No. 733,233. PATENTED JULY 7, 1903.

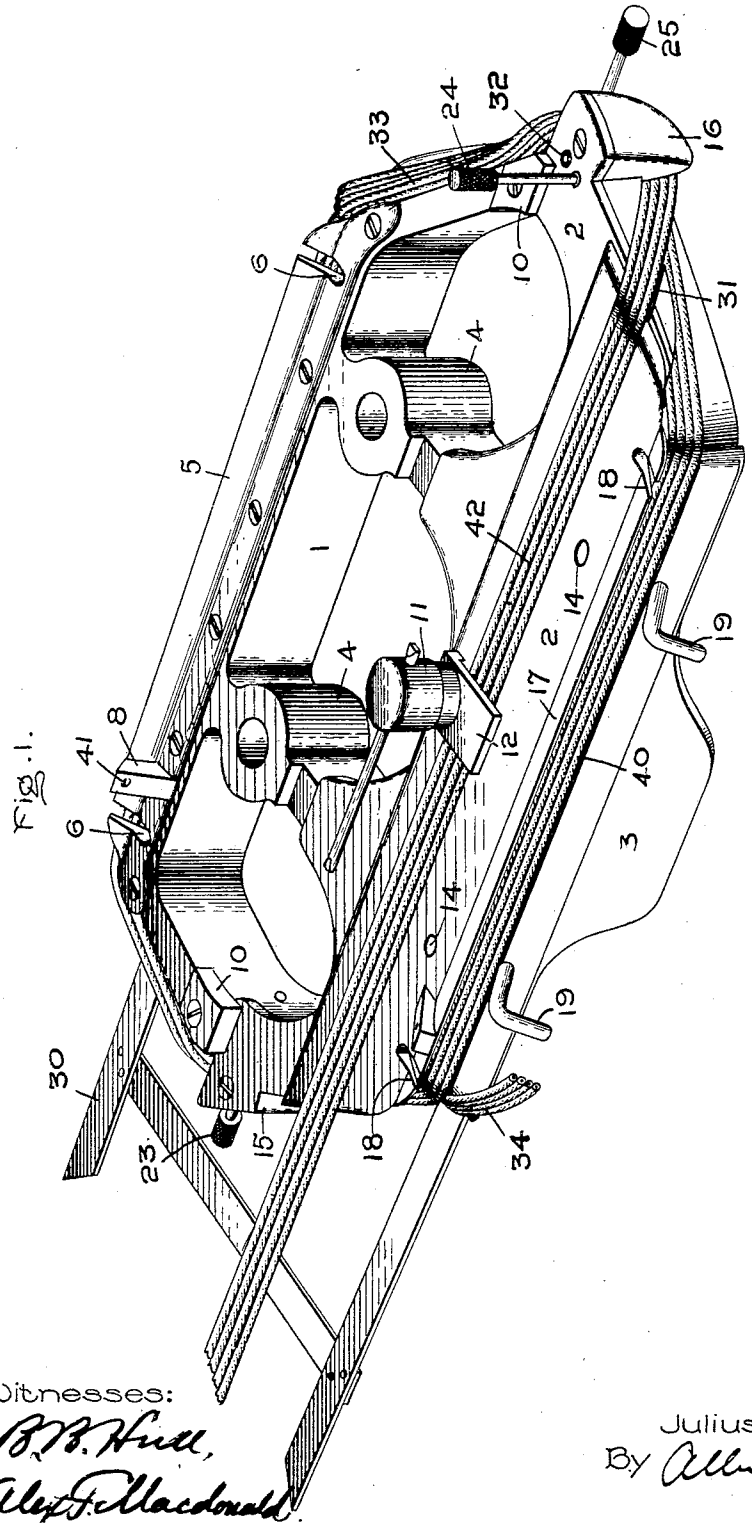
J. W. LUNDSKOG.

METHOD OF WINDING COILS.

APPLICATION FILED JUNE 21, 1901.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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NO MODEL. 3 SHEETS—SHEET 2.

