

Nov. 10, 1925.

1,561,204

R. F. BEERS

TRANSFORMER

Filed July 26, 1923

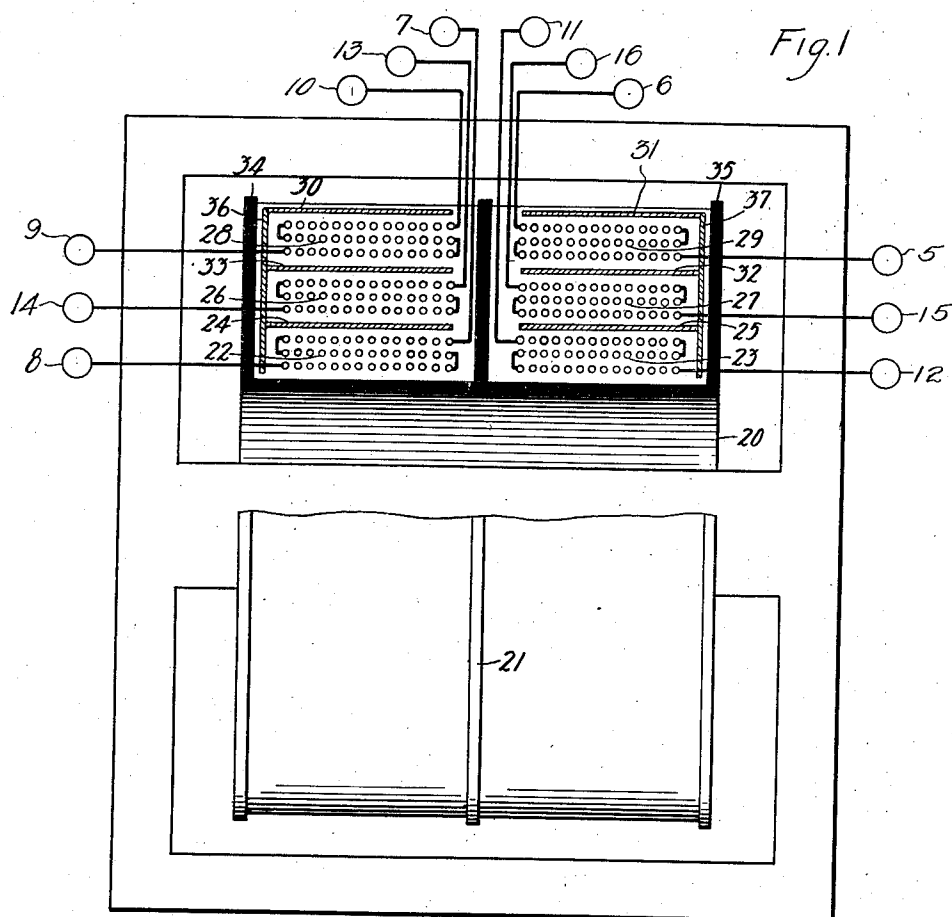
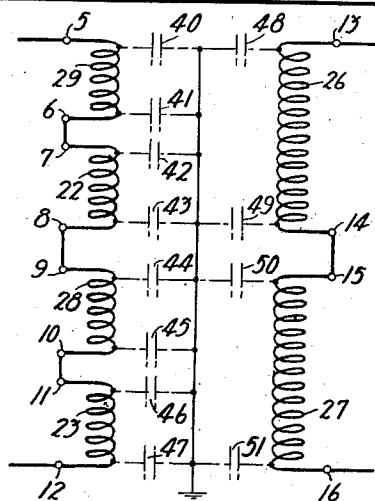


Fig. 2.



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UNITED STATES PATENT OFFICE.

ROLAND F. BEERS, OF BROOKLYN, NEW YORK, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TRANSFORMER.

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To all whom it may concern:

Be it known that I, ROLAND F. BEERS, a citizen of the United States, residing at Brooklyn, in the county of Kings, State of New York, have invented certain new and useful Improvements in Transformers, of which the following is a full, clear, concise, and exact description.

This invention relates to transformers.

10 An object of this invention is to reduce the magnetic leakage and capacity unbalances between the windings of a transformer.

One way the above object may be accomplished when applied to a transformer, with 15 a shell type of core is to wind each winding in a plurality of sections on different parts of the core, the layers of one winding being located between layers of the second winding. This arrangement, particularly when 20 the inner and outer portions of the second winding are connected alternately, results in a transformer of very low magnetic leakage. The capacity between the windings may be balanced and made of negligible value by 25 inserting shields between the individual portions of the windings, around the outer winding and between the spool heads and the windings, whereby the various sections of the windings may be so connected as 30 to give a symmetrical distribution of the natural capacities between the various windings and the shield.

Referring to the drawings, Fig. 1 illustrates an embodiment of this invention particularly adapted for use in the so-called 35 shell type of transformers; and Fig. 2 illustrates in a schematic manner the symmetrical distribution of the natural capacity effects of the transformer.

