E. F. PARKS.

ELECTRICAL COIL AND METHOD OF WINDING SAME.

APPLICATION FILED MAR. 15, 1917.

Patented Sept. 17, 1918.

2 SHEETS—SHEET 1.

1,278,993.

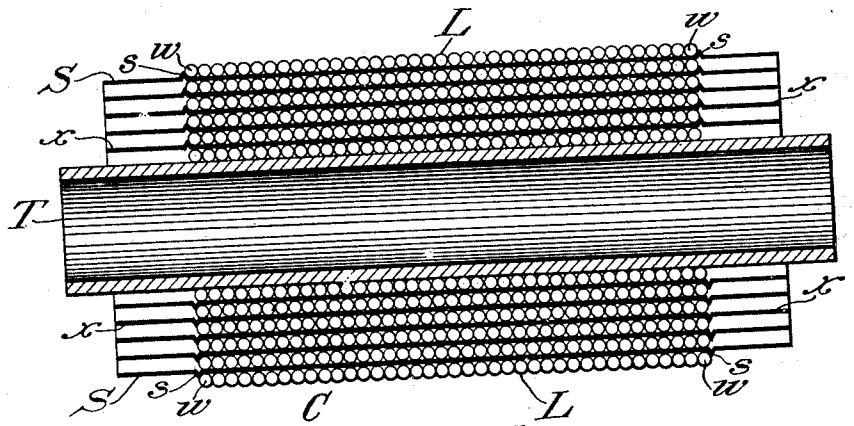

Fig. 1.

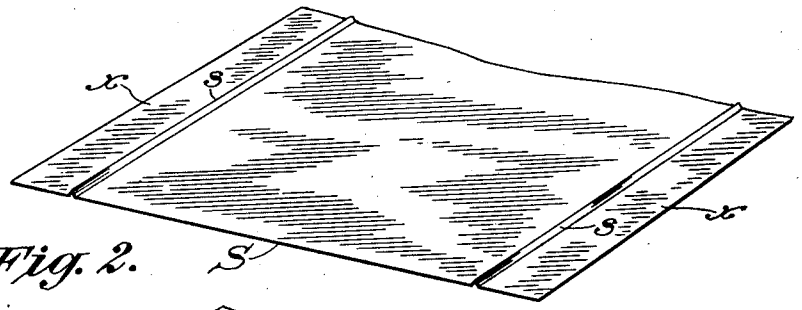

Fig. 2.

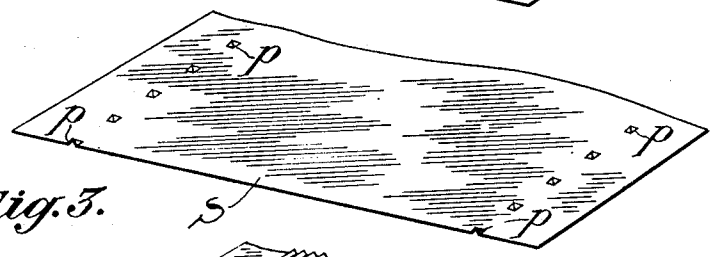

Fig. 3.

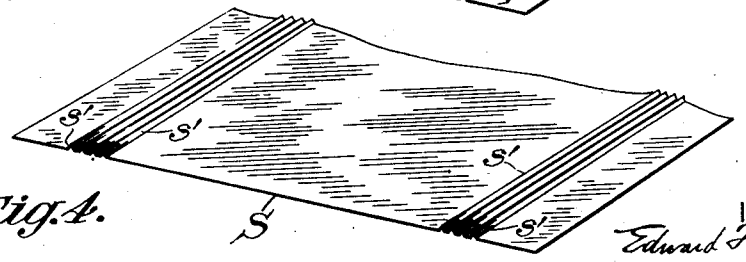

Fig. 4.

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2 SHEETS—SHEET 2.