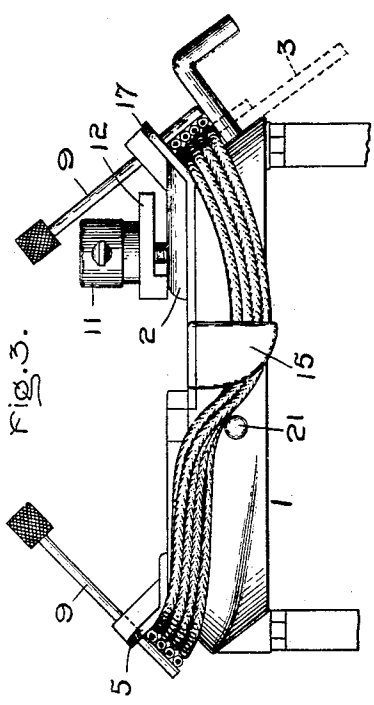


Fig. 3.

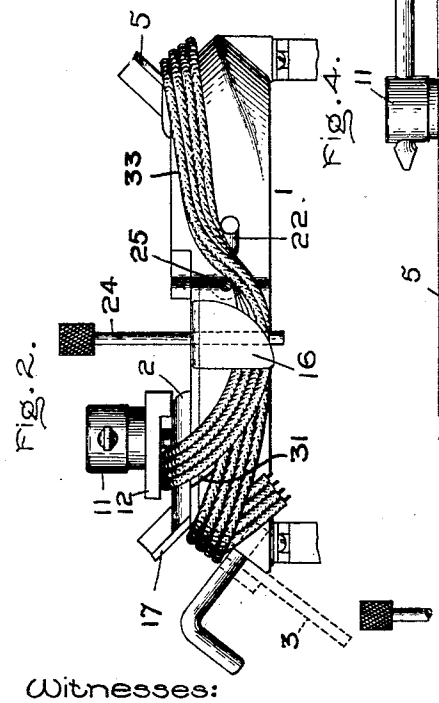


Fig. 2.

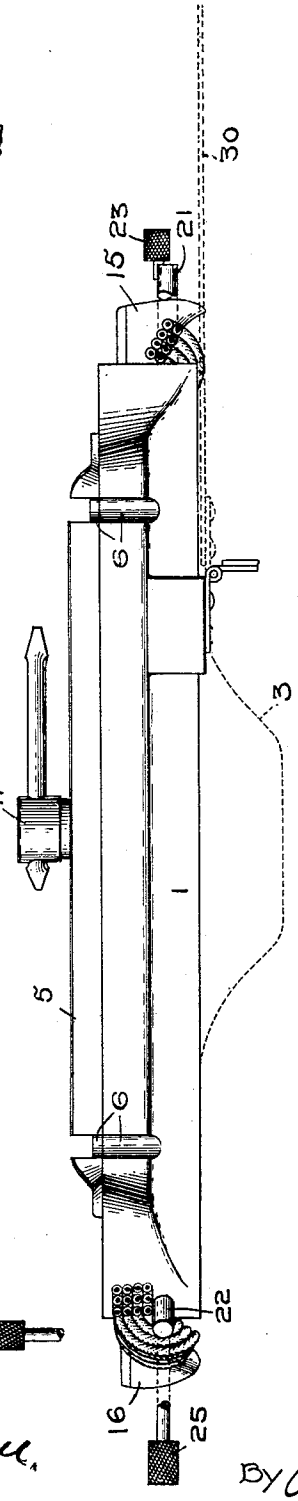


Fig. 4.

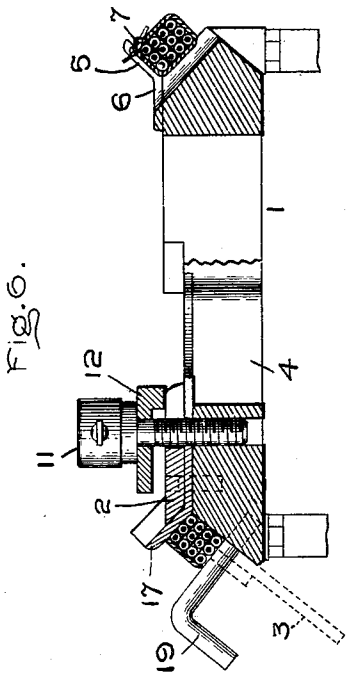


Fig. 6.

