C. W. FRANCIS.

METHOD FOR MAKING WINDINGS.

APPLICATION FILED NOV. 19, 1920.

1,396,033. **Patented Nov. 8, 1921.**

Fig. 1.

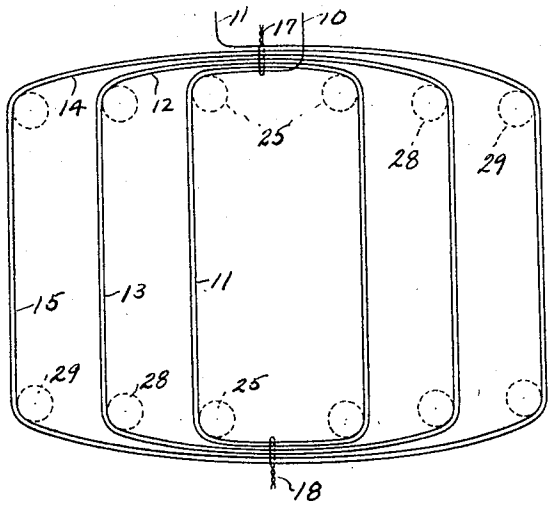


Fig. 2.

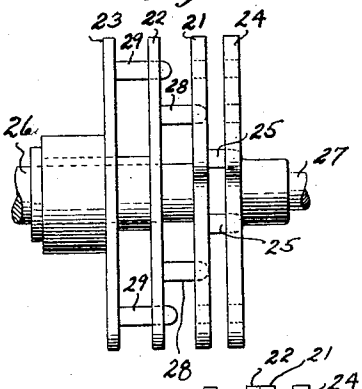


Fig. 3.

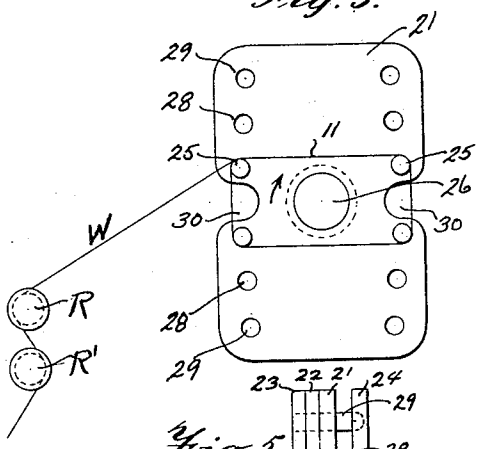


Fig. 4.

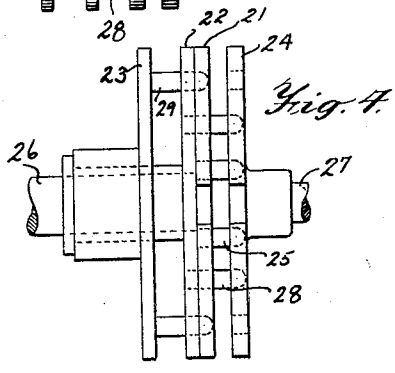
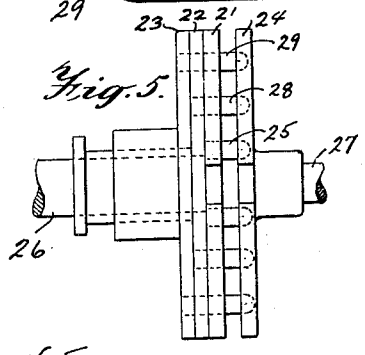


Fig. 5.



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UNITED STATES PATENT OFFICE.

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METHOD FOR MAKING WINDINGS.

1,396,033. Specification of Letters Patent. Patented Nov. 8, 1921.

Original application filed February 3, 1920, Serial No. 356,027. Divided and this application filed November 19, 1920. Serial No. 425,052.

To all whom it may concern:

Be it known that I, CHARLES W. FRANCIS, a citizen of the United States, residing at Paterson, in the county of Passaic and State of New Jersey, have invented certain new and useful Improvements in Methods for Making Windings, of which the following is a specification.

My invention relates to methods for making a winding which is particularly adapted for the field coils of multi-polar electric machines, it being understood that the method is capable of use in the making of windings of a large variety of shapes and for different purposes.

One of the objects of my invention is to provide a method for making a winding in which there shall be a number of flat, separate coils of increasing sizes and arranged with sufficient space between the sides of the coil so that the same may be slipped around the poles of a multi-polar field piece, which winding shall be of one continuous piece of wire, so that the winding can be made cheaply and at the same time have its insulation uniform throughout the completed winding.

