June 2, 1931. H. R. LOUBET 1,808,670

TRANSFORMER

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Fig. 1

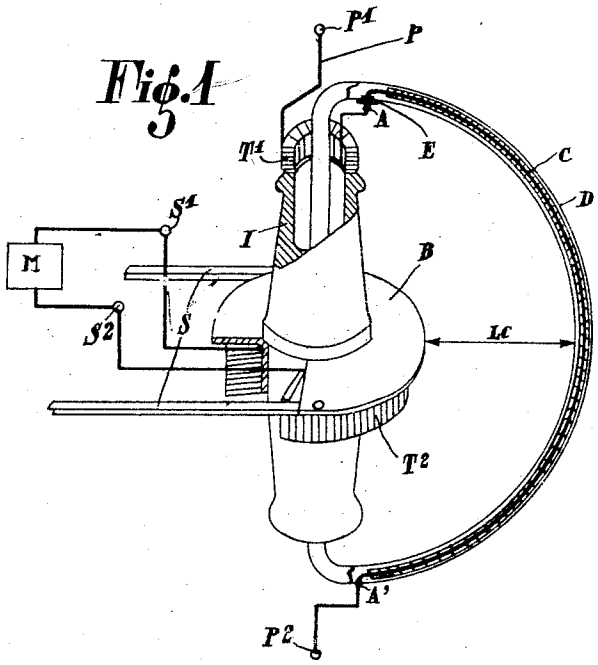


Fig. 2

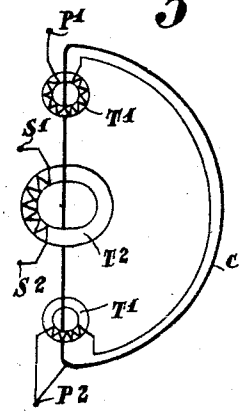


Fig. 3

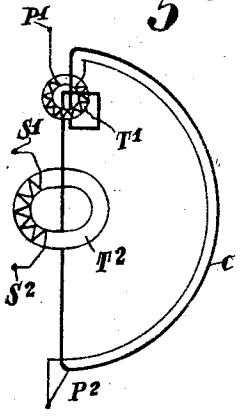
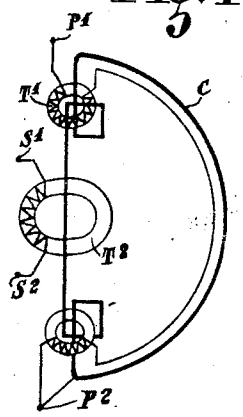


Fig. 4



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TRANSFORMER

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Fig. 5

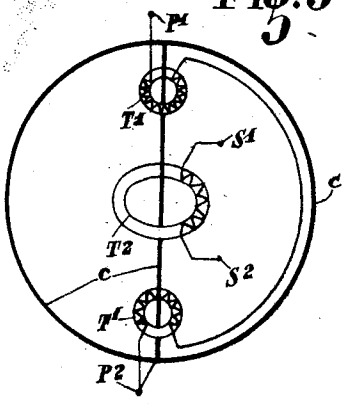


Fig. 7

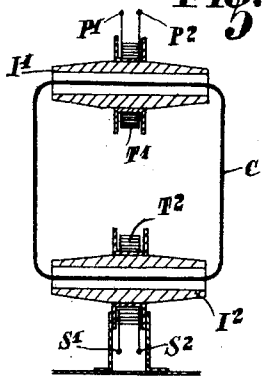


Fig. 6

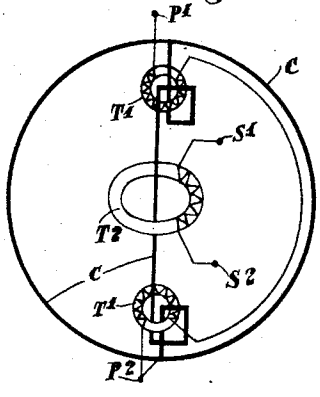
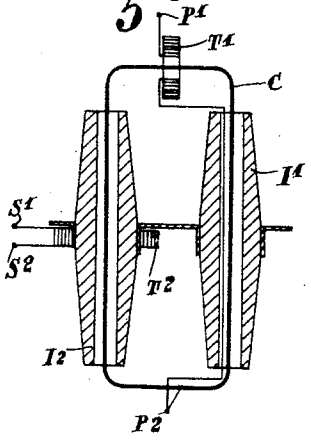