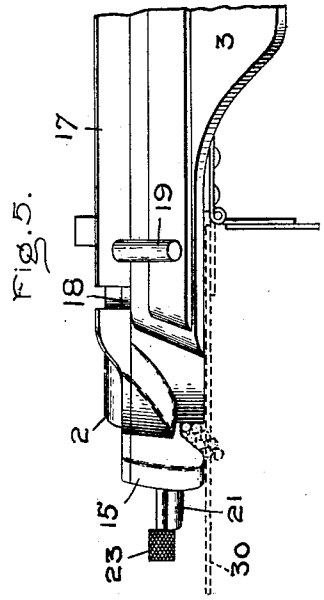


Fig. 5.

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No. 733,233. PATENTED JULY 7, 1903.

J. W. LUNDSKOG.

METHOD OF WINDING COILS.

APPLICATION FILED JUNE 21, 1901.

NO MODEL. 3 SHEETS—SHEET 3.

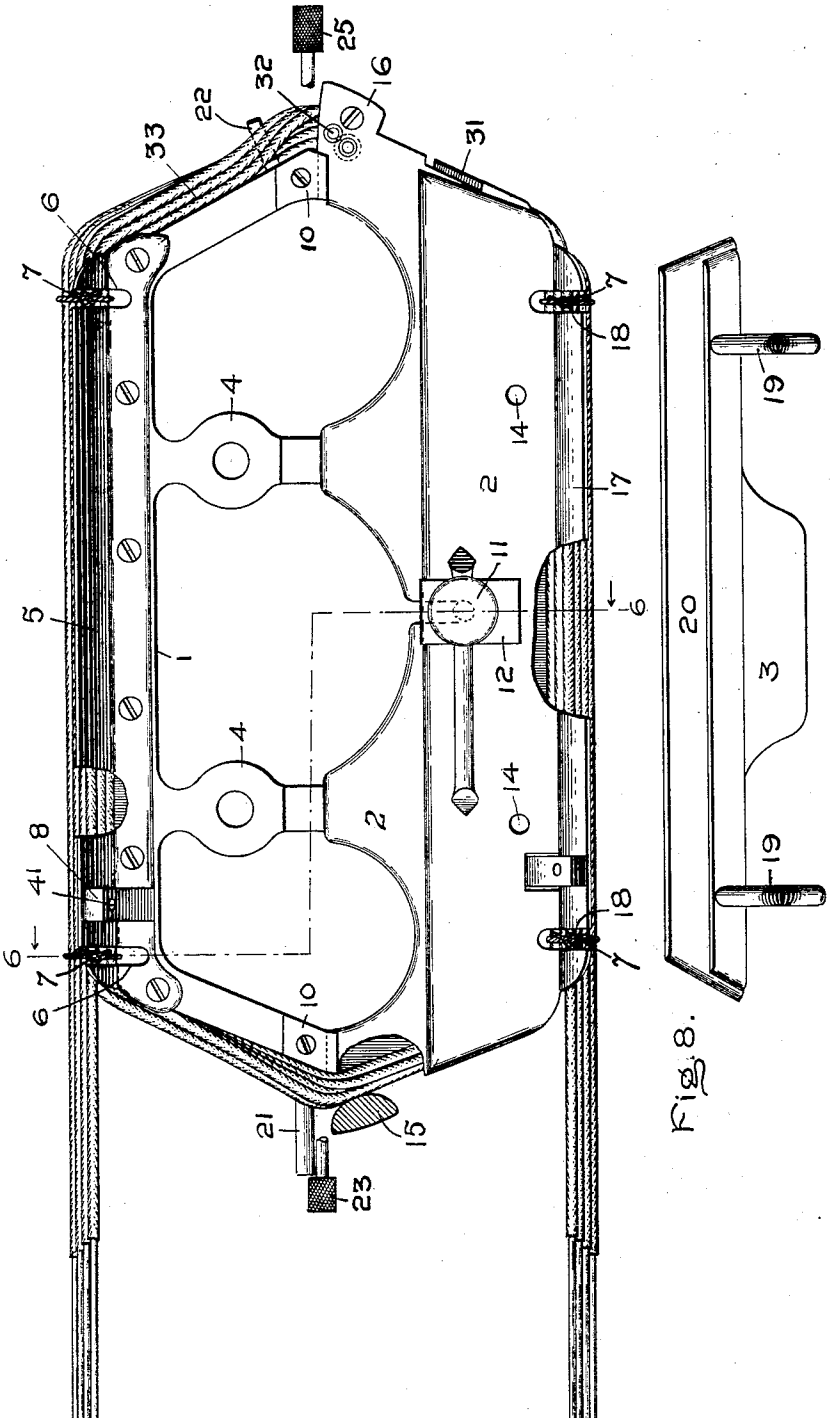


Fig. 7.

Fig. 8.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 733,233. 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 WINDING COILS.

SPECIFICATION forming part of Letters Patent No. 733,233, dated July 7, 1903.

Application filed June 21, 1901. Serial No. 65,429 (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 Winding Coils, of which the following is a specification.

The present invention relates to the method of winding interchangeable coils intended for electrical apparatus, and more especially to coils of the well-known Eickemeyer type.

The object of the invention is to provide a method of winding coils composed of a number of separate wires or strands, whereby the conducting-leads may be brought out at the outside of the coil without objectionable crossings, and this in a simple and inexpensive manner.

In the accompanying drawings, which illustrate a means for carrying out my invention, Figure 1 is a perspective view of a winding-form with a coil partially wound thereon. Fig. 2 is a right-hand end view. Fig. 3 is a left-hand end view. Fig. 4 is a rear elevation. Fig. 5 is a partial front elevation of the left-hand side. Fig. 6 is a sectional view taken on the lines 6 6 of Fig. 7 looking in the direction of the arrows. Fig. 7 is a plan view of the form, and Fig. 8 is a plan view of the removable side plate.

The winding-form as a whole is composed of three principal parts—the base 1, the removable top plate 2, and the removable side plate 3. The plate is held in place by detachable pins or equivalent device, as will hereinafter appear. The base 1 in the present instance is formed of metal; but it can be made of wood or other material, as desired. The sides of the base are parallel and are beveled or inclined toward each other, as is best indicated in Figs. 2, 3, and 6. In other words, the