No. 733,234. PATENTED JULY 7, 1903.

J. W. LUNDSKOG.

METHOD OF FORMING COILS.

APPLICATION FILED JUNE 21, 1901.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

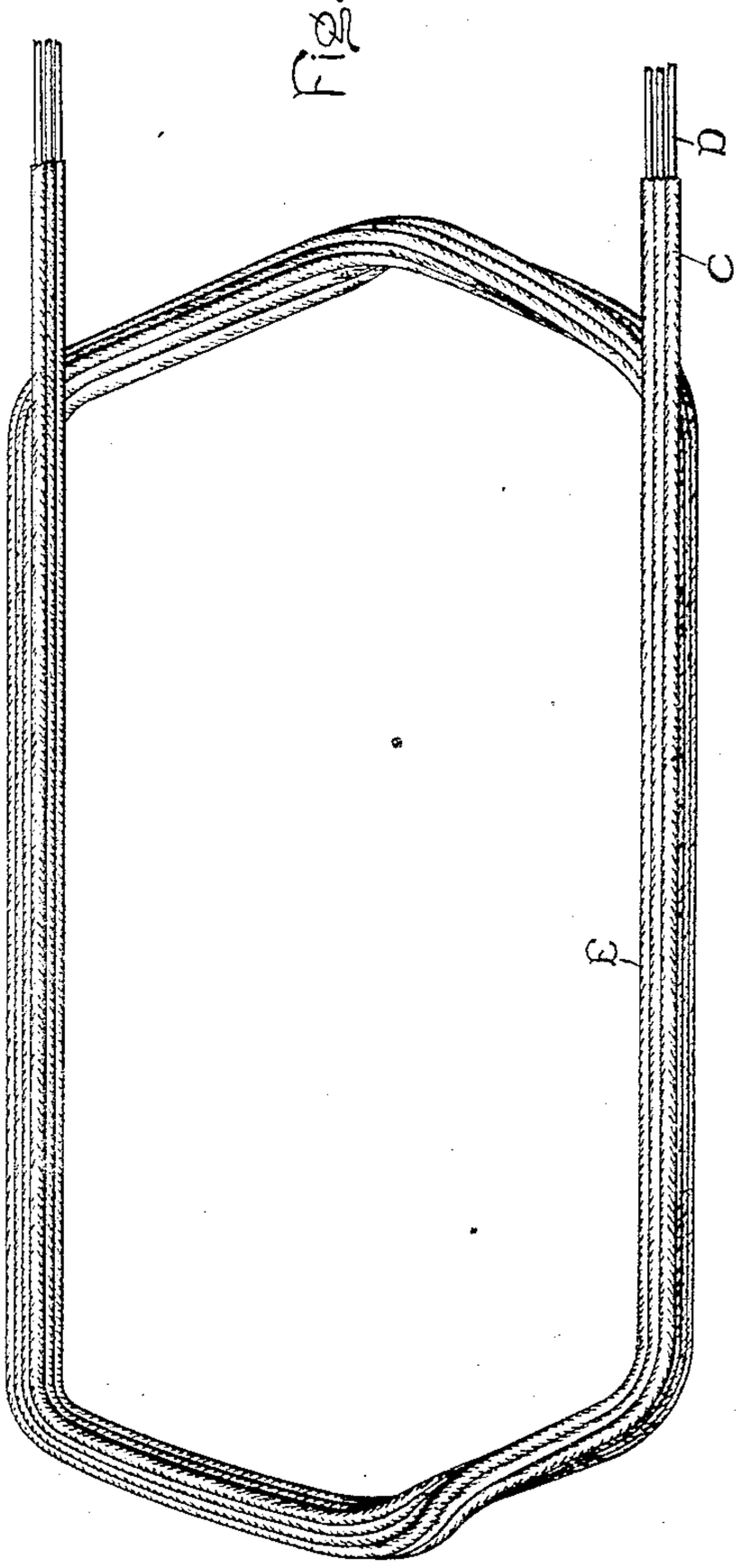


Fig. 5.

Fig. 4.

Fig. 3.