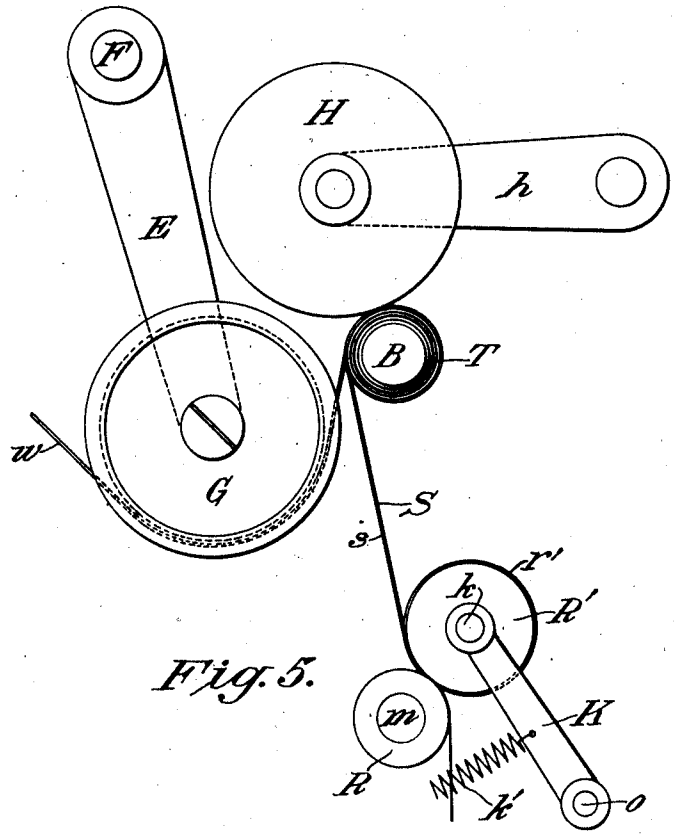

Fig. 5.

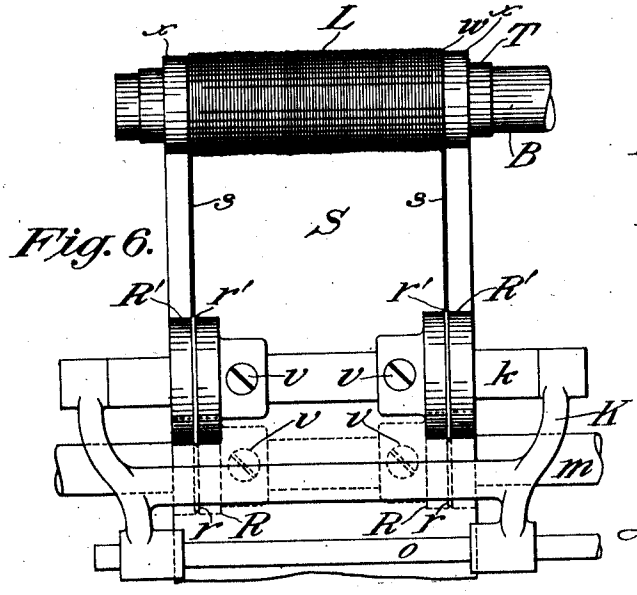

Fig. 6.

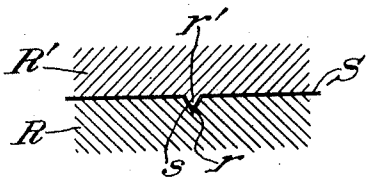

Fig. 7.

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EDWARD F. PARKS, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO UNIVERSAL WINDING COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

ELECTRICAL COIL AND METHOD OF WINDING SAME.

1,278,993. Specification of Letters Patent. Patented Sept. 17, 1918.

Application filed March 15, 1917. Serial No. 155,114.

To all whom it may concern:

Be it known that I, EDWARD F. PARKS, a citizen of the United States, residing at Providence, in the county of Providence, State of Rhode Island, have invented certain new and useful Improvements in Electrical Coils and Method of Winding Same, of which the following is a specification.

My invention relates to improvements in electrical-coils and method of winding same. My improvement is directed particularly to that type of electrical-coil or helix in which the turns or convolutions of the wire or other conductor are separated by sheets of paper or strips of similar insulating-material inserted between the layers.

