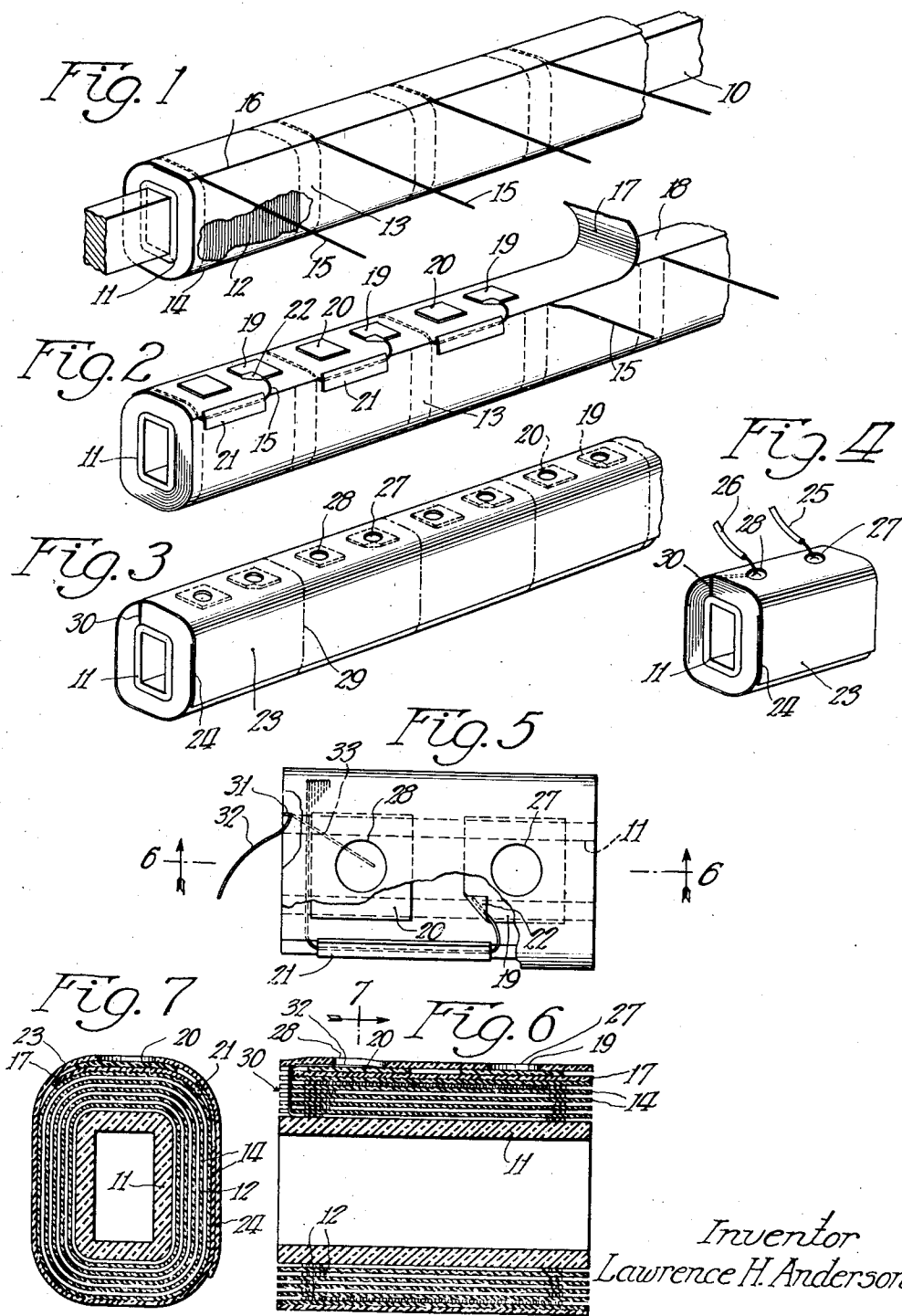


Dec. 15, 1931.

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ELECTRIC COIL MANUFACTURE

1,836,948

Filed Nov. 6, 1930



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ELECTRIC COIL MANUFACTURE

Application filed November 6, 1930. Serial No. 493,744.

The invention relates to improvements in electric coil manufacture and has particular reference to the quantity production of coils or windings used in various kinds of electromagnetic devices.

The principal objects of the invention are to provide an improved construction such that between the time when the coil is completed and the time when it is assembled and connected in the device wherein it is to be used, the danger of damaging the terminal connections of the winding is reduced to a minimum; to provide a construction such that maximum protection is given to the inside terminal connection of the winding without undue expense; to provide an improved terminal arrangement and mounting therefor which shall possess durability, rigidity, and insulating properties to a high degree and which shall be of minimum bulk so that the coil will be accommodated with facility in the space allotted to it in the electrical device wherein it is to be used; to provide a construction which shall be neat, rugged, fool-proof and efficient, while being exceptionally economical to manufacture; to provide an improved process or method for producing an electric coil of the character described and in general, to provide an improved construction of the class indicated.