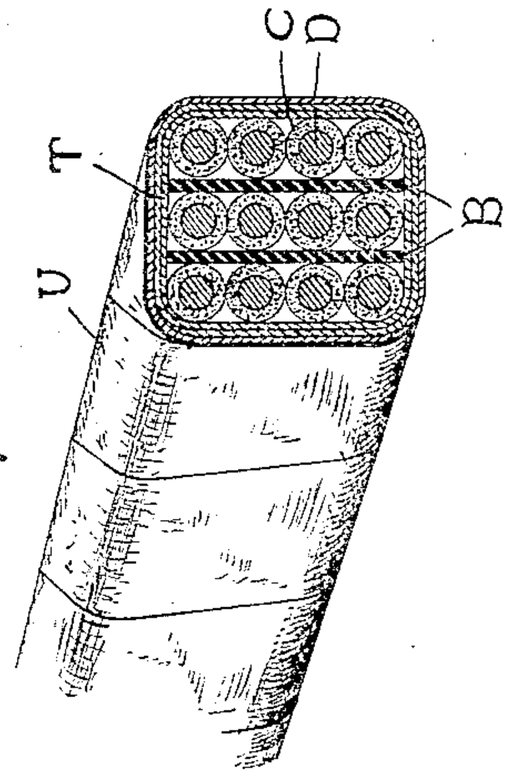
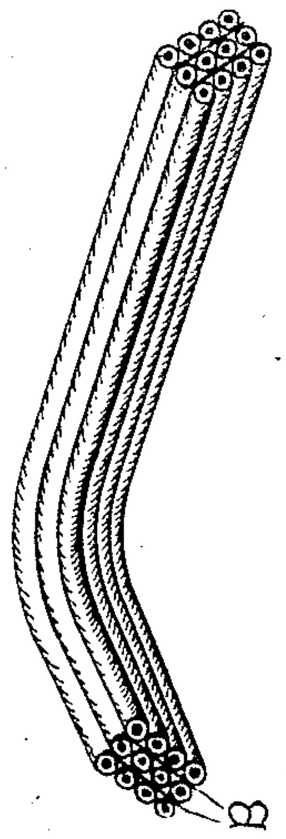


Fig. 2.



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APPLICATION FILED JUNE 21, 1901.

NO MODEL. 2 SHEETS—SHEET 2.