Another object of my invention is to provide a method for making such a winding as has just been described and others of a similar character in which coils occupying the same plane may be wound so that each succeeding coil surrounds the preceding inner coil and yet is separated therefrom by a considerable space, and particularly a method by which such winding may be carried out in a continuous manner by the placing of suitable forms in position after the preceding form has received its predetermined number of turns of wire.

With these and other objects in view, my invention consists of the method hereinafter fully described and particularly pointed out in the appended claims.

This application is a division of my application Serial No. 356,027, filed February 3rd, 1920, entitled "Apparatus for making windings."

In the drawings, Figure 1 illustrates one form of winding which my method is adapted to produce; Fig. 2 is a side elevation on a relatively small scale of an illustrative arrangement of forms on which the winding of Fig. 1 may be produced; Fig. 3 is a front elevation of Fig. 2 with some of the parts removed showing the first or inner coil of the winding being formed; and Figs. 4 and 5 are views similar to Fig. 2, but with successive outer forms moved into position.

In the drawings, the same parts are referred to by the same reference characters in the several views.

Fig. 1 is a side elevation, more or less diagrammatic, of a form of winding such as the method described herein is particularly designed to make. In this drawing only two layers of wire have been shown in each coil, but it will be understood that as many as desired may be provided, and particularly that the number of turns in each plane, which will determine the width of the winding, may be of any desired number. Beginning at the terminal 10, the wire, which is continuous throughout the winding, passes into the inner coil 11 around which, in the diagrammatic view, it passes twice completely, the end 12 then passing to the next coil 13 around which it again passes twice completely, with its end 14 passing to the outer coil 15, the end of which, 16, is preferably bent upwardly parallel to or around the terminal 10. It will be understood that any desired number of coils may be formed in the winding.

It will be observed that in the form shown in Fig. 1, the top and bottom of the respective coils are adjacent each other, whereas the sides are widely separated from the sides of adjacent coils.

In order to provide an easy method by which the winding may be kept in shape and position until the winding is placed in the machine in which it is to be used, I preferably provide a temporary binding wire such as 17, 18, at the top and bottom of the winding, this temporary binding wire being fastened so as to hold the coils together until they are in position of use.

It, of course, is not new to form a winding of a number of coils, but the particular advantage of my method consists of forming such a winding from a continuous piece of wire so that the insulation on the wire is continuous throughout the winding. Furthermore, in the forming of such a winding, the delay occasioned by fastening the ends of successive coils together is avoided.

In order to form such a coil as that shown

in Fig. 1, I preferably wind the desired number of turns around a former which is shaped to give the required interior shape to the inner coil 11, such turns being continued until the desired size of coil is obtained. Then, without removing the inner coil 11 from its former, I place a secondary former around the inner coil 11 and continue the winding from the coil 11 around this secondary former, which winding is continued again for the required number of turns when I again place another secondary former around the preceding one, and continue the winding around this. The placing of successively larger secondary formers around the preceding formers is thus continued until the desired number of coils is obtained, when the ends of the winding are carried up adjacent to each other, and preferably the entire winding temporarily bound, as by temporary binders 17, 18 of Fig. 1.

As one convenient design of formers which may be used conveniently to carry out my method, I preferably arrange a series of plates 20, 21 and 22, each having projecting pins located so as to enable one of the coils of the desired winding to be formed thereon. A follower plate 24 is provided to be held normally in a fixed position, but being capable of movement away from the plate 21, so that the finished winding may be removed from the pins constituting the formers. The plate 21 has projecting from the face thereof, pins 25, and the follower plate has holes into which the pins 25 may project, the plates 21 and 24 being positioned so as to have a space therebetween into which the wire W, shown in Fig. 3, may be passed and wound around the pins 25 as the plates 21 and 24 are rotated. Rollers R and R′ may be provided in the usual manner to give a tension to the wire as it is being wound on the former. As a matter of convenience, the former plates may be mounted on a shaft 26 so that they may be readily rotated, and the follower plate 24 may be mounted on a stud or support 27, this support being arranged to permit the plate 24 to be moved to the right of Fig. 2.

The plate 22 is provided with a set of pins 28 which, while the coil is being wound on the pins 25, are projected into, but not through, holes in the plate 21. Similarly, pins 29 on the plate 23 are projected through holes in the plate 22, but do not extend into the space between the plates 21 and 24.

