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J. G. WELLINGS ET AL

1,748,857

ELECTRIC TRANSFORMER

Filed Aug. 25, 1928

Fig. 1.

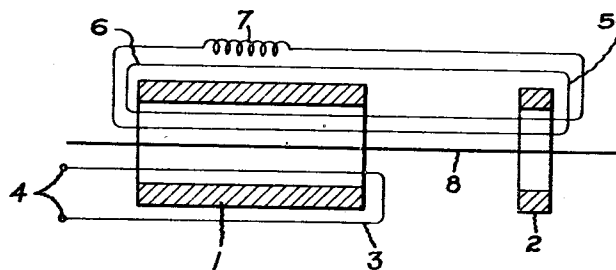
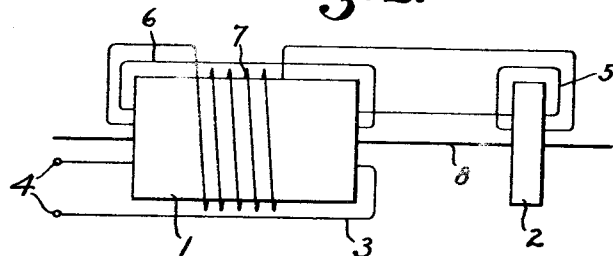


Fig. 2.



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ELECTRIC TRANSFORMER

Application filed August 25, 1928, Serial No. 302,084, and in Great Britain September 6, 1927.

Our invention relates to electric transformers and more particularly to instrument or current transformers. The general object of the invention is to provide an instrument or current transformer so constructed and arranged that its current ratio will diminish substantially with increasing primary current. For example, a transformer constructed in accordance with the invention may have a current ratio of 300:1 with a primary current of 150 amperes and a current ratio of only 60:1 with a primary current of 1500 amperes.

The invention involves providing the transformer with an auxiliary primary winding opposed to the main primary winding, this auxiliary winding being so arranged that its current falls off relatively to the main primary current as the latter current increases. Thus, the input and output of the transformer increases at a greater rate than that at which the main primary current increases.

In one arrangement according to the invention, the object is attained by the use of a main core and an auxiliary core, the main core having main and auxiliary primary windings and a secondary winding and being arranged to operate at low flux densities while the auxiliary core has a primary and a secondary winding. The secondary winding of the auxiliary core supplies current to the auxiliary primary of the main core in opposition to the current in its main primary which is common to both cores. The auxiliary core is arranged to operate at a part of the magnetization curve near the knee, for which purpose an impedance is connected in series with the secondary winding of the auxiliary core. This impedance preferably possesses inductive characteristics. The effect of the auxiliary excitation on the main core is to diminish the ampere turns available for the main core secondary. Owing to saturation of the auxiliary core, however, this effect does not increase in proportion to the increase in primary current and the secondary current, therefore, increases more than in proportion to an increase in the primary current.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which Fig. 1 shows diagrammatically a current transformer constructed in accordance with the invention, the main and auxiliary cores being shown in section, and Fig. 2 shows a slightly different arrangement of parts.

In the particular arrangement shown in the drawing, main and auxiliary ring cores are used, the main core 1 having the same radial dimension but several times the axial length of the auxiliary core 2. A main secondary winding 3 connected to the secondary load 4 is wound on the main core 1. A secondary winding 5 on the auxiliary core 2 and an auxiliary primary winding 6 on the main core 1 are preferably wound together over both cores with the same number of turns in these two windings. However, if the cores 1 and 2 are not very close together, it may be desirable to wind the turns of the windings 5 and 6 separately on their respective cores and connect the two windings in series as shown in Fig. 2. An impedance 7 is connected in series with the windings 5 and 6 and may be conveniently provided by winding an extension of these windings on the main core 1 which thus serves as the core of an open cored reactor as shown in Fig. 2. A main winding 8 on both cores 1 and 2 may consist of a single turn conductor passing through the two cores.

Owing to the relatively large load on the auxiliary core 2, due to the impedance 7, the number of magnetizing ampere turns on this core is a relatively large proportion of the number of primary ampere turns and the electromotive force induced in the winding 5 consequently leads considerably the electromotive force in the reversed primary winding 6. Owing, however, to the inductive nature of the impedance 7, the auxiliary secondary current is nearly in phase with the current in the reversed primary winding 6 and hence subtracts nearly arithmetically from it to give the ampere turns available for the main secondary winding 3 and the load 4. Owing, moreover, to saturation of the auxiliary core 2 which is arranged to operate near the knee

of its magnetization curve, the current in the auxiliary secondary winding 6 does not increase substantially above a predetermined value and the current in the main secondary winding 3, therefore, increases more rapidly than the current in the main primary winding 8.

It has been found that a suitable arrangement of the windings may include 40 turns in the winding 3, 80 turns in each of the windings 5 and 6 and 300 turns in the impedance 7, these latter turns being wound on the main core 1 and having a resistance of four ohms. The invention provides a current transformer which is particularly applicable for use in protective systems and may be used for supplying current to thermal or other types of overload relays.

The invention has been explained by describing and illustrating a preferred embodiment thereof but it will be apparent that changes may be made without departing from the scope of the invention as defined in the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A current transformer including a main magnetic core and an auxiliary magnetic core, a common source of excitation for both of said cores, said main core having a secondary winding and an auxiliary primary winding, said auxiliary core having a secondary winding connected to supply main core exciting current to said auxiliary primary winding and in opposition to said common source, and said auxiliary core being arranged to operate normally near saturation, whereby the opposing flux in said main core increases only slightly with increasing primary current after said auxiliary core is saturated.

2. A current transformer including a main magnetic core and an auxiliary magnetic core, said main core having a main primary winding, a secondary winding and an auxiliary primary winding, said auxiliary core having a primary winding and a secondary winding, said auxiliary secondary winding being connected to supply main core exciting current to said auxiliary primary winding and in opposition to the main primary current, and said auxiliary core being arranged to operate at a point near the knee of its magnetization curve, whereby the effective number of ampere turns available for exciting said main core increases faster than the number of ampere turns in its main primary winding after said auxiliary core is saturated.

3. A current transformer including a main magnetic core and an auxiliary magnetic core, said main core having a main primary winding, a secondary winding and an auxiliary primary winding, said auxiliary core having a primary winding and a secondary winding, said auxiliary secondary winding being connected to supply main core exciting

current to said auxiliary primary winding and in opposition to the main primary current, and said auxiliary core being arranged to operate at a point near the knee of its magnetization curve, and an impedance connected in series with said auxiliary secondary and auxiliary primary windings, whereby the number of ampere turns available for exciting said main core increases faster than the number of ampere turns in its main primary winding after said auxiliary core is saturated.

4. A current transformer including main and auxiliary magnetic ring cores, said main core having a main primary winding, a secondary winding and an auxiliary primary winding, said auxiliary core having a primary winding and a secondary winding, said auxiliary secondary winding being connected to supply main core exciting current to said auxiliary primary winding and in opposition to the main primary current, and said auxiliary core being arranged to operate at a point near the knee of its magnetization curve, and an inductive winding on said main core connected in series with said auxiliary secondary and auxiliary primary windings, whereby the number of ampere turns available for exciting said main core increases faster than the number of ampere turns in its main primary winding after said auxiliary core is saturated.

In witness whereof, we have hereunto set our hands this fourth day of August, 1928.

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