June 3, 1941. G. CAMILLI 2,244,386

TRANSFORMER

Filed May 20, 1939

Fig. 1.

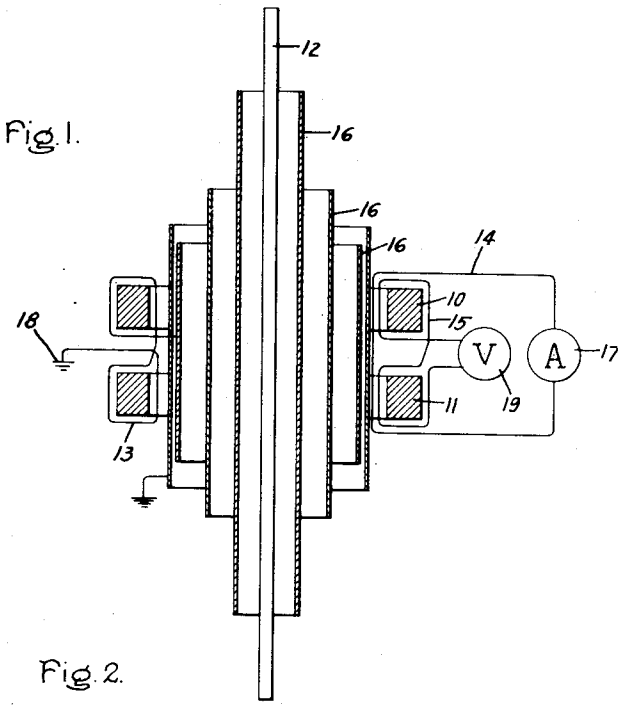
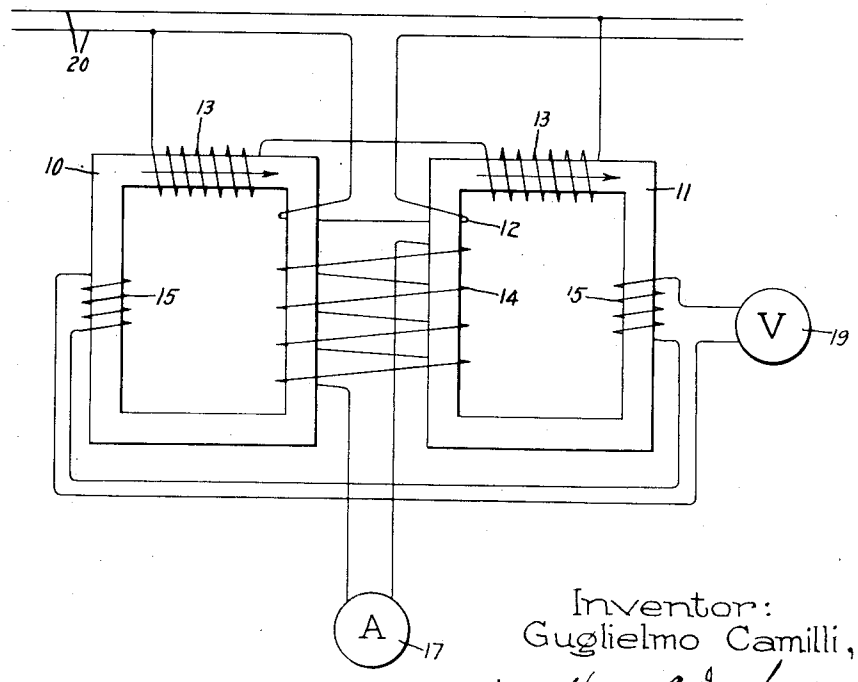


Fig. 2.



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2,244,386

TRANSFORMER

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6 Claims. (Cl. 171—119)

My invention relates to transformers. The general object of the invention is to provide an improved transformer structure which may be used simultaneously both as a potential transformer and a current transformer. One of the advantages of this arrangement is the convenience of using a single transformer for operating both potential and current devices. Another advantage of the arrangement is its compactness and economy in material because the magnetic core requires no more magnetic material than is ordinarily necessary in a single transformer.

In the conventional current transformer the magnetic core is operated at a very low flux density in order that the magnetizing current and the consequent core losses may be small. The permeability of the core, however, should be as high as possible for maximum accuracy. The permeability increases with increasing flux density to some maximum value, depending upon the particular material used in the core, and then decreases if the flux density is further increased. The ordinary silicon steel commonly used in current transformer cores has a maximum permeability when the flux density is something like 16,000 lines per square inch. Another object of the invention is to provide an improved transformer arrangement which may be operated as a current transformer with high core flux density but without corresponding loss in accuracy as a result of high magnetizing current.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which Fig. 1 is a diagrammatic, sectional view of a transformer constructed and arranged in accordance with the invention and applied as a bushing transformer, and Fig. 2 is an explanatory, diagrammatic view of a magnetic core and windings arranged and connected in accordance with the invention.