surfaces occupy planes which are radial with respect to each other. The object in so inclining the sides is to bring the side portions of the coil into their proper relation with respect to the center of the armature when mounted thereon. As the diameter of the armature changes the distance between the sides of the coil may be varied or their angular relation. This is governed by the number of poles in the machine and also by the number of coils on the armature. The same principle of construction, however, applies to small as well as large coils. The ends of the form are somewhat V-shaped to provide for the outwardly-extending portions of the coils containing the offsets and have flat surfaces. Extending across the center of the form are two ribs 4, each having a hole through which bolts are passed to clamp the form in place on a suitable head. In the present instance it is intended to mount the form in such manner that it occupies a horizontal plane, as this is the most convenient; but it may be mounted in any other plane, if desired, or it may be made movable, as desired. Permanently mounted on the rear side or back of the base and held in place by screws is a flat strip of metal having a lip 5, against which the wires are seated when being placed on the form. The lip may be formed integral with the base; but I have found it cheaper to construct it in the manner shown. It is also desirable to make it removable, so that a new piece may be substituted when the old one is worn out. Near the ends of the flat strip slots 6 are provided and corresponding slots are also provided in the base 1, which coincide therewith. These slots are to facilitate the tying of the several convolutions forming the finished coil. After the coil is wound in place and before removing from the form strings are passed down through these slots and the coil tied, as is indicated at 7, Figs. 6 and 7. Near the left-hand end of the piece 5 is formed a projection 8, containing a hole 41 for the reception of a pin, such as 9, Fig. 3. These pins are removable and are intended to temporarily hold the wires in place during the act of winding.

