Nov. 17, 1931. O. SCHMUTZ 1,832,662

TRANSFORMER

Filed Feb. 15, 1930

Fig. 1

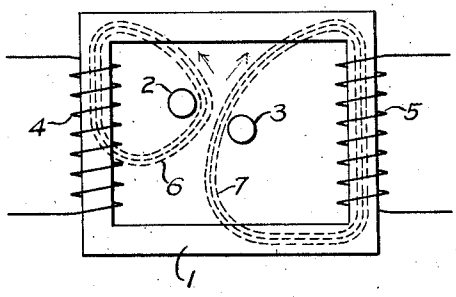
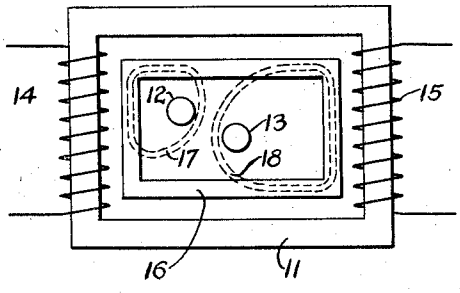



Fig. 2.




INVENTOR
Oskar Schmutz.
BY
ATTORNEY

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# UNITED STATES PATENT OFFICE

OSKAR SCHMUTZ, OF BERLIN-SIEMENSSTADT, GERMANY, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

## TRANSFORMER

Application filed February 15, 1930, Serial No. 428,634, and in Germany March 19, 1929.

My invention relates to current transformers that are intended to supply current to their secondary windings upon unbalanced current conditions between a plurality of primary circuit conductors, and relates particularly to means for shielding the secondary windings of such transformers from the effects of stray fluxes.

The use of current transformers that are effective upon unsymmetrical current values in a plurality of primary circuits for indicating ground faults or short circuits between phases of an alternating-current circuit or in electrical apparatus connected to such circuits are well known. Such transformers are frequently employed to actuate circuit-interrupting means to disconnect the faulty apparatus or portion of the circuit from the remaining portion of the circuit. It is preferable, in such cases, to use a single transformer rather than a plurality of transformers and to so arrange all of the primary circuit conductors that they shall be inductively related to a single-core structure surrounding them. So long as the currents in the primary conductors are balanced, the sum of the instantaneous currents will be zero, and no current will flow in the secondary winding of the transformer.

Unsymmetrical positioning of the primary conductors with respect to the core member, or an unsymmetrical load on the conductors, will create fluxes that are caused to traverse the secondary winding of the current transformer. Current may thus be generated in the secondary winding of the transformer by the stray fluxes, that interlink only one of the primary conductors and, if sufficiently large, will cause operation of the relays for removing a faulty portion of the circuit, even though no fault has occurred.

An object of my invention is to provide means for preventing stray fluxes from one or more of a plurality of primary circuit conductors from energizing the core of a current transfomer.

According to the invention, the creation of stray fluxes in the core member of the transformer by the primary circuit conductors is prevented by providing a shield or closed magnetic path, formed of laminated or other material of high magnetic permeability, and locating it between the conductors constituting the primary-winding circuit and the conductors constituting the secondary-winding circuit. The conductors of these two circuits are, therefore, separated from one another by the shielding action of this magnetic path, so that any stray fluxes created by the primary circuit conductors will flow in the magnetic shield that is provided, and will not reach the core or the secondary winding of the transformer.

My invention will be better understood by reference to the drawings in which:

Figure 1 is a diagrammatic view showing the usual form of current transformer, and

Fig. 2 is a diagrammatic view of a transformer organized in accordance with my invention.

Referring to Fig. 1 of the drawings, the transformer comprises a core member 1 forming a closed magnetic path and having an opening to receive the primary-winding conductors 2 and 3 which represent the two conductors of a single phase circuit. The coils 4 and 5 constitute the secondary winding of the transformer and may be connected to indicating instruments, or to control apparatus for effecting a desired operation upon the occurrence of a fault in the primary circuit of the transformer. The unsymmetrical positioning of the two conductors 2 and 3, with respect to the core member 1, causes unsymmetrical leakage fluxes 6 and 7 which traverse the core member and the secondary winding coil of the transformer, and generate currents therein which may be sufficient to cause the operation of the signal or control devices.

Fig. 2 of the drawings shows a current transformer organized in accordance with my invention, in which a core 11 is energized from the primary-winding conductors 12 and 13, thus energizing the coils 14 and 15 of the secondary-winding circuit. A magnetic shield 16 is provided to form a closed magnetic path of high permeability positioned between the conductors 12 and 13 which constitute the primary winding of the

current transformer, and the windings 14 and 15 which are wound upon the core member 11 to constitute the secondary winding of the transformer. Any stray fluxes which may be caused by the unsymmetrical location of the primary conductors 12 and 13 will pass through the magnetic shield 16, as indicated by the broken lines 17 and 18 and will be thereby prevented from passing through the winding of the secondary circuit of the transformer.

An unbalance in the current carried by the conductors 12 and 13 will cause a flux to travel through the magnetic circuit of the core 11 to produce a current in the secondary winding of the transformer. This current will be of the same magnitude as though the magnetic shield 16 were not present, as long as magnetizing ampere turns of the primary winding are the same. The shield will, therefore, provide protection against the penetration of stray fluxes into the secondary winding but will not prevent proper energization of the secondary winding of the transformer upon the occurrence of a fault in the primary-winding circuit.

Since modifications may be made in the apparatus and circuits described without departing from the spirit of my invention, I do not wish to be limited otherwise than by the scope of the appended claims.

I claim as my invention:

1. In a current transformer, a core constituting a closed magnetic circuit, a plurality of primary-winding conductors extending through said core, a conductor wound about the core to form a secondary winding, and a member constituting a closed magnetic circuit positioned between the primary-winding conductors and the secondary-winding conductors.

2. In a current transformer, a core of magnetic material, a plurality of circuit conductors for magnetizing said core, and a magnetic shield comprising a closed magnetic path about said conductors and positioned between said conductors and said core.

3. In a current transformer, a core constituting a closed magnetic circuit, a plurality of primary-circuit conductors for energizing said core, and means for preventing flux other than the resultant flux from all of said conductors from entering said core.

4. In a current transformer, a core constituting a closed magnetic circuit, a plurality of primary-circuit conductors comprising the several conductors of an alternating-current circuit, a secondary winding inductively related to said core, and means for preventing leakage flux from said primary-circuit conductors from entering said core.

5. In a current transformer, a core constituting a closed magnetic circuit, a plurality of primary-circuit conductors extending through said core and comprising the several conductors of an alternating-current circuit, a secondary winding formed about the core, and a magnetic shield comprising magnetic material constituting a closed magnetic circuit about said primary conductors and positioned between said primary conductors and said core.

In testimony whereof, I have hereunto subscribed my name this 3rd day of January, 1930.

OSKAR SCHMUTZ.