The object of my improvement is to provide means for holding the turns of wire in place as they are coiled on the surface of the paper strip to prevent them from sliding laterally or slipping out of position, whereby to maintain all of the several turns in each layer in closely contiguous relation. To this end my invention consists particularly in scoring or creasing the sheets or strips of paper or other material to provide raised shoulders or fin-like ridges extending longitudinally of their marginal edges and adapted to abut the end turns of wire to prevent displacement thereof. The scoring or creasing of the paper may be accomplished previous to, or during, the operation of feeding it into the coil, the latter being the preferred method as providing for more economical production of the coil.

The manner and means for carrying out the improvement are fully described in the following specification, illustrated by the accompanying drawings, in which like reference characters designate like parts. In the drawings:—

Figure 1 is a sectional view of my improved coil taken in a plane intersecting its axis and showing the manner of creasing the paper strips which are inserted between the layers of wire turns;

Fig. 2, a perspective view of a portion of the creased insulating strip or sheet;

Fig. 3, a similar view showing the paper strip provided with rows of protuberances along its sides;

Fig. 4, a perspective view of the strip showing it creased to provide a plurality of ridges extending longitudinally of its marginal edges;

Fig. 5, a view of the essential elements of the coil-winding mechanism shown in end elevation and illustrating the method of inserting the paper or other sheet-material into the coil;

Fig. 6, a front elevation of the same showing the paper-creasing or scoring rolls; and

Fig. 7, an enlarged, sectional detail of the creasing-rolls.

It is now the general practice in producing electrical coils for certain purposes to wind them from enamel-covered wire and to provide insulation between the layers by inserting strips of paper or like sheet-material therebetween. In some cases bare wire is employed and the individual turns or convolutions in each layer are separated and insulated, one from another, by strands of silk or other textile material. In most cases, however, the wire is first insulated by coating it with enamel which is baked on to provide a hard, glazed surface and this coating renders it extremely smooth and slippery, making it difficult to retain it in place during its winding. This tendency of slippage or displacement of the turns of the wire becomes more pronounced as the winding increases in diameter due to the constructive pressure of the outer layers on the inner ones.

Various expedients have been attempted for restraining the turns of the windings from slipping or sliding out of place along the coil, such as inserting binding-strips to tie the turns together; cementing each layer of coils in place before proceeding with the next; and in other instances by employing abutments or flanges at the ends of the layers. Most of these methods require several manual operations or steps which impede the winding process and therefore limit the rate of production, so that they are objectionable from an economical standpoint. In my present improvement I have provided a method of holding the turns of the coil in place which may be applied as the coil is being wound without arresting or disturbing the winding operation and without adding to the cost of production.

Fig. 1 illustrates my improved coil C composed of turns of wire *w* wound on a tube or core T with sheets of insulating-material S

inserted between the layers L. These sheets or strips S may be of paper or any other suitable material wrapped around the coil either in single or multiple thicknesses with their marginal edges projecting from between the ends of the layers as shown at x, x. Each sheet S is first creased along its longitudinal edges with ridges s, s, see Fig. 2, or in some cases a series of protuberances p, p, etc., as shown in Fig. 3, could be forced up from its surface. When the sheet or strip S is inserted in the coil its creased portions or ridges s are arranged to lie alongside the end turns of wire w in the layers L, which are laid on over the paper, to serve as abutments to hold the coils from spreading or sliding out of place. Fig. 4 shows the sheet S creased to form several ridges s', s' at each side and the wire w will lie between these raised portions of the paper to prevent the end turns from slipping. If desired the paper might be creased across its whole width, but usually this is not required, the single outer creases shown in Fig. 2 being generally sufficient to restrain the coils from movement.

As shown in Fig. 1 the first or inner layers L of wire turns is laid on the bare core or tube T, but if preferred a wrapping of the creased sheet S may be applied thereto before winding on the wire. After the first layer L has been completed with the required number of turns w, the sheet S is fed into position to cause it to wrap about the coil, and meanwhile the wire is caused to wind back thereover to hold it in place. As soon as the windings reach the opposite end of the coil to complete this layer another sheet S is wrapped therearound and the wire is traversed back again over this sheet toward the opposite end of the coil. The winding continues in this way without interruption with the successive layers L building up one on another with the sheets S interposed therebetween. As before indicated the distance between the creases or ridges s on the sheets S is proportioned to the length of layer being wound so that each end coil of each layer will lie in contact with its appropriate crease or abutment. Through this arrangement the creases s at the sides of the strip form annular, raised ledges or shoulders which abut the sides of the end turns of the wire whereby to hold them from slippage or displacement.