The front portion of the base is somewhat lower than the back portion, having been cut away to receive the removable top plate 2. This is best shown in Figs. 1 and 6. The removable top plate 2 is held in position at the rear end by the projecting pieces 10, which are secured to the base by screws and is clamped in place by the bolt 11, which passes through a slot therein. The bolt also passes through a clamping-piece 12, that holds the first end of the wires used to form a coil in place. In addition to this dowel-pins are

provided which enter the holes 14. The top plate may be removed by loosening the bolt 11, raising it until the dowel-pins pass out of the holes 14, and finally pulling it outward until the inner edge of the plate clears the projections 10. On the ends of the removable top plate 2 are offset-forming hooks 15 and 16, around which the wires forming the coil are arranged to be passed. These hooks coöperate with the permanently-mounted pins 21 and 22 to form the offsets in the coils. In the present instance the hooks are shown as being made of separate pieces and secured to the plate by means of screws and solder; but, if desired, they may be made integral therewith. For convenience of construction the detachable top plate 2 is shown as being composed of two pieces, as is illustrated in Fig. 6; but, if desired, it may be made of a single piece. I have found, however, that it is somewhat simpler to make these winding-forms out of several pieces of metal and rigidly unite them, rather than to cast or cut them from solid stock, as by so doing the shape of the forms may be more readily varied to compensate for any undue binding which might take place between the various coils. By making the parts as described the cost of construction is reduced to a minimum, and it is a simple matter to substitute new hooks and pins when the old ones are worn. The front edge of the removable plate 2 is provided with a lip 17, which is designed to retain the wires in place during the act of winding. The ends of the lip are slotted at 18, as is also the base. This is to facilitate the tying of the coils before removing them from the form.

Extending parallel with the front side of the form and held in position by the L-shaped pins 19 is a removable plate 3, which has a thickness equal to the diameter of the wire being used to form a coil and during one part of the operation of winding is substituted for the wire. The detachable plate 3 rests on the inclined side of the base, and the L-shaped pins 19 pass through it into the base. To remove the plate, the pins are pulled out, after which they are returned to place and act as a support for the coil. This last feature is well illustrated in the left-hand side of Figs. 2 and 6. As shown in Fig. 8, the plate 3 is provided with a depressed portion 20, which when the plate is mounted on the form constitutes, in effect, a wire-receiving groove. The plate is mounted in position when the first convolution is put on, as shown in Fig. 1, and is removed to make room for the second convolution, and the thickness of the stock corresponds to the diameter of the wire used in winding. Therefore as the diameter of the wire varies so would the thickness of this particular plate. At the opposite ends of the base permanent pins 21 and 22 are provided. These pins are employed to support the wire as the various convolutions are placed on the form. They also coöperate with the hooks 15 and 16 on the removable plate 2 to form the offsets in the coils. In addition to the permanent pins a number of temporary or detachable pins are provided, which are inserted and withdrawn from time to time as the winding progresses. On the left-hand side of the form a single pin 23 is employed, while on the right-hand end two detachable pins 24 and 25 are employed. The pin 24 is arranged to be mounted either in the position shown or in the hole 32. The object of these pins will be more apparent when the operation of winding is described.

Situated under the form and pivotally secured thereto is a gage 30, that is employed in determining the starting and finishing points for the wire and also to indicate the proper point to cut each particular wire in the coil. The wires, as shown in Fig. 7, are cut in a series of steps, so that when the coil is applied to an armature each commutator-lead will be of the exact length required.

The present form is intended for winding four wires at once, making what is known as a "four-turn coil;" but it is to be understood that my improved method of winding is not limited to this, for the principle can be followed in making forms where different numbers of turns are desired. In changing the number of turns certain minor changes would of course be made in the form to meet the conditions.

In winding coils the wires are first cut to the approximate length, then gaged to the proper starting-point, then passed across the top of the detachable top plate 2, and under the clamp 12, which retains them in place. The wires are then passed down through the slot 31 at the right-hand end of the detachable plate 2 and under the hook 16, thence around the lower end of the detachable pin 24, which is placed in the extreme right-hand hole 32. From here the wires pass under the removable pin 25, Fig. 2, thence over the permanent pin 22 to the back of the form in an anticlockwise direction, and thence along the flat back face of the form, thus making the first layer. The wires are then bent at the left-hand end of the form and pass over the permanent pin 21, Fig. 3, and under the hook 15 on the left-hand end of the detachable plate 2. From here the wires pass to the front of the form, Fig. 1, and lie on top of the removable plate 3, the latter being held in place by the detachable L-shaped pins 19. The pin 24 on the right-hand side of the form is then placed in the inner hole, as shown in Fig. 1, and the wire is bent around the right-hand end of the form. This means that at this particular point the second turn or convolution passes in back of or underneath the first convolution. After the wires pass under the removable pin 24 and over the permanent pin 22, Fig. 2, they appear as the top or second layer, as at 33, Figs. 1 and 2. They then pass along the back of the form to the left-hand end and constitute