Fig. 8



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Patented June 2, 1931 1,808,670

UNITED STATES PATENT OFFICE

HENRI RENÉ LOUBET, OF PARIS, FRANCE, ASSIGNOR TO COMPAGNIE POUR LA FABRICATION DES COMPTEURS ET MATERIEL D'USINES A GAZ, OF MONTROUGE, FRANCE, A JOINT-STOCK COMPANY OF FRANCE

TRANSFORMER

Application filed March 14, 1930, Serial No. 435,855, and in France March 20, 1929.

Transformers the primaries of which only include a single turn formed in the majority of cases by a straight bar passing through the opening in the magnetic circuit, which transformers are commonly termed "bar transformers", possess among other advantages that of only requiring for their insulation a single bushing or leading-in insulator; whence the expression "bushing transformers" adopted for this type of apparatus. But, in their usual form, these transformers can only be designed to take currents of several hundred amps: for smaller currents, the ampere-turns becoming insufficient, such apparatus can no longer be used for feeding wattmeters and meters.

The object of the present invention is to produce a transformer possessing great accuracy and which may be designed to take a very low current, although the insulation may be formed by a single bushing insulator.

The invention is based on the principle of using an auxiliary transformer to step up the line current which may be very weak, to such a value that when applied as the primary current a very satisfactory transformer of the bushing type is secured.

Several embodiments of the invention have been illustrated diagrammatically and by way of example in the accompanying drawings in which:

Fig. 1 illustrates one embodiment of the bushing transformer used in conjunction with an auxiliary transformer.

Fig. 2 shows a modification of Fig. 1, using two transformers.

Figs. 3, 4, 5 and 6 are further modifications.

Fig. 7 illustrates another modification using bushing insulators for the bushing transformer and the auxiliary transformer respectively.

Fig. 8 illustrates another modification of Fig. 1, in which the outer portion of the bar conductor is also insulated by means of a bushing insulator.

In the embodiment illustrated in Fig. 1, T_1 is the auxiliary transformer connected to the line at P_1 and P_2 and the magnetic circuit of which is in the form of a torus about which is wound N turns of the primary winding p through which flows the line current.

The bushing transformer has been comprehensively designated T_2 and is carried by a flange B mounted on a suitable support S. The insulation for the transformer T_2 takes the form of the bushing insulator I, supporting at its upper end the auxiliary transformer T_1 and passing through an opening in the magnetic circuit of the transformer T_2, which magnetic circuit is likewise constituted by a torus. The primary of the bushing transformer T_2 is formed by a conducting bar C which is of large cross section and which passes centrally of the bushing insulator I.

It will be observed that the conducting bar C likewise passes up through the auxiliary transformer T_1 and, as will be seen presently, it acts as the secondary of said auxiliary transformer. The bar C is rectilinear in form over the portion thereof passing through the two transformers T_1 and T_2. Outside said transformers, it is bent round to form roughly a semi-circle so that the air gap Lc between it and the flange B shall be sufficient for the voltage involved, the flange B being at the potential of the torus T_2 whereas, as will be seen presently, said conductor C is at the line high tension potential similarly to the auxiliary transformer T_1.

The primary winding p of the auxiliary transformer T_1, is led from said transformer T_1 to the point A where a connection is made with a suitably insulated cable D housed in the semi-circular portion of the conductor C which is tubular and passing out therefrom to said point of connection A through the porcelain insulator E. At the point A', where the lower end of the cable D leaves the conductor C, a contact is established between the cable and conductor, said point of contact being connected to the line at P_2. It therefore follows that the primary p of the auxiliary transformer T_1 is at the same potential as the conductor C.