As before stated, the strips or sheets S may be creased in any preferred manner preparatory to inserting them into the coil and the winding of the latter may be accomplished either by hand or through the employment of the usual rotating arbor and wire-guiding devices. In order to increase the rate of production, however, I prefer to wind the coils with automatically-operating means which not only lays the wire in place, but also acts to insert the paper strips and to crease them along their margins as they are fed into the coil. The machine for performing these several functions forms the subject-matter of a separate patent application to be filed later, but in order that the complete method of producing the coil may be now understood I have illustrated the essential elements of the mechanism in the present drawings.

Referring to Fig. 5, B designates the rotating winding-spindle or mandrel which supports the tube T on which the coil is wound, and G is the guiding-pulley over which the wire leads to direct it to the spindle while traversing it therealong. The pulley or wire-guide G is here shown as being carried at the end of an arm E hinged to a rod F, which latter is adapted to be reciprocated parallel with the winding-spindle B through any suitable arrangement of means as usually employed. A pressure-roller H carried at the end of a hinged arm h is adapted to bear against the turns of wire as they are laid in place on the coil and as the winding increases in diameter the roller H and guide-pulley G swing outwardly from the axis of the spindle B.

Below the spindle B are two sets of sheet-feeding rolls R, R′ which are formed to crease the paper or other strip S as it passes therebetween. Referring particularly to Fig. 6, one pair of rolls R, R is mounted on a rotatable shaft m which is driven positively during the strip-feeding cycles by suitable means not here shown. Another pair of rolls R′, R′ is mounted on a shaft k journaled in a frame K which is pivotally supported on a rod o. The frame K is controlled by a spring k', or its equivalent, to cause the rolls R′, R′ to bear against the paper or strip S as it feeds over the rolls R, R, as shown in Fig. 5. The two rolls R, R are scored with relatively shallow, circumferential grooves r, r, see enlarged view, Fig. 7, and the rolls R′, R′ are formed on their peripheries with annular fin-like projections or blades r', r', fitted to said grooves. Both sets of rolls R and R′ are slidable on their supporting shafts m and k to adapt them to be adjusted longitudinally thereof, and are secured in position by the set-screws v, v or through any other suitable means. The rolls R, R and R′, R′ are adjusted in relation in accordance with the width of the paper or other strip being employed, and in conformity with the length of coil to be wound. As shown in Fig. 7, the fin r' on each roll R′ is adapted to run in the groove r in the roll R with a slight clearance therebetween. Therefore, as the strip S is fed between the rolls, the fins r' will press the paper into the grooves r to crimp or crease it to form the longitudinal marginal ridges s, s as shown in Fig. 2.

The complete method of operation for winding the coil is as follows: The end of the wire *w* is first fastened to the tube T and the spindle B is started to rotate while the guide G is given a relatively slow traverse-motion therealong. If a strip of paper is to be first laid on the tube, as is sometimes found expedient to provide an initial, wire-retaining means, its end is fed between the rolls R, R and R′, R′ and its leading edge brought up in under the first turn of the wire on the tube as shown in Fig. 5. As the spindle B rotates it will wrap the paper or other strip S about the tube T and meanwhile the wire *w* will start to wind thereover to hold it in place. After the paper has been wrapped around the tube T one or more times, in accordance with the thickness desired, the strip is severed at the required point and the wire continues to be wound onto the tube until the prescribed number of turns are in place. As soon as the layer of wire is completed in this manner the movement of the traverse-guide G is reversed and the wire starts to wind back again in the opposite direction. Meanwhile, another length of paper is inserted under the first turn of the wire and this is applied around the outside of the first layer of the coil as illustrated in Fig. 1. This cycle of operations continues to wind the wire into the coil, layer on layer, with the paper strips interposed therebetween. Preferably, the feeding of the paper is accomplished automatically at predetermined intervals of the winding as each new layer is commenced, and the strip is also cut off through the operation of automatically-controlled means which are not herein shown or described as an explanation of their method of operation is not necessary to an understanding of the present invention. Through the employment of these automatic means, however, the winding of the coil may be carried on continuously without arresting the operation to insert the strips of insulation and hence the rate of production is greatly increased.