By my method, to produce the winding shown in Fig. 1, the end of the wire is first attached in any suitable manner to the former plate 21, and all the former plates, together with the follower plate, are then rotated a predetermined number of turns until the inner coil 11 of the winding is formed on the pins 25. Then, preferably, without stopping the rotation of the formers, the plates 22 and 23 are moved to the position shown in Fig. 4 which will cause the pins 28 to be projected across the space between the plates 21 and 24. Thereupon, the wire will be passed around the four pins 28 to form the coil 13 of the winding. When this coil is finished, the plates are again moved to the position shown in Fig. 5 with the pins 29 projecting across the space between the plates 22 and 24, and the last coil 15 of the winding is then formed around these pins.

Spaces 30 are provided in the sides of the plates 21 and 24 of sufficient depth to enable the temporary fastening wires 17, 18 to be passed around the finished coil. Such fastening wires are now placed around the winding to retain the several coils in position and to prevent the coils from unwinding. Then the plate 24 is moved to the right of Fig. 5 and the finished winding, after the wire W is cut, is slipped from the ends of the several pins constituting the former. The plates are then restored to the position shown in Fig. 2 ready for the next winding.

It will be noted that the position of the pins 25, 28 and 29 as shown in Fig. 3 is such that the upper and lower sides of the coils in the windings are in contact with each other, as shown in Fig. 1. It will also be noted that by mounting the formers in the manner shown, successive formers may be thrown into operation without stopping the rotation of the coil which has just been formed.

It will be understood that the arrangement of formers, which I have illustrated, is merely one of a large number of arrangements which may be used conveniently to carry out my method and that two such arrangements may be hand-operated or automatically operated by power machinery. Obviously, the arrangement of the pins 29, as shown in Fig. 3, will be varied in accordance with the form of the winding to be produced.

I claim:—

1. The method of forming from a continuous piece of wire, a winding having a plurality of separate flat coils of progressively increasing area, which consists in winding a coil by a continuous relative motion between the source of wire supply and a form; surrounding the coil thus formed, while the said relative motion between it and the supply of wire continues, with a larger form, between which and said source of wire supply the said relative motion exists; continuing the winding from the coil just formed to and around the larger form by means of said continuing relative motion and repeating these steps with successively larger forms while maintaining the relative motion between the source of wire

supply and the coils and their forms until the desired number of coils is formed.

2. The method of forming from a continuous piece of wire, a winding having a plurality of separate flat coils of progressively increasing area, which consists in winding a coil by a continuous relative motion between the source of wire supply and a form; surrounding the coil thus formed, while the said relative motion between it and the supply of wire continues, with a larger form, between which and said source of wire supply the said relative motion exists; continuing the winding from the coil just formed to and around the larger form by means of said continuing relative motion; repeating these steps with successively larger forms while maintaining the relative motion between the source of wire supply and the coils and their forms until the desired number of coils is formed; then stopping said relative motion, binding the adjacent sides of the coils together and removing the entire winding from all the forms.

3. The method of forming from a continuous piece of wire, a winding having a plurality of separate flat coils of progressively increasing area, which consists in winding a coil on a continuously rotating form, surrounding the coil last formed, while it is rotating, with a unitary larger rotating form and continuing the winding from the coil last formed to and around the larger form, repeating these steps, while continuing the rotation of the formed coils with their forms, until the desired number of coils is formed, then stopping the rotation and removing the entire winding from all the forms.

4. The method of forming from a continuous piece of wire, a winding having a plurality of separate flat coils of progressively increasing area, which consists in winding a coil on a continuously rotating form, surrounding the coil last formed, while it is rotating, with a unitary larger rotating form and continuing the winding from the coil last formed to and around the larger form, repeating these steps, while continuing the rotation of the formed coils with their forms, until the desired number of coils is formed, then stopping the rotation, binding the adjacent sides of the coils together, and removing the entire winding from all the forms.

5. The method of forming a winding having a plurality of coils all in the same plane and successively surrounding one another, which consists in winding a coil on a form, surrounding said coil by a larger form by moving said last-named form into position from one face of said coil, winding a second coil on said larger form with wire continued from the first coil, surrounding the coils thus formed by a larger form brought into position from the same face of the coil, repeating these steps until the desired number of coils is wound, fastening the coils together, and removing the whole winding from the forms by moving it in the same direction that the forms were moved when brought into position.

CHARLES W. FRANCIS.