

E. R. GILL.

TRANSFORMER AND MEANS FOR WINDING SAME.

(Application filed May 4, 1899.)

(No Model.)

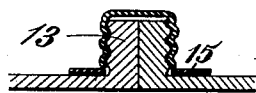
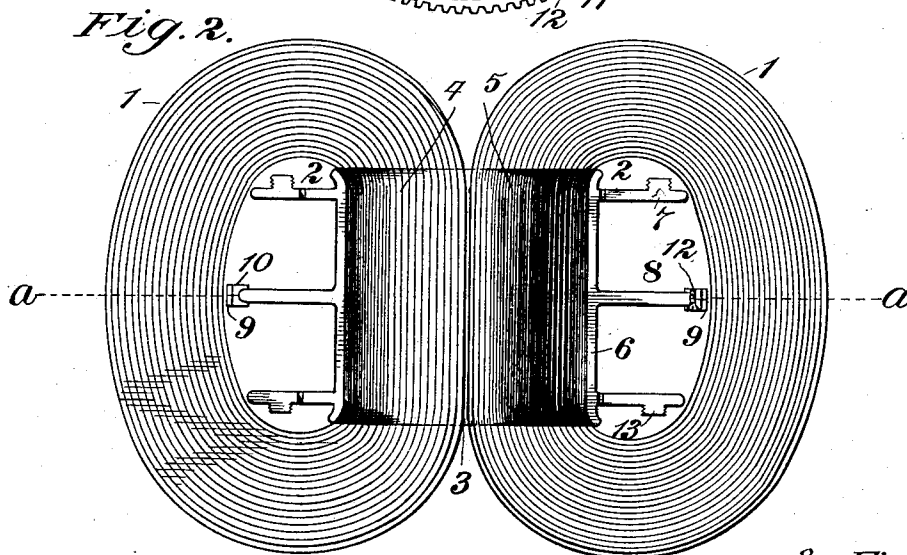
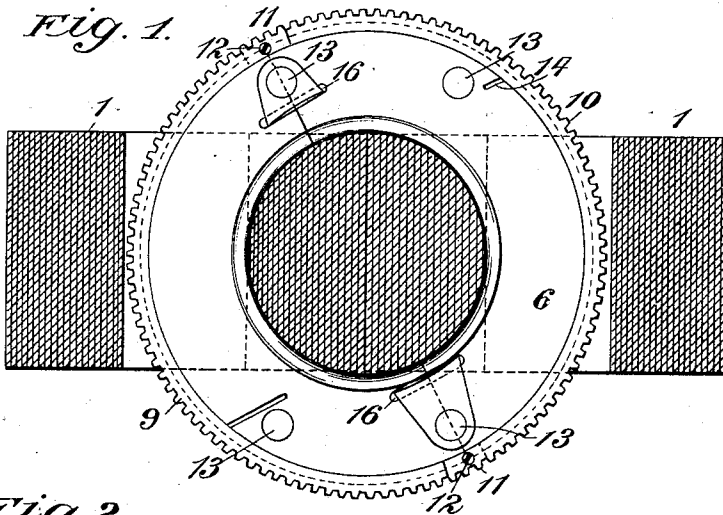
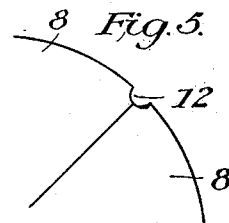
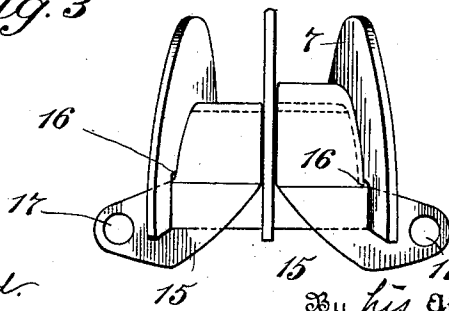


Fig. 3.



Witnesses
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UNITED STATES PATENT OFFICE.

EDWIN R. GILL, OF NEW YORK, N. Y., ASSIGNOR TO INVENTION DEVELOPING COMPANY, A CORPORATION OF NEW JERSEY.

TRANSFORMER AND MEANS FOR WINDING SAME.

SPECIFICATION forming part of Letters Patent No. 714,891, dated December 2, 1902.

Application filed May 4, 1899. Serial No. 715,529. (No model.)