40 The transformer spool 20 illustrated in Fig. 1 is divided into two sections by a suitable separator 21, on opposite sides of which are located the two inner windings 22 and 23 which form part of the transformer primary winding. On top of the windings 22 45 and 23 and substantially covering the same are suitable shielding means such as sheets of copper foil 24 and 25, the purpose of which will be described later. Wound 50 around the shielding means 24 and 25 are the two sections 26 and 27 of the secondary winding of the transformer. The remaining sections 28 and 29 of the primary winding are superposed on the secondary winding 55 sections and are shielded from the trans-

former case and from the secondary winding sections by metallic shielding means 30, 31, 32 and 33. Unless the spool heads 34 and 35 are metallic, it will generally be preferable to insert between the spool heads and the 60 windings, metallic sheets 36 and 37 connected to the other copper foil sheets to form part of the shielding arrangement.

In order to obtain a transformer of low magnetic leakage while still having a sym- 65 metrical distribution of the natural capacity effects existing between the various parts of the transformer, it is preferable that the four sections of the primary winding be connected such that terminal 5 forms one 70 terminal to be connected to the line, terminals 6 and 7 connected together, terminals 8 and 9 connected together, terminals 10 and 11 connected together, while terminal 12 75 serves as the other connection to the line. The two sections of the secondary winding are preferably connected such that terminals 13 and 16 are the exterior terminals 80 while terminals 14 and 15 are connected together.

Such an arrangement, in addition to pro- 80 ducing a transformer of low magnetic leakage also insures a symmetrical distribution of the natural transformer capacities as shown in Fig. 2. Capacity 40 represents the 85 natural capacity between the inner layer of winding 29 and the shield 32; capacity 41, the natural capacity between the outer layer of winding 29 and the shield 31; capacity 42, the natural capacity between the outer 90 layer of winding 22 and shield 24, capacity 43, the natural capacity of winding 22 to the shielding strip 36, which capacity may be regarded as concentrated at the inner wind- 95 ing thereof; capacity 44, the natural capacity between the inner layer of winding 28 and the shield 33, capacity 45, the natural capacity between the outer layer of winding 28 and the shield 30; capacity 46, the 100 natural capacity between the outer layer of winding 23 and the shield 25, capacity 47, the natural capacity between the winding 23 and the shield 37, which capacity may be regarded as concentrated at the inner layer; 105 capacity 48, the natural capacity between the outer layer of winding 26 and shield 33; capacity 49, the natural capacity between the inner layer of winding 26 and shield 24; capacity 50, the natural capacity 110 between the inner layer of winding 27 and

the shield 25, capacity 51, the natural capacity between the outer layer of winding 27 and shield 32.

In case it is desired to wind the transformer in a greater number of sections, the same procedure may be followed, namely, by including one of the transformer windings between layers of the other winding, and by connecting alternately the inner and outer portions of the other windings.

The various shielding means disclosed may all be connected together and grounded if desired in order to reduce the capacity between the windings to a low value while still maintaining a symmetrical distribution of the natural capacity effects of the windings to the shielding means.

The type of the transformer described above has been found, on account of its low magnetic leakage and symmetrical capacity distribution, to be particularly efficient in transmission circuits in which uniform transmission efficiency is desired for a wide range of frequencies. In one particular case, for example, the transformer of this invention was found to have a substantially constant transmission efficiency from 300 to 6,000 or 8,000 cycles per second.

What is claimed is:

1. A transformer comprising a winding of a plurality of layers, a second winding interposed between the layers of said first winding, said first winding being wound in a plurality of sections located on different parts of the transformer core, the portions of said first winding in the plurality of sections exterior to the second winding being alternately connected with the portions of the first winding on the interior of the second winding to form the said first winding.

2. A transformer comprising a winding of a plurality of superposed layers located at different radial distances from the transformer core, a second winding interposed between the layers of said first winding,

each of said windings being wound in a plurality of sections located at different points along the transformer core, said windings being symmetrically arranged and having the individual sections interconnected with respect to the individual layers and their distribution along the core so that the transformer is balanced with respect to the transformer terminals for natural capacity effects existing between the windings.

3. A transformer comprising a winding of a plurality of superposed layers located at different radial distances from the transformer core, a second winding interposed between the layers of said first winding, said first winding being wound on a plurality of sections located at different points along the transformer core, shielding means between the various portions of said windings and around the outer winding, the portions of said windings being interconnected with respect to the individual layers and their distribution along the core so that the natural capacity effects between the windings and shielding means are symmetrically situated with respect to the transformer terminals.

4. A transformer comprising a winding of a plurality of layers, a second winding interposed between the layers of said first winding, said first winding being wound in a plurality of sections located on different parts of the transformer spool, the portions of said first winding in the plurality of sections exterior to the second winding being alternately connected to the portions interior to the second winding to form the first winding, the connections of the various sections being arranged to give a symmetrical distribution of the natural capacities existing between the various parts of the transformer.

In witness whereof, I hereunto subscribe my name this 23rd day of July A. D., 1923.

ROLAND F. BEERS.