As the paper feeds into the coil it is formed with the creases or ridges which assume a position contiguous to the end turns of the wire and thus act as supporting or retaining abutments to hold the windings in place. After the winding operation is finished the coil is usually impregnated with shellac, bakelite, or some other cementitious compound, forced thereinto under pressure. The cement fills the intestices between the turns of the wire and when hardened by drying or baking reinforces the whole coil to protect it from damage. The penetration of the cement into the paper also stiffens its texture and reinforces its creased portions so that these will have an added strength to hold the windings in place. Through this means the wire turns are held securely in position in contiguous relation as required to maintain the physical structure and electrical efficiency of the coil. My improved method of producing the coil, therefore, not only makes for economy in its manufacture, by eliminating manual operations, but also saves the use of end heads or flanges, and provides a superior product as above pointed out.

Various modifications might be made in the structure of the coil and the method of producing it without departing from the spirit or scope of the invention; therefore, without limiting myself to the exact embodiment shown, what I claim is:—

1. An improved coil for electrical purposes composed of a succession of layers of turns of conducting-material, with relatively thin sheets of insulating-material such as paper interposed therebetween, each sheet being creased along its marginal edges to form fin-like ridges projecting from its surface into position to abut the end turns of the wire in each layer to restrain them from sliding or slipping out of place.

2. An improved coil for electrical purposes comprising superimposed layers of windings of wire, and intervening sheets of relatively thin insulating-material such as paper inserted between the wire layers, said sheets being provided with creased portions pressed up from their surfaces and disposed in position to abut the sides of the wire windings to hold them in place and prevent them from slipping longitudinally of the coil.

3. An improved coil for electrical purposes comprising a series of superimposed layers of wire windings with relatively thin sheets of paper interposed therebetween to insulate the layers one from another, said paper being scored or creased to raise its surface in annular fin-like ridges extending circumferentially of the coil in position to lie alongside the turns of the wire in each layer whereby to prevent lateral displacement thereof.

4. An improved method of producing electrical coils consisting in winding a conductor in successive layers of convolutions or turns and inserting sheets of insulating-material between the layers, said sheets being creased longitudinally of their marginal edges to form fin-like ridges which assume a position contiguous to the sides of the wire turns to hold them in place and prevent them from slipping on the surface of the sheets.

5. An improved method of producing electrical coils consisting in winding wire in successive layers disposed about a central core and wrapping a strip of paper around each layer after its completion, said strip being previously creased to raise fin-like ridges

on its outer surface whereby to form abutments adapted to lie alongside the turns of wire laid over the paper to restain the windings from lateral displacement or slippage.

6. An improved method of producing electrical-coils consisting in winding wire on a central core in a succession of superimposed layers, and periodically feeding sheets of insulating-material into the coil to cover each layer at its completion, while concurrently creasing the sheets longitudinally of their marginal edges during the feeding operation to form annular fin-like ridges projecting from the surface thereof when the sheets are wrapped around the layers to abut the sides of the wire turns wound thereover.

7. An improved method of producing electrical-coils consisting in winding wire on a continuously rotating mandrel while traversing it back and forth longitudinally thereof to dispose the turns in concentric layers; periodically feeding sheets of paper into position to cause them to be wrapped about each layer at its completion while the turns of the succeeding layer are coiled thereover; and concurrently pressing the sheet of paper between rolls during the feeding operation to crease it longitudinally of its marginal edges whereby to raise fin-like ridges which project from the outer surface of the wrapped sheet in position contiguous to the sides of the wire windings to serve as abutments to hold the windings from displacement.

In testimony whereof I affix my signature.

EDWARD F. PARKS.