To all whom it may concern:

Be it known that I, EDWIN R. GILL, a citizen of the United States, residing in the city, county, and State of New York, have invented

a certain new and useful Improvement in Transformers and Means for Winding the Same, of which the following is a specification.

My invention relates to an improved form of alternating-current transformer or converter and to means for winding and forming the same and involves certain features applicable to a large class of electrical machinery.

One object of my invention is the provision of a form of magnetic core for transformers which can be quickly and easily constructed and wherein low reluctance per unit of length of magnetic circuit is combined with as short and broad a magnetic circuit as possible. My invention also avoids using iron so disposed as to be out of the shortest path for the magnetic lines. At the same time a saving of copper, and consequently a lessened C²R loss during working, is accomplished by the disposition of the coils in circular form.

Another object of my invention is the provision of means whereby the coils may be wound directly upon my jointless magnetic core with a minimum of labor in applying both copper and insulation.

Another object of my present invention is the provision of such a disposition of secondary windings in a converter as shall insure a maximum apparent ohmic conductivity therein and shall at the same time take up a minimum space for copper and insulation.

A preferred embodiment of my present invention is shown in the accompanying drawings, wherein—

Figure 1 is an end view of a transformer built in accordance with my invention before winding, the iron core being cut away on the line *a a* of Fig. 2. Fig. 2 is a plan view of the same with one half-spool removed. Fig. 3 is a perspective view of a half-spool, showing my preferred disposition of secondary windings and my means for making connections with exterior circuits. Fig. 4 is a detail sectional view of one of my copper-capped terminal knobs, and Fig. 5 is a side view of

My improved core is made by winding com-

minuted iron in continuous lengths in a suitable form in two halves, which are afterward joined for production of a double magnetic circuit. I prefer to wind my half-cores as shown at 1 in the drawings and to use long thin strips of iron or steel. This is clearly indicated in the section in Fig. 1. I prefer to use one continuous length in each half-core; but it is evident that successive lengths joined together may be used without departing from the practically jointless nature of the magnetic circuit produced. This absence of joints in the magnetic circuits is one of the important features of the class of my inventions to which this present improvement belongs. As wound in the first instance the half-cores are made up of simple coils of iron or mild steel strip in uniform section, and the cross-section of the resulting half-cores is illustrated by the outer portion of the core as shown in Fig. 1. The open space 2 in Fig. 2 shows the type of form or mold upon which I prefer to wind my core-forming strips.

After formation of the half-cores as described above they are set together on their flat faces on the plane 3 in Figs. 1 and 2, and the two contiguous cross-sections 4 and 5 are machined down or otherwise fitted to a substantially circular cross-section, as shown in Fig. 1.

I have found it convenient to use concave milling-tools for this purpose; but any desired tools and methods may be employed without departing from the spirit and scope of my present invention. I have found it desirable, however, where a single spool is thus used upon a single circular portion of the core to employ a spool of the form shown in the drawings herewith filed. This spool 6 is devised to afford an interchangeable system of primaries and secondaries wherein different potentials may be employed on either circuit. For this purpose I prefer to provide in addition to the end flanges 7 a dividing-flange 8, which divides the spool-space into two parts, preferably equal.

The winding of the coils upon my jointless core involves applying to said core a divisible spool 6 and then rotating said spool to wind the wire.

In order to supply the power for rapid and

certain rotation of the spool 6, I prefer to employ a divisible gear 9 10 upon the periphery of the dividing-flange 8. As shown in Fig. 2, this gear preferably fits over the periphery of the dividing-flange 8, so as to lap down a short distance toward its center and thus afford a firm bearing, preventing the gear from slipping off sidewise. Any other means may of course be employed for this purpose within my invention. The two halves of the divisible gear are preferably secured in place by the device, as shown, wherein a half-thickness of each half-gear overlaps a like reduced thickness of the other half, as at 11, and a pin or screw 12 passes through the overlapping portions.

To render the driving of the flange 8 a positive one, I prefer to provide half-notches at the extremities of the meeting edges of the two half-flanges and to make the pins or screws 12 pass through the spaces thus provided. This is clearly shown at 12 in Fig. 2.

I prefer to provide copper-capped knobs 13 on the outer surfaces of the spool-flanges. For the purposes of the present improvement, however, I prefer to employ four knobs on each spool-head, bringing out all the windings on each side of the dividing-flange to the knobs on their own end of the spool. I thus have two primary and two secondary terminals on each end.