the second convolution. The left-hand detachable pin 23 is then removed, and in passing the end the wires are given a half turn or twist and the wires advance to the point 34, Fig. 1. The plate 3 is then removed by pulling out the pins 19, and the wires are forced into the space formerly occupied by it. In other words, the wires 34 now become the under layer and are located next to the front face of the form. The wires continue as the under layer across the front of the form and along the right-hand end through the hook 16 on the detachable plate 2. At this stage in the winding the pin 24 is removed to make room for the wires, and the latter are given a half turn or twist after they pass beyond the hook, so that instead of being the under layer and next to the frame they become the top layer and pass along the back side of the form under the lip 5. After the wire is wound or placed under the second convolution 40 the pins 19 are inserted in place in the front of the form, which holds the two turns or convolutions in place. The last or upper layer extends along the back side of the form to the end of the gage 30, and the several wires are cut at the angle indicated by the end of the gage. A pin is then inserted in the hole 41 at the left-hand end of the form to hold the wires in place. The clamp 12 is released, and the coil is completed by removing the portion 42, which was the first end of the wires applied to the form from the slot 31, and bending it over the second convolution or turn 40. It will thus be seen that the first portion of the coil is wound in one direction, while the balance of the coil is wound in the opposite direction, the steps taking place in a sequential manner. After the wires 42 have been wound in place they are extended outwardly to the end of the gage 30 and are cut at an angle in accordance with the end thereof. Preferably before the wires are cut a pin 9 is inserted in the projection 17 to retain the wires in place. Strings are then passed down through the slots 18, of which there are four, and the several convolutions are tied together, as indicated in Figs. 6 and 7. The clamping-bolt 11 is then released, which permits the top plate 2 to be raised slightly to detach it from the dowel-pins. The plate is then moved slightly toward the front, which takes it out of engagement with the projections 10 on the base 1. After the plate 2 is removed the coil can be taken from the frame by withdrawing the back pin from the hole 41 and moving it slightly to a point where it will be disengaged from the lip 5.

I have found it to be the most convenient to clamp the wires 42 to the form; but, if desired, they may be held by a clamp located on some other support.

By winding an intermediate portion of the coil, such as 40, first, then winding an under layer, such as 34, next, and finally winding the portion 42 I am enabled to bring the commutator-leads out on the outside of the coil, thereby making a coil with smooth end curves and no crossings. This greatly simplifies the winding of the coil, renders it easy to insulate, and reduces the danger from short-circuiting to a minimum.

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

1. The method of forming a coil composed of layers of wire, which consists of first winding a layer or layers from an intermediate portion thereof, then forming the remaining layers in the desired relation by sequentially winding the end portions of the wire, as set forth.

2. The method of forming a coil composed of layers of wire, which consists in placing the wires that are to form a layer side by side, then winding a layer or layers from an intermediate portion thereof, then forming the remaining layers in the desired relation by sequentially winding the end portions of the wire, as set forth.

3. The method of forming a coil composed of layers, each layer having more than a single wire, which consists in winding a layer or layers from an intermediate portion of the wires, then forming the remaining layers by sequentially winding the end portions of the wire in such manner as to bring the ends or leads on the outside of the coil, substantially as described.

4. The method of winding a coil which consists in winding an outer layer over a temporary support, then removing said support and winding an inner layer in the space formerly occupied by it, and finally winding the outside layer.

5. The method of winding a coil which consists in starting at a point intermediate the ends of the wires, then winding an intermediate layer over a temporary support, then removing said support and winding an inner layer in the space formerly occupied by it, then carrying the wire of the inner layer to an outer layer, and finally winding the first end of the coil.

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.