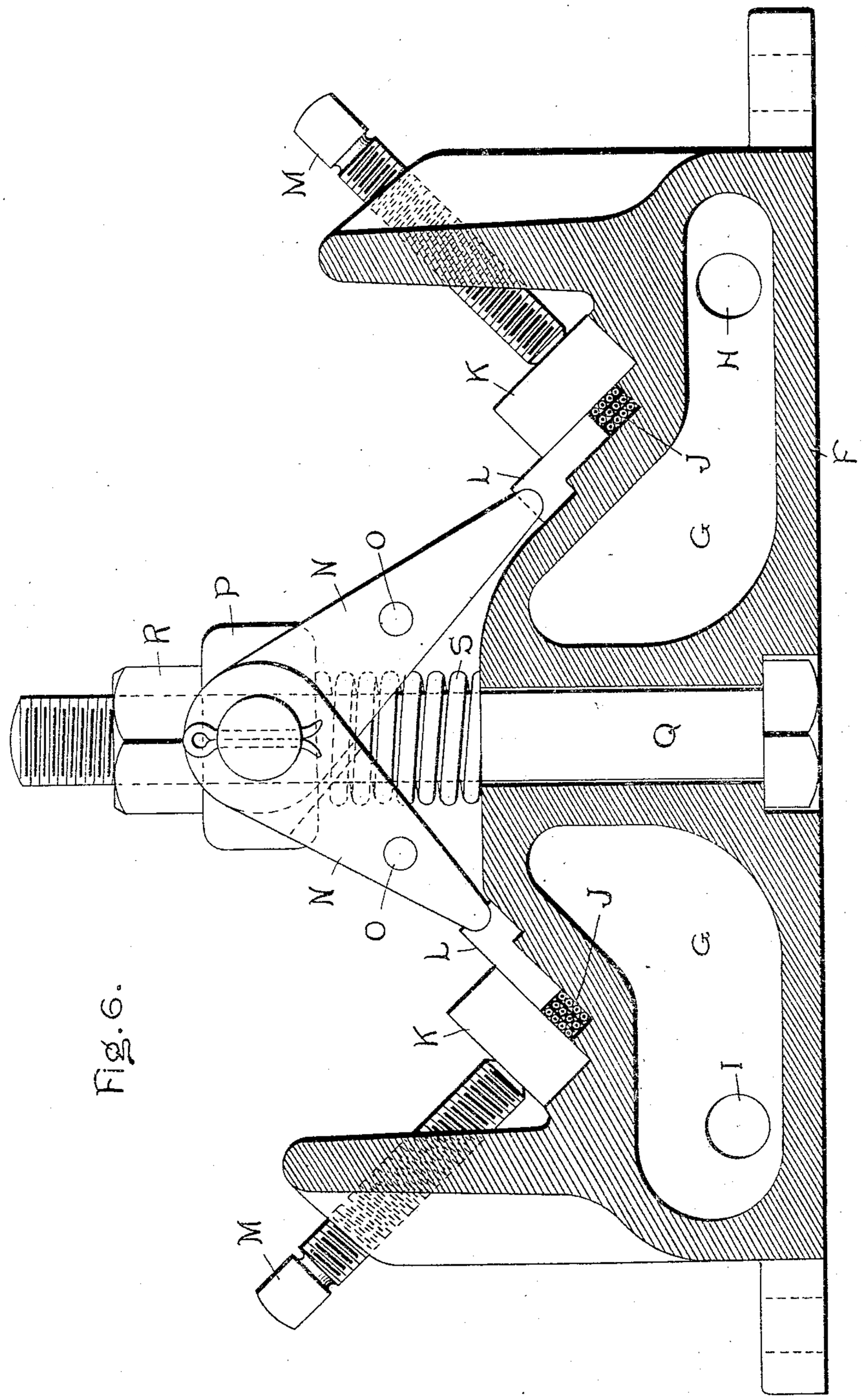

Fig. 6.

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No. 733,234. Patented July 7, 1903.

UNITED STATES PATENT OFFICE.

JULIUS W. LUNDSKOG, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

METHOD OF FORMING COILS.

SPECIFICATION forming part of Letters Patent No. 733,234, dated July 7, 1903.

Application filed June 21, 1901. Serial No. 65,430. (No model.)

To all whom it may concern:

Be it known that I, JULIUS W. LUNDSKOG, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Methods of Forming Coils, of which the following is a specification.

The present invention relates to the manufacture of coils for electrical apparatus, and more particularly to coils intended for armatures.

It is customary to make coils for electrical apparatus with strips of insulating material between the several layers or convolutions for the purpose of increasing the insulation. I have discovered that by properly treating the piece or pieces of insulation between the layers or convolutions they will not only increase the insulation, but will act as a binder to hold the separate conductors together.

In the accompanying drawings, which illustrate an embodiment of my invention, Figure 1 is a plan view of an armature-coil. Fig. 2 is a perspective view of a portion thereof. Fig. 3 is a perspective view of a portion of a coil, on an enlarged scale. Fig. 4 is a cross-section of the coil, showing the insulating-strips between the wires disposed at right angles to those shown in Fig. 3. Fig. 5 is a left-hand end view of the coil shown in Fig. 1, and Fig. 6 is a cross-section of the press used in forming the coil.

In Fig. 1 I have shown what is known as a "three-turn coil, which coil may be wound in any suitable manner. In my pending application, bearing Serial No. 65,429, filed June 21, 1901, I have shown and described a form for winding coils of this character; but since the particular means employed in winding form no part of the present invention no further reference will be made thereto. Broadly speaking, the coil on Fig. 1 can be wound in two different ways—first, by winding a plurality of separate coils, each coil having the requisite number of turns, and afterward uniting them; second, by treating the wires of which the coil is composed as a single wire and winding them all at once.

After the coil has been given the proper shape, which may or may not be the same as that illustrated in Fig. 1, strips B, preferably of some tough insulation, are inserted between the several convolutions. These strips are made of insulating material, such as paper or fiber, and are covered with an insulating compound that is sufficient in quantity when melted or softened to impregnate the insulating-covers C on the conductors D. The strips B are separately prepared and the insulating compound is permitted to harden thereon before being placed between the conductors. I have found that shellac or varnish will work very satisfactorily for coating the strips; but I do not desire to be understood as limiting my invention to these materials, since I may employ any insulating compound that will soften or melt under a definite increase in temperature and when allowed to cool or harden will act as a binder for the various turns or convolutions. The side portions E are separated slightly to permit the insertion of the strips B, and as the coil at this stage in its manufacture is somewhat loosely put together the insertion is a simple matter. Ordinarily the strips are placed only between those conductors forming the side portions E of the coils; but, if desired, they can be extended into the end portions, as indicated in Fig. 2.

In Fig. 3 I have shown what is termed a "three-coil four-turn" winding, and in this case two insulating-strips B are provided, which extend vertically.

In Fig. 4 I have shown my improvement in connection with what is known as a "four-coil three-turn" winding, and three strips of insulating material are provided, which extend at right angles to the strips in Fig. 3. The position of the strips has been changed in order to separate the wires of one coil from the wires of a second coil; but, if desired, the insulation can be extended through the wires in the manner illustrated in Fig. 3. The particular arrangement of the strips as they pass between the various convolutions is immaterial so long as the necessary insulation is af-

forded. The arrangements shown have been found to be very desirable, since they impart rigidity to the coils.

