

Automatic means for effecting the required feeding may comprise simply a vibrating attachment for shaking the chute, both vertically and in a direction parallel to the axial bore of the sleeve 216. Means for effecting such shaking or vibration comprises, in the embodiment shown, a rotatable cam member 280 carried on a shaft 281 rotatably supported in a bracket 282 from the base B. A cam follower member 290 is suitably supported from the bottom of the chute 275 in the path of rotation of the cam 280 so that, when the latter is rotated, its engagement with the cam follower will cause the chute to receive the required vibration or shaking just mentioned. The shaft 281 carrying the cam 280 may be suitably driven by the agency of the gear 285 meshing with the gear 286 on an extension drive shaft 287 of the driving motor M.

Operation of the device just described is substantially as follows: A plurality of closely wound coil segments are placed in the chute 275 and the motor M started after the turn spacing wheel 240 has been adjusted to produce the required pitch of the coil. The shaking action of the chute guides the closely wound coils therein, one at a time, toward the outlet 278 and from there into the rotating tube 216 of the turn spacing attachment. Since the latter is rotating, the coil turns are drawn along and forwardly therein emerging from the exit end 219 and into engagement with the spacing wheel 240. The rotation of the guide tube 216 causes the coil to screw itself out of the wedging edge 240*b* of the wheel 240 with the resultant spacing of individual adjacent turns as shown clearly at the right of Fig. 7. The coils with spaced turns thus emerging are taken from the turn spacing device and directly used by the operator in the assembly line.

As in the modification of Figs. 5 and 6, relative rotation of the sleeve 216 and the wedging wheel 240 is such as to eliminate any substantial possibility of marring or marking of the coil during the spacing of the turns thereof. Electrical heating units made from coils having the turns spaced in the attachment just described are singularly free of marring or other defects and also universally uniform and accurate in their electrical characteristics.

It is to be noted that both with respect to modifications of Figs. 5 and 6 and 7–9 inclusive, the relative adjustment of the slide block positioned in the slide slot is not large enough to destroy the engagement of the gear teeth of the idler gears with those on the gears carried by the drive shafts supporting the wedging wheels 240, 140. In the event that larger displacements of the wedging wheels are desired, the idler gears 152 or 252 will have to be supported in adjustable relationship on suitable brackets (not shown) which will permit them to be adjustably positioned to maintain the necessary engagement of the gears involved.

It is to be noted further that each of the wedging wheels described are made preferably of oil hardened polished steel, although other suitable materials are also contemplated.

It is to be noted, too, that each of the tubes or sleeves 71, 116, and 216 is made of hardened polished steel or other highly wear-resisting material. In the case of tubes 116 and 216, the bores 118 and 218 thereof are so admeasured in diameter as to receive a specifically dimensioned coil with sufficient frictional engagements to either assist in the rotary motion of the coil (Fig. 5) or to impart rotary motion to the coil as in Fig. 7. This, of course, necessitates the substitution of a tube with a different diameter for each differently diametered coil which it is desirable to space. In practice, however, this is rarely detrimental, because of the fact that the resistance coils used by a single manufacturer generally have a standard diameter.

The attachment shown in Fig. 3 is somewhat more flexible or adaptable in this respect because the bore 72 is larger than that necessary to receive the coil C. The compensator or adapter 78 in the form of a sleeve of hardened steel is inserted into the bore 72 as shown. If this adapter has an internal diameter substantially equal to that of the coil whose turns are to be spaced, it makes it possible to use the turn spacing attachment of Fig. 3 for a plurality of differently diametered coils. Similar types of adapters could, of course, be provided for use in the bores 118 or 218 of the sleeves 116 and 216 of the other two modifications.

It is to be understood, of course, that various modifications within the scope of the appended claims is contemplated. There is no intention of limitation to the exact details shown and described.

What I claim is:

1. In a coil winding machine wherein coils having closely spaced turns are initially formed, a device for spacing said turns from each other comprising a guide member supported from said machine and having a bore to receive said coils and in which the latter move, a fixed support, a member movably carried on said support, a rotary wedging member carried by said movable member and movable with it transversely of said bore and adapted to engage between successive turns of coil emerging therefrom to space the same from each other and means for adjusting the depth of entry of said rotary wedging means between said turns to vary the extent of spacing

effected between said turns, said adjusting means including a part rotatably mounted in said support but fixed against longitudinal movement therein, said part engaging threadedly with said movable member whereby rotation of said part will effect movement of said movable member relative to said support.

2. In a coil winding machine wherein coils having closely spaced turns are initially formed, a device for spacing said turns from each other comprising a rotatably supported guide member having a bore to receive said coils and in which the latter move, a rotatable wedging member movable transversely of said bore and adapted to engage between successive turns of coil to space the same from each other, means for adjusting the depth of entry of said wedging means between said turns to vary the extent of spacing effected between said turns, and common means for rotating both said guide member and said wedging member each on its own axis of rotation.