As shown, I prefer to have two of the knobs 13 formed on the dividing-line of the spool, one-half of each knob being on the edge of each half-flange. The copper cap when fitted on said knob—as shown, for instance, in Fig. 4—will then hold the half-spools together. This is not essential, however, as the driving-gear 9 10 will hold the spool together until the wires are applied.

In order to make connection between the two ends of each primary and their proper terminals, I preferably provide two slits 14 and 14^a in each end flange. The direction of each slit is best made perpendicular to the line of division of the spool. This obviously facilitates molding where porcelain or other moldable material is used for the spool.

It is well known that, especially with high frequencies, alternating currents tend to crowd to the surface of wires of large diameter, and to thus increase their apparent ohmic resistance. To obviate this, I prefer to make my low-tension secondary of a flat wide strip, as shown in Figs. 1 and 3. This applies, of course, to the primary in a step-up converter.

To shorten the time consumed in winding and in making a proper overlap at the end of each layer, as also to lessen potential difference between successive convolutions, I prefer to make my secondary conductor-strip the full width of the space to be wound, only leaving room for a certain amount of overlap of the insulating layer between successive conductor layers. This insulation may be made very thin, as it is common and convenient practice to allow about one volt per turn

of secondary, and hence in my construction the insulation between layers will only have to resist about one volt potential difference.

In Fig. 3 I have shown my preferred method of leading out my low-pressure terminal strips. At the left of the dividing-flange in this figure the space is shown unfilled, only the first end of the conducting-strip 15 being shown. In the right-hand space all the secondary is shown wound up and the outer end of the strip 15 is shown led out. In each case the strip protrudes from a slit 16, one half of which is preferably provided in each half-flange, as seen in Fig. 1. In order to change the direction of the strip from the tangential direction for winding purposes to substantially parallel to the spool-axis, the strip is turned and folded on itself through ninety degrees, as plainly shown in Fig. 3. I prefer to make connection between said strip and its proper terminal by the means illustrated, wherein an aperture 17 is provided near the end of the strip, which aperture fits over the copper terminal, to which it should be soldered. (See Fig. 1.)

The method of construction of my improved converter or of similar electric apparatus is now clear. After forming the core in the manner above described and preferably annealing it the divisible spool is applied thereto and the divisible gear 9 10 is fastened to the flange 8 thereof. The inner end of one secondary strip being connected to its terminal the gear 9 10 is brought into mesh with an appropriate driving-gear, and the rotation of the spool is made to wind the strip 15 and its insulating layer simultaneously. When the secondary is completed and its end connected to its terminal, appropriate dividing insulation is applied as usual and the primary winding commences. For this purpose the primary winding is introduced through slit 14^a and the wire wound by rotating the spool, the outer end of the winding being brought out through slit 14 to its terminal. After repeating this in both spool-spaces, applying the final insulation, and removing the gear 9 10 the converter is completed.

It is obvious that the spaces might be used separately for primary and secondary, respectively, if desired, and indeed many modifications of the construction herein shown and described might be resorted to without departing from the scope of my invention, which is not limited to the precise details herein shown and described.

What I claim is—

1. In an electromagnetic device, a divisible supporting-spool for the coils thereof, provided with an extra flange, and a divisible gearing fitting the periphery of said extra flange.

2. In an electromagnetic device, a divisible supporting-spool for the coils thereof having an extra flange, said flange being notched on its periphery; in combination with a divisible gear adapted to fit on the periphery of

said extra flange and having overlapping ends to its two portions, and means for fastening said overlapping ends together.

3. In an electromagnetic device, a divisible
5 supporting-spool for the coils thereof, registering half-slits in the sections of said spool-flanges, and flat conducting-strips wound on said spool, the ends thereof being folded on themselves through about ninety degrees, and
10 protruding through said slits.

4. In an electromagnetic device, a divisible
supporting-spool for the coils thereof, conducting-terminals on the outer faces of the flanges of said spool, a flat conducting-strip
15 wound on said spool and brought out to the outer faces of the flanges, the ends of said strip being provided with means for making connection with said terminals.

5. In a transformer, a core composed of sections, each of which is composed of a practically continuous coiled strip of iron, said sections being shaped to fit together in one common section. 20

6. In a transformer, a core composed of two sections, each of which is composed of a practically jointless and continuous strip of iron, said sections having each a flat face and a semicylindrical portion at said face, so that
25 when said sections are placed with the flat parts against each other, a practically cylindrical common portion is formed. 30

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Witnesses:

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