The transformer shown in Fig. 1 includes a magnetic core formed in two parts 10 and 11 provided with two primary windings 12 and 13 and two secondary windings 14 and 15. The primary winding 12 is shown diagrammatically in Fig. 1 as the conductor of a condenser type bushing provided with cylindrical, conductive layers 16 which form a series of condensers and which assume potentials determined by the capacities between the layers. The secondary winding 14 surrounds the magnetic core 10 and 11 just as in the conventional current transformer and may be connected to an instrument 17 such as an ammeter for indicating the current in the primary conductor or winding 12. The primary winding 13 is connected between one of the conductive layers 16 and a ground connection 18. This primary winding 13 surrounds both parts 10 and 11 of the magnetic core, but it surrounds them differentially with respect to the primary winding 12 so that the voltages induced in the two parts of the winding 13 by the winding 12 are equal and opposed and therefore so that no resultant voltage between the terminals of the winding 13 is induced by the winding 12. The secondary winding 15 also surrounds both parts 10 and 11 of the magnetic core differentially with respect to the primary winding 12 so that no resultant voltage is induced by the primary winding 12 between the terminals of the secondary winding 15. The secondary winding 15, however, will obviously cooperate with the primary winding 13 and these two windings 13 and 15 with the two parts 10 and 11 of the core will operate as a potential transformer so that the secondary winding 15 may be connected to a voltmeter or other voltage device 19. The primary windings 12 and 13 are both connected to the same source of primary current and the winding 13 is preferably proportioned to induce a magnetic flux in both parts 10 and 11 of the core corresponding to the maximum permeability of the particular magnetic material used in the core. This permits the primary winding 12 and the secondary winding 14 to operate as a current transformer with maximum permeability in the core but without any losses due to the magnetizing current. If the magnetic core 10 and 11 is formed with the usual high quality silicon steel commonly used in the cores of current transformers, the core will operate at maximum permeability with the primary winding 13 proportioned to induce a magnetic flux of something like 16,000 lines per square inch, but this flux density may of course be varied with different magnetic materials and any increase of flux density provided by the primary potential winding 13 will of course increase the permeability of the core and the accuracy of the current ratio between the currents in the primary winding 12 and the secondary current winding 14.

The arrangement of the two core parts 10 and 11 and the various windings shown in Fig. 2 are similar to the corresponding arrangements shown in Fig. 1, but the two parts 10 and 11 of the core are spread apart to show the connections more clearly. Greater compactness is of course secured if the two parts 10 and 11 of the core are disposed close together with only sufficient space between them to accommodate the windings 13 and 15 as indicated in Fig. 1. As

shown in Fig. 2 the primary winding 12 is connected in series with one side of an electrical circuit 20 to operate with the secondary winding 14 as a current transformer supplying current to the ammeter or other instrument 17. The primary winding 13 is connected across the two sides of the same circuit 20 to operate with the secondary winding 15 as a potential transformer connected to the voltmeter 19 to indicate the voltage of the circuit 20.

The invention provides a compact and economical transformer which may be used simultaneously as both a potential and a current transformer. It further provides a current transformer of extremely high accuracy.

The invention has been explained by describing and illustrating specific arrangements and applications thereof, but it will be apparent that changes may be made without departing from the spirit of the invention and the scope of the appended claims.

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

1. A transformer including a magnetic core formed in two parallel parts, primary and secondary current windings on said core parts, and primary and secondary potential windings on said core parts and wound differentially with respect to said current windings.

2. A transformer including a magnetic core formed in two parallel parts, primary and secondary current windings on said core parts, and primary and secondary potential windings on said core parts and wound differentially with respect to said current windings, said primary potential winding being proportioned to induce magnetic flux at high density in said core parts.

3. A transformer including a magnetic core formed in two parallel parts, primary and secondary current windings on said core parts, and primary and secondary potential windings on said core parts and wound differentially with respect to said current windings, said primary potential winding being proportioned to induce magnetic flux in said core parts at a density corresponding substantially to maximum permeability of the core material.

4. A transformer including a magnetic core formed in two parallel parts, primary and secondary current windings on said core parts, and a magnetizing winding on said core parts and wound differentially with respect to said current windings, said primary and magnetizing windings being connected to the same source of current.

5. A transformer including a magnetic core formed in two parallel parts, primary and secondary current windings on said core parts, and a magnetizing winding on said core parts and wound differentially with respect to said current windings, said primary and magnetizing windings being connected to the same source of current, and said magnetizing winding being proportioned to induce magnetic flux at high density in said core parts.

6. A transformer including a magnetic core formed in two parallel parts, primary and secondary current windings on said core parts, and a magnetizing winding on said core parts and wound differentially with respect to said current windings, said primary and magnetizing windings being connected to the same source of current, and said magnetizing winding being proportioned to induce magnetic flux in said core parts corresponding substantially to maximum permeability of the core material.

GUGLIELMO CAMILLI.