3. In a coil winding machine wherein coils having closely spaced turns are initially formed, a device for spacing said turns from each other comprising a rotatably supported guide member having a bore to receive said coils and in which the latter move, a rotatable wedging member movable transversely of said bore and adapted to engage between successive turns of coils to space the same from each other, means for adjusting the depth of entry of said wedging means between said turns to vary the extent of spacing effected between said turns, drive means and gear means coupled to said drive means and to both said guide member and said wedging member for rotating both said guide member and said wedging member each on its own axis of rotation by said drive means.

4. A device for spacing turns of a coil comprising a guide member having a bore through which said coil is movable, a rotatable wedging member movable transversely of said bore and into adjustable wedging position between successive turns of coil to space the same from each other, means for adjusting the depth of entry of said wedging member between said turns to vary the extent of spacing effected between said turns, and common means for rotating both said guide member and said wedging member each on its own axis of rotation.

5. A device for spacing turns of a coil comprising a rotatable guide member having a bore through which said coil is movable, a rotatable wedging member movable transversely of said bore and into adjustable wedging position between successive turns of coil to space the same from each other, means for so moving said wedging member, common means for rotating both said guide member and said wedging member each on its own axis of rotation, a chute in conjunction with said guide member for leading coils thereto, and means for vibrating said chute to cause feeding of said coils thereon to said guide member.

6. A device for spacing turns of a closely wound coil comprising a guide member having a bore through which said coil is movable, a slide frame, a slide block movable in said slide frame transversely of said bore, a rotatable member fixed against longitudinal displacement extending from said frame into and threadedly engaging said slide block for moving said slide block in said frame and transversely of said bore, and a wedging member rotatably supported from said slide block and movable with the latter transversely of said bore.

7. A device for spacing turns of a closely wound coil comprising a guide member having a bore through which said coil is movable, a frame, a slide block movable in said frame, adjustable means for moving said slide block, a wedging member rotatably supported from said slide block with its axis of rotation substantially parallel to the axis of said bore and movable with said slide block transversely of said bore, and common means for rotating both said wedging member on its own axis of rotation and said guide member on its own axis of rotation.

8. A device for spacing turns of a closely wound coil comprising a guide member having a bore through which said coil is movable, a frame in conjunction with said guide member, a slide block movable in said frame, adjustable means for moving said slide block, a wedging member rotatably supported from said slide block with its axis of rotation substantially parallel to the axis of said bore, and movable with said slide block transversely of said bore, vibratory means for feeding coils to said guide member, and common means for rotating said wedging member on its own axis of rotation and said guide member on its own axis of rotation and operating said vibratory means.

9. A device for spacing turns of a closely wound coil comprising a tubular guide member through which said coil is movable, a rotatable wedging member having a sharp edge arranged adjacent an end of said guide member and adapted to overlap said end with its edge, the axis of rotation of said wedging member extending parallel to the direction of movement of said coil through said tubular guide member, means for moving said wedging member for adjusting the extent of said overlapping, and means for rotating both said guide member on its own axis of rotation and said wedging member on its own axis of rotation.

10. A device for spacing turns of a closely wound coil comprising a tubular guide member through which said coil is movable, a rotatable wedging member having a sharp edge arranged adjacent an end of said guide member and adapted to overlap said end with its edge, the axis of rotation of said wedging member extending parallel to the direction of movement of said coil through said tubular guide member, means for moving said wedging member for adjusting the extent of said overlapping, means for rotating both said guide member on its own axis of rotation and said wedging member on its own axis of rotation, and chute means for leading coils to said guide member.

11. In a coil winding machine wherein coils having closely spaced turns are formed on a mandrel, an attachment for spacing said turns from each other comprising a guide member supported from said machine and having a bore in axial alignment with said mandrel into which said coils are delivered from said mandrel, a slide frame supported by said guide member, a slide member in said frame movable transversely of said bore, an adjustable rotatable wedging member supported from said slide member and movable transversely of said bore and adapted to engage between turns of coil emerging therefrom, and means for adjusting the position of said wedging member relative to said bore, said last-named means including a member rotatably supported in said frame and engaging threadedly with said slide member, whereby rotation of said

rotatably supported member will effect movement of said slide member transversely of said bore.

12. A device for spacing turns of a closely wound coil comprising a guide member having a bore through which said coil is movable, a frame extending transversely of said bore, a slide block movable in said frame and transversely of said bore, a rotatable member extending from said frame into and threadedly engaging said slide block for moving said slide block in said frame and transversely of said bore, means to prevent longitudinal displacement of said rotatable member and to serve as a positioning lock therefor, and a wedging member rotatably supported from said slide block with its axis of rotation substantially parallel to the axis of said bore and movable with said slide block transversely of said bore.

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