In Fig. 6 I have illustrated a press which is employed in finishing the coils. The press consists of a base F, having a chamber G formed therein. The chamber is provided with an inlet H and an outlet I, through which steam can be passed for the purpose of heating the coil, and after the coil has been sufficiently heated the steam can be cut off and water admitted to reduce the temperature. On the upper surface of the base surfaces J are provided to receive and hold the coils in place. Sliding blocks K and L are employed for compressing the coil while it is hot. The block K is actuated by a pair of set-screws M, which are mounted in upwardly-extending ribs formed integral with the base. The block L is actuated by means of a pair of levers N, that are connected by the pin or rod O, which is arranged to cause simultaneous movement of the levers on the same side of the center bolt. Only one lever is shown in engagement with the block L on each side of the center bolt; but it is to be understood that there is a second lever placed directly behind the first, so as to press on the opposite end of the coil. The upper end of each lever is pivotally secured to a block P, which block is mounted on the vertically-extending bolt Q. The block P is moved downward in a manner to force the sliding blocks L against the coil by means of a nut R and the levers N and is moved upward to release the blocks by the compression-spring S, situated between it and the base F. Both sides of the press are similar as to construction and operation, so further description is unnecessary.

After the coil has been wound and the strips of insulation B inserted in place the coil is placed in the press, the surfaces J being approximately equal in length to the sides of the coil. After the coil has been mounted in place the blocks K and L are put in position and the set-screw M and the levers N advanced until the coil is securely held in place. After this steam is admitted to the base and the temperature increased until the insulating compound on the strips B softens or melts, after which additional pressure is applied to the blocks K and L. This causes the insulating compound to be forced into the fabric covering on the conductors and at the same time insures the external dimensions of the sides of the coil being correct. Steam is now cut off from the chamber G and in place thereof water is admitted to reduce the temperature. The control is obtained by means of a suitable valve. (Not shown.) After the temperature of the press has been reduced to a point where the insulating compound hardens the levers N and set-screws M are released, the blocks K and L detached, and the coil removed. The coil as it now stands can be applied directly to an armature or to any other piece of electrical apparatus for which it is intended. When the coil is removed from the press, it is very rigid and the side portions are firmly united, so that the coil may be freely handled even though it is composed of a plurality of separate coils which were originally nested or placed one within the other.

For certain kinds of work it is desirable to have additional insulation on the side portions of the coils, as is illustrated in Fig. 3. Surrounding the conductors is a wrapping T, of insulating material—such, for example, as oiled fabric. In the present instance two layers are shown; but this may be varied to meet the conditions for which the coil is intended. The oiled fabric T is preferably secured to the conductors by a more or less complete coating of varnish or shellac. After the fabric has been placed in the sides of the coil the coil is given a covering of tape U. This taping is preferably spirally wound and extends over the ends, as well as the sides, of the coil.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The method of forming a coil for electric apparatus, which consists in inserting between the convolutions of the coil pieces of insulation which soften or melt at a certain increase in temperature, then subjecting the coil and insulation to the action of heat and while so heated applying pressure, and finally reducing the temperature.

2. The method of forming a coil for electric apparatus, which consists in inserting between the turns of the coil a body of insulating material which softens or melts at a definite increase in temperature, then subjecting the coil and insulating material to the action of heat and while so heated applying pressure, and finally reducing the temperature while the pressure is maintained.

3. The method of forming a coil for electric apparatus, which consists in placing between the conductors a piece of material covered with an insulating compound which will soften or melt at a given increase of temperature, then subjecting the compound to the necessary increased temperature, and afterward reducing the temperature until the compound hardens.

4. The method of forming a coil for electric apparatus, which consists in placing between the insulated turns of the conductors a piece of material having a coating of insulating compound which softens or melts at a certain increase in temperature, and is sufficient in amount to impregnate the insulation on certain portions of the wires when softened or melted, then subjecting the same to the necessary temperature to soften or melt the compound, and finally reducing the temperature until the compound hardens.

5. The method of forming a coil for electric apparatus, which consists in placing a piece of material covered with a compound between adjacent convolutions, which compound is capable of softening or melting at a certain increase in temperature, then raising the temperature of the compound to the necessary point and while so heated applying pressure to the coil, and finally reducing the temperature

In witness whereof I have hereunto set my hand this 18th day of June, 1901.

JULIUS W. LUNDSKOG.

Witnesses:

DUGALD MCK. MCKILLOP,

JOHN J. WALKER.