The invention is of particular value and the above objects of the invention are to a certain extent facilitated when the coils are wound in multiple in the general manner set forth in the United States patent to James C. Anderson, No. 644,311 which may be practiced conveniently by the aid of a machine of the general type set forth in Patent No. 654,583 issued to the same patentee.

In the drawings which illustrate the construction of a coil embodying the invention and which also illustrate the process steps involved in its manufacture,

Fig. 1 is a perspective view of a series of the coils at the completion of the actual winding process,

Fig. 2 is a perspective view of said coils after having been removed from the winding mandrel and at later stages involved in the application of the terminals,

Fig. 3 is a perspective view of said coils at a still later stage in the operation,

Fig. 4 is a perspective view showing one of the completed coils and the manner in which the leads of the electromagnetic device are connected to the coil terminals,

Fig. 5 is a plan view of one of the coils, certain parts being broken away or detached in order to better illustrate the mechanical construction,

Fig. 6 is a section taken on the line 6—6 of Fig. 5, and

Fig. 7 is a section taken on the line 7—7 of Fig. 6.

In practicing the invention according to the above mentioned patented process, the coils are wound simultaneously in multiple, preferably on a mandrel 10 of suitable cross-section over which is placed a tube 11, preferably of suitable insulating material which may be sawed at an appropriate later stage of the process. The mandrel 10 is of such fit in the tube 11 that the mandrel may be withdrawn without damaging the coil structure. According to the preferred method, the independent wires each corresponding to one of the desired coils are wound around the foundation tube 11 in parallel relation and suitably spaced so that the layers 12 of the coil are spaced apart a substantial distance as indicated at 13. It will be understood that all of the wires or coils are wound simultaneously in multiple as the mandrel 10 is rotated and that there are suitable feed or traversing devices for guiding the wires as the mandrel rotates so that each of the layers 12 will be of the desired length in a direction parallel to the axis of the mandrel or coil and will have the requisite number of turns.

As shown, each coil is composed of a plurality of superposed similar layers registered with each other and in order to insulate the layers from each other, there are inserted between the adjacent superposed layers wrappings of sheet insulating material as indicated at 14, each of these wrappings comprising a strip or sheet of paper or analogous material large enough to extend circumferentially over the entire series of coil sections with the necessary overlap at the ends and

also of sufficient width circumferentially to extend around the subjacent layer of wire turns with a sufficient overlap.

After the completion of the final layer of wire turns, the final or outside insulating wrap 14 is applied as indicated in Fig. 1, leaving the outer ends of the windings 15 extending outwardly and tangentially from under the edge 16 of the final wrapping 14 of the layer insulations, in order to facilitate subsequent handling of the coil structures, the margin 16 of the sheet may preferably be secured in position by paste, glue, or analogous material.

The next steps in the operation are illustrated in Fig. 2. After the tube with all of the coil sections thereon is removed from the mandrel 10, the next operation is to apply to the top of the structure a precautionary strip of insulating material such as paper 17 extending the entire length of the structure and being of such character that it can be securely cemented in position by means of a layer of shellac 18.

After the strip 17 of insulation has been cemented to the exterior of the multiple coil structure, there are cemented to the top surface of the strip 17, a series of pairs of terminal plates 19, 20, one pair to each coil section so as to take care of the inside and the outside terminals of the coil winding. The plates 19 and 20 are preferably small squares of tinned copper suitably located to provide a space therebetween and also to provide a space between the edges of the plates and the edges of the coils when the latter are subsequently severed from the structure. Said plates may be secured in position by means of shellac applied to the upper surface of the strip 17. It will be understood that the pairs of plates 19 and 20 are placed in alignment so as to facilitate subsequent operations and to provide for standardization of the ultimate product.

The terminal plates 19 are designed to take care of the outside end of the coil winding and to this end the outside terminal portion 15 of the winding is preferably secured in place by pasting a strip of paper 21 or the like to the side of the coil, the terminal portion 15 being caught under the strip 15 as indicated in Fig. 2. The outer end of the wire 15 is bared and secured to the plate 19 by soldering or the like and in order to make a still better mechanical job, the corners 22 of the terminal plates 19 are bent over the ends of the wires as shown in Figs. 2 and 5.

Preferably after the structure has reached the stage of completion indicated at the left hand end of Fig. 2, an outside wrapping is applied for purposes of insulation and protection against mechanical abuse. Said wrapping comprises a sheet of strong but not bulky material, for example, thin kraft paper 23 suitably overlapped and having its

ends cemented together by shellac or the like as indicated at 24. Also, in order to expose the terminal plates so that the wires 25, 26, (see Fig. 4) may be subsequently applied by soldering, the external wrapping sheet 23 is provided with a series of pairs of punched holes 27, 28, spaced and positioned to register with the terminal plates 19 and 20, it being understood that the holes 27, 28 are of substantial less diameter than the width or length of the terminal plates so that after the wrap 23 has been applied, the terminal plates 19 and 20 will be held securely in position even though the shellac or cement may in itself be insufficient to anchor them under all conditions of service. It will be understood, also, that when the outside wrap 23 is applied, sufficient shellac or other suitable cement is applied to the exterior of the coil structure so that the wrap is anchored against sliding movement on the exterior of the coil section.