This device operates in the following manner:

The apparatus is mounted in the line between P_1 and P_2. The line current flowing through the N turns of the primary p of the

auxiliary transformer T_1 is stepped up to a high value in the single conductor C.

The current in the conductor C is then stepped down by the transformer T_2 to a current commensurate with that taken by the measuring apparatus M and the latter is electrically insulated from the line circuit by the insulator I.

As shown in Fig. 2, the accuracy may be increased by using several auxiliary transformers T_1. Moreover a greater number of ampere-turns of the conductor C may be placed on the auxiliary transformer T_1 than on the bushing transformer T_2. Such an arrangement has been illustrated in Fig. 3, while in Fig. 4 has been shown the combined arrangements of Figs. 2 and 3.

Instead of a single conductor C, several may be used in parallel or in series, an arrangement in parallel being shown in Fig. 5, while Fig. 6 shows this arrangement in conjunction with the use of two auxiliary transformers T_1.

Several of what appear to be the most preferable forms of the invention have been described, but any alternatives in which the current is stepped up to enable it to be fed to a bushing transformer, come within the scope of the invention.

Thus the auxiliary transformer T_1 might be insulated from the conductor C for a fraction or the whole of the voltage by means of an insulator I_1, while a second insulator I_2 insulates the conductor C and the bushing transformer T_2. This has been illustrated in Fig. 7.

Incidentally it is not essential that the magnetic circuit should take the form of a torus. Moreover, as illustrated in Fig. 8, the conductor C may be likewise insulated outside the portion thereof passing through the bushing transformer T_2. Thus in Fig. 8, I_2 designates the insulator for the bushing transformer T_2 whereas I_1 designates the insulator used for that portion of the conductor C situated outside the transformer T_2. It will be seen moreover in Fig. 8 that the conductor C has been given a rectangular instead of a semi-circular form outside the transformer T_2.

Finally the roles of the transformers T_1 and T_2 may be reversed. Thus T_2 will be fed from the high tension and the measuring apparatus will be fed by T_1; in this case the conductor C may be on the low tension side.

I claim:

1. In a device for feeding current to electrical measuring apparatus, the combination of a transformer designed to take a high current, an electric circuit, a bushing insulator passing through said transformer, an auxiliary transformer supported by said bushing insulator and including a primary fed by the current flowing in said circuit, a secondary to said auxiliary transformer forming the primary of said first transformer and stepping up the current to the high value for which said first transformer is designed, and a secondary to said first transformer adapted to step down the current to a low value commensurate with that taken by the electrical measuring apparatus.

2. In a device for feeding current to electrical measuring apparatus, the combination of a transformer designed to take a high current, an electric circuit, a bushing insulator passing through said transformer and supporting same, an auxiliary transformer including a primary fed by the current flowing in said circuit, a secondary to said first transformer formed by a straight conductor passing through said bushing insulator, said straight conductor including a portion situated without said bushing insulator, a second bushing insulator supporting said auxiliary transformer and being located in spaced relation to said first bushing insulator, said conductor, which is bent round to form a closed loop, passing through said second bushing insulator and at the same time forming the secondary of said auxiliary transformer and stepping up the line current to the high value for which said first transformer is designed, and a secondary to said first transformer adapted to step down the current flowing in said straight conductor to a value commensurate with that taken by the electrical measuring apparatus.

3. In a device for feeding current to electrical measuring apparatus, the combination of a transformer designed to take a high current, an electric circuit, a bushing insulator passing through said transformer, an auxiliary transformer including a primary fed by the current flowing in said circuit, a secondary to said first transformer formed by a straight conductor passing through said bushing insulator, and bent round outside said bushing insulator so as to form a closed circuit, said straight conductor including a looped portion forming the secondary of said auxiliary transformer and stepping up the line current to the high value for which said first transformer is designed, and a secondary to said first transformer adapted to step down the current flowing in said straight conductor to a value commensurate with that taken by the electrical measuring apparatus.

HENRI RENÉ LOUBET.