

June 17, 1941.

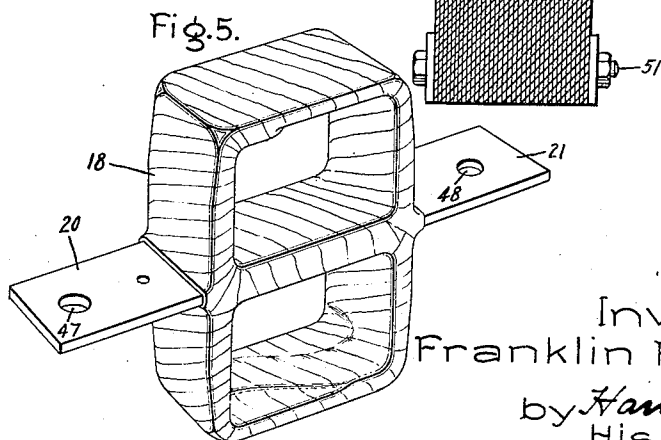
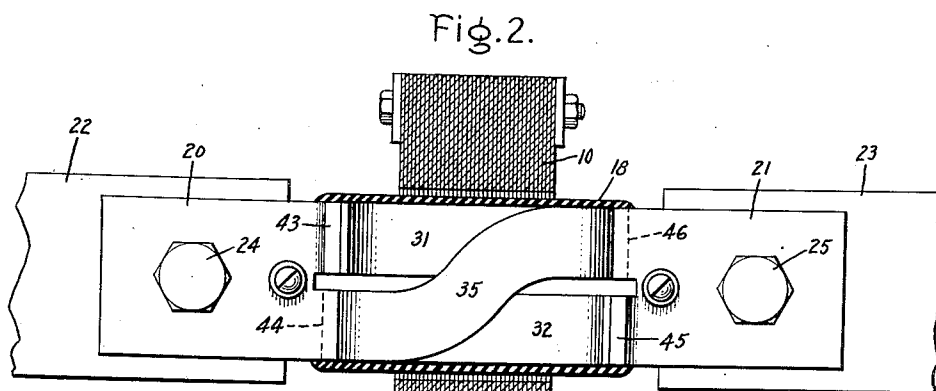
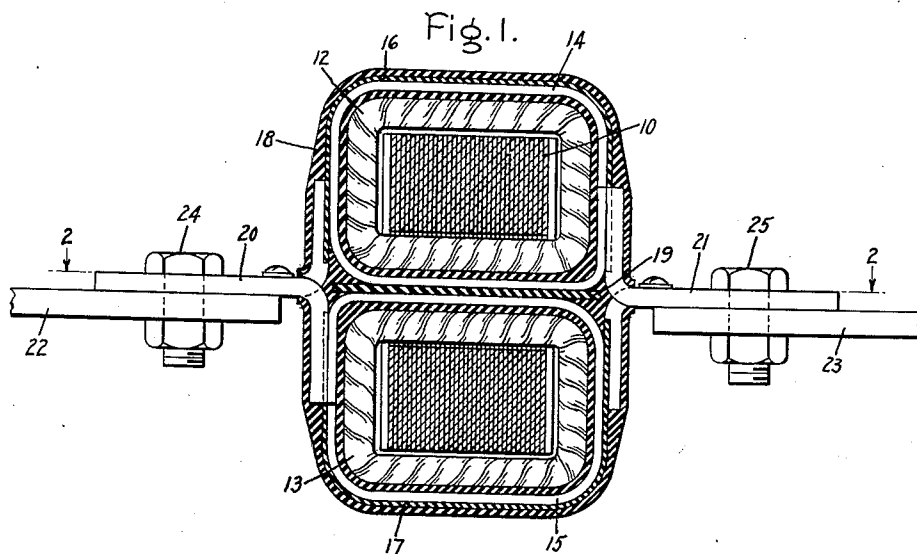
F. R. D'ENTREMONT

2,246,167

TRANSFORMER

Filed March 16, 1940

2 Sheets-Sheet 1



Inventor:
Franklin R. D'Entremont,
by *Harry E. Durham*
His Attorney.

June 17, 1941.

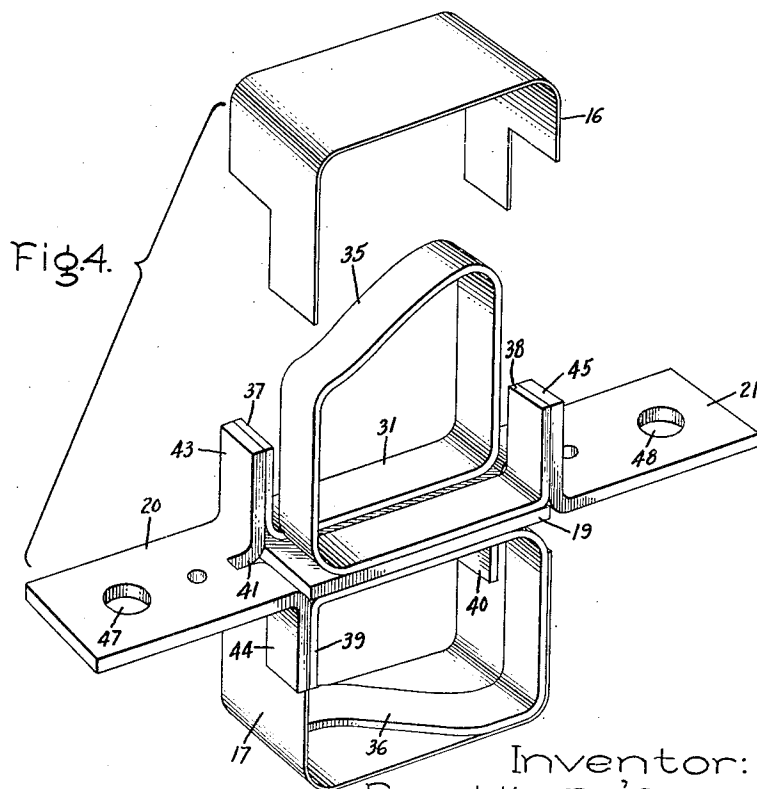