After the outer wrap 23 has been applied, the structure is in the condition shown in Fig. 3 and the coil sections may then be separated from each other by sawing the structure transversely midway in the space between adjacent windings as indicated at 29. The ends of the multiple structure are also sawn transversely in a similar manner in order to make a somewhat better job than could otherwise be produced.

Having sectionalized the coils from the multiple structure, the next operation is the bringing out of the inside end of the winding. This is effected by reaching in with a hooked needle or other similar device. Means must now be provided for leading this inside wire end to a terminal 20. To effect such result, one corner of the face of the coil section is slit or cut preferably by means of a knife fitted with a suitable guard to prevent too great penetration. In this manner the margin of each of the layer insulation sheets is slit, the slits being aligned as indicated at 30 in Fig. 3, and together constituting a channel or conduit 31 of sufficient size and depth to accommodate the wire end 32 which has been fished out from the inside layer of the winding. Ordinarily in coils of the character herein dealt with, the wire is usually quite fine and there is no difficulty in accommodating it in a slit of the character described. In order to secure the outer end of the wire terminal 32 to the plate 20, there is inserted through the aperture 28 of the outer covering a hooked needle or similar device by means of which the end 32 can be pulled through the space between outer wrap 23 and the terminal plate 20 and into the aperture 28 as indicated in dotted lines at 33 in Fig. 5 of the drawing.

After the wire end 32 has been drawn through and into the aperture 28 as shown in Fig. 5, the end of the wire is soldered to the exposed surface of plate 20. It is under-

stood that when the coil end 32 is soldered to plate 20, the wire is pulled taut so that it will be embedded in the slit or channel 31 which is of suitably greater depth than the diameter of the wire so that the wire will be sunken below the general level of the face of the coil section. This completes the manufacture of the coil.

It will be observed that a coil made according to the above described plan is devoid of projecting parts liable to become detached or misplaced and that a sufficient amount of insulation is provided wherever the same is needed without, however, in any sense materially increasing the bulk of the completed coil. Hence, the coils will fit into a minimum of space in the apparatus for which they are designed. Also, the terminal plates are held so securely in position and the winding terminals are so efficiently connected thereto that there is virtually no danger of disturbing or damaging the ends of the windings or the connections to the coil terminals when the coil is connected into the apparatus by means of the usual leads 25 and 26. These leads 25 and 26 may be soldered to the portions of the plates 19 and 20 exposed through the apertures 27, 28 without the slightest danger of damaging the coil or its connections, or its insulation.

Incidentally, the process and construction above described lends itself to mass production and particularly where several coils are wound in multiple on a single mandrel according to the manner set forth in the Anderson patents above referred to.

The herein described details of construction and manipulation are illustrative of merely one application of the invention, the scope of which should be determined by reference to the appended claims, said claims to be construed as broadly as possible, consistent with the state of the art.

I claim as my invention:

1. The improvement in the art of manufacturing electric coils which consists in simultaneously winding a series of independent wires in multiple around a tube of insulating material and in a series of independent layers spaced along said tube, placing over the entire series of layers a single wrapping of sheet insulating material common to the series of layers, repeating said steps while registering the upper layers in correct superposed relation over the bottom layer until a sufficient number of turns has been applied, securing over the exterior of each of the respective top layers a pair of terminal plates insulated from said top layer, connecting the outer coil ends respectively to alternate plates of the series, cutting the structure intermediate the spaced layers so as to form independent coils, said cutting operation being effected after application of the plates to the structure and, subsequent to the cutting operation,

connecting the inside wire ends respectively to the other plates of the pairs.

2. An electric coil comprising a continuous wire winding composed of a series of superposed layers of wire turns, wrappings of sheet insulating material interposed between adjacent superposed layers and extending a substantial distance laterally and outwardly beyond the margins of the layers, said extensions being provided with superposed slits extending inwardly of the extensions towards the respective layers, said slits together constituting a channel from the inside layer end to the outside of the coil and an insulated terminal secured on the exterior of the coil, the inside end of the winding having an integral extension imbedded in said channel and having its outer end connected to said terminal.

3. An electric coil comprising a series of superposed registered layers of wire turns, a wrapping of insulating material around the outside or top layer, an outside wrap of sheet insulating material extending around said first wrap and provided with an aperture therein, and a sheet metal terminal plate connected to one end of said coil winding and interposed between said wraps and underlying said aperture.

October 29, 1930.

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