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T. M. DICKINSON

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HIGH FREQUENCY CURRENT TRANSFORMER

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Fig. 2.

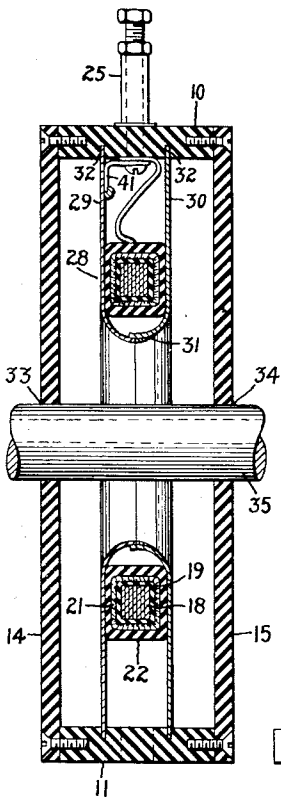
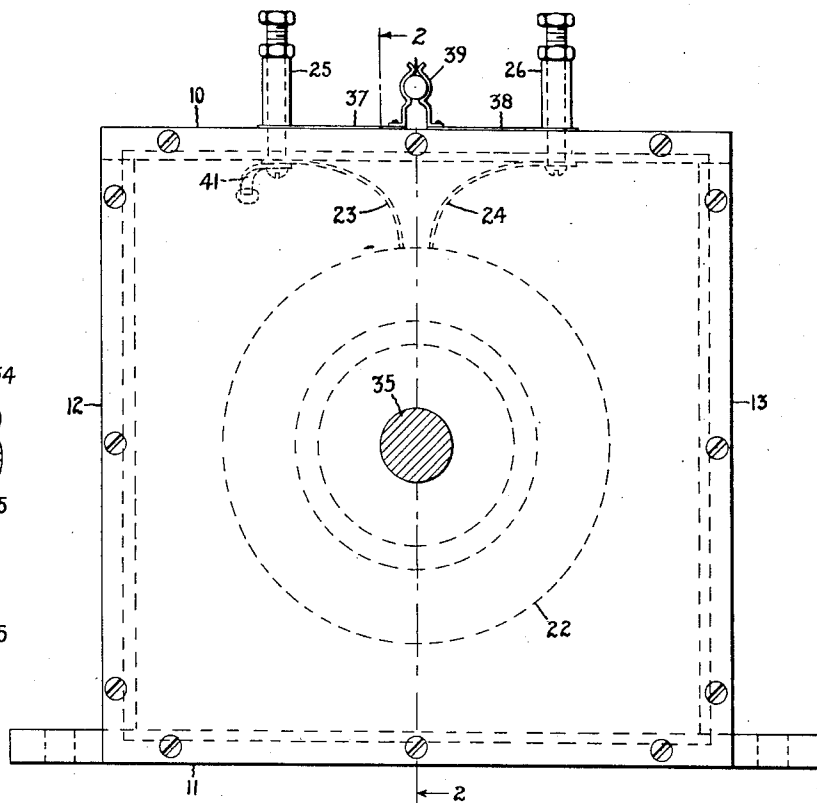


Fig. 1.



Inventor:
Theodore M. Dickinson,
by *Harry E. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

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HIGH FREQUENCY CURRENT TRANS-
FORMERTheodore M. Dickinson, Schenectady, N. Y., as-
signor to General Electric Company, a corpora-
tion of New York

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5 Claims. (Cl. 175—358)

The present invention relates to electrical induction apparatus and more particularly to instrument or current transformers of the high frequency type. It has for a general object the provision of apparatus of this type with a new and improved insulating and shielding structure whereby the dielectric losses are maintained at a minimum and the creepage paths at a maximum.

It is a more specific object of the invention to provide a new and improved high frequency current transformer of a simplified design having relatively few parts which may be easily manufactured and readily assembled to provide an efficient device at low cost.

Further objects and advantages will appear from the following description taken in connection with the accompanying drawing, while the invention will be pointed out with greater particularity in the appended claims.

In the drawing, Fig. 1 is a side elevation of a transformer constructed in accordance with the invention; and Fig. 2 is a cross-sectional view of the structure of Fig. 1 taken along the line 2—2.

The transformer as illustrated comprises a boxlike insulating housing having an upper terminal board 10, a base 11, end walls 12 and 13, and opposite side plates 14 and 15. Arranged within the housing is a secondary unit including an annular magnetic core 18 which may be built up of punched laminations and covered with a spiral wrapping 19 of suitable insulating tape. A secondary winding 21 is provided on the core member having its turns substantially uniformly distributed thereon, the conductor being preferably of a multistrand type, such as Litz wire, each strand being insulated and fully transposed so that the secondary current flow is fully balanced in all strands. The secondary winding is covered with a suitable wrapping of insulation indicated at 22, and the leads 23 and 24 thereof are connected to suitable terminals 25 and 26, respectively, mounted on the insulating terminal board 10.

The secondary unit comprising the core and its surrounding coil is suspended within the housing in a spaced relation with respect to the various walls thereof by means of an electrostatic shield 28 which substantially encloses the unit. The electrostatic shield is formed of two sheets 29 and 30 of a suitable nonmagnetic metal, such as brass, extending substantially parallel adjacent the opposite sides of the secondary unit and which have aligned central openings the edges of

which are belled or curved toward each other and soldered together as indicated at 31, so as to cover the opposite sides and inner surfaces of the secondary unit. The diameter of the opening in the electrostatic shield is just slightly smaller than the diameter of the opening through the secondary unit so that the unit is firmly supported between the two plates by the cooperating belled portions thereof. The belled portions of the two plates defining the opening through the shield are smoothly rounded, the soldered joint being filed smooth so that there will be no sharp projections from the contour of the opening in the shield which might cause a high concentration of voltage stress and possibly formation of corona at such points. The shield may be secured within the housing in any suitable manner as by fitting the edges or outer portions of the shield into parallel cooperating grooves provided in the inner surfaces of the terminal board, base plate and end walls as indicated at 32. As will be seen in Fig. 2, the outer portions of the shield extend beyond the outer annular side of the unit so as to space the unit from the supporting portion of the housing. The shield and secondary unit are furthermore so mounted within the housing that the plane of the secondary unit is substantially parallel with the side plates 14 and 15 and midway therebetween, the housing frame members being of such a width that a considerable space exists between the shield and the adjacent side plates. The side plates 14 and 15 are provided with openings 33 and 34, respectively, in axial alignment with the opening through the shield and secondary unit and through which openings may be extended the primary conductor indicated at 35. The diameter of the openings 33 and 34 is preferably just slightly greater than that of the primary conductor so that the latter conductor will be held substantially axially with respect to the secondary unit. It is preferred that the side plates 14 and 15 be of such a material as will have a relatively low dielectric loss and while various materials having this quality may be used, I prefer to use one such as is described in the reissue Patent No. 15,727 to P. B. Crossley, issued December 4, 1923, because of the fact that it may be machined.

Arranged on the terminal board 10 and connected to the secondary terminals 25 and 26 by conductor strips 37 and 38 is a film cutout device 39 of a well known type which will break down and establish a short circuit across the secondary terminals in the event that the secondary cir-

cuit is unintentionally opened with a primary current flowing to prevent injury to connected apparatus or the transformer itself. The electrostatic shield may also be grounded as by connection 41 to a normally grounded secondary terminal, such as terminal 25.

In the arrangement as described it will be noted that the secondary unit is wholly supported by means of the electrostatic shield around the primary conductor and, accordingly, due to the lack of solid dielectric supporting means therefor, the dielectric losses are accordingly reduced to a minimum. The plates 14 and 15 are the only dielectric extending in close proximity to the primary conductor, and these plates are so thin and of such a material that the dielectric losses therethrough are extremely low. The electrostatic shield effectively short circuits the capacity currents from the primary conductor and precludes the flow of such currents to the secondary winding, it being understood that while such capacity currents may be negligible in a low frequency or 60-cycle system, they are very appreciable in the high or radio frequency ranges and would seriously impair the accuracy of the current measurements unless kept from the instrument circuit. The electrostatic shield furthermore precludes the formation of corona from the relatively sharp corners and edges of the secondary unit.

The diameter of the opening through the secondary unit including the electrostatic shield is such that the air gap between the outer surface of the primary conductor and the shield will be safely greater than the critical breakdown value for the rated voltage difference between the primary conductor and ground. Furthermore, the extent of the electrostatic shield, and hence also the dimensions of the housing including the plates 14 and 15, will be such that the creepage path from the primary conductor to either ground or the secondary terminals will be of such high resistance as to minimize the possibility of a breakdown over the surface thereof.

The secondary circuit is thus effectively protected from high voltages which may be used on the primary conductor 35.

Having described the principle of the invention in what I consider to represent a preferred embodiment, I desire to have it understood that the specific structural arrangement shown is merely illustrative and that the invention may be carried out by other means.

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

1. A current transformer comprising a secondary unit including an annular magnetic core member and a secondary winding having its turns distributed around said core member, an electrostatic shield comprising a pair of non-magnetic metal sheets arranged adjacent the opposite sides of said core member and having aligned central openings, the edges of said openings being belled toward each other and secured together, the opening so formed in said shield being of such a diameter relative to the inner diameter of said unit that the belled portions engage with the inner surface of said unit to firmly support said

unit between said sheets, a support for said shield, and insulating members secured to said support and spaced from the opposite sides of said shield, said insulating members having openings in axial alignment with the opening in said shield for receiving a primary conductor.

2. A high frequency current transformer comprising a secondary unit including an annular magnetic core member, and a secondary winding having turns distributed around said core member, an electrostatic shield having substantially parallel side portions extending outwardly adjacent the opposite sides of said unit and curved portions covering the inner annular side of said unit and defining an opening through said unit, supporting means engaging outer portions of said shield side portions for supporting said unit, said outer portions of said shield portion extending beyond the outer annular side of said unit so as to space said unit from said supporting means, a pair of insulating members secured to said supporting means in a spaced relation from the opposite sides of said unit, said insulating members having openings in axial alignment with the opening through said unit for cooperatively receiving a primary conductor.

3. A high frequency current transformer comprising a secondary unit including an annular magnetic core having a secondary winding with turns distributed therearound, a metal electrostatic shield substantially covering the opposite plane sides and inner annular side of said unit, portions of said shield extending outwardly from the outer edge of said unit, and an enclosing housing for said unit having means engaging with the outer ends of said shield portions for supporting said unit, said housing having insulating means extending on the opposite sides of said unit and spaced therefrom, said insulating means having openings in axial alignment with the opening through said unit for supporting a primary conductor.

4. A high frequency current transformer comprising an insulating housing providing a support portion, a secondary unit including an annular magnetic core having a secondary winding arranged thereon, means including an electrostatic shield extending through said unit and outwardly on the opposite sides thereof for mounting said unit on said support portion, said housing having insulating members secured to said support portion in a spaced relation from the opposite sides of said unit and shield for holding a primary conductor axially with respect to said unit, and terminals for said secondary unit carried on the outer surface of said support portion of said housing.

5. A high frequency current transformer comprising an insulating housing, a secondary unit including an annular magnetic core having a secondary winding arranged thereon, an electrostatic shield extending through said unit and outwardly adjacent the opposite sides thereof, grooves in portions of said housing, and outer portions of said shield extending into said grooves for mounting said unit within said housing.

THEODORE M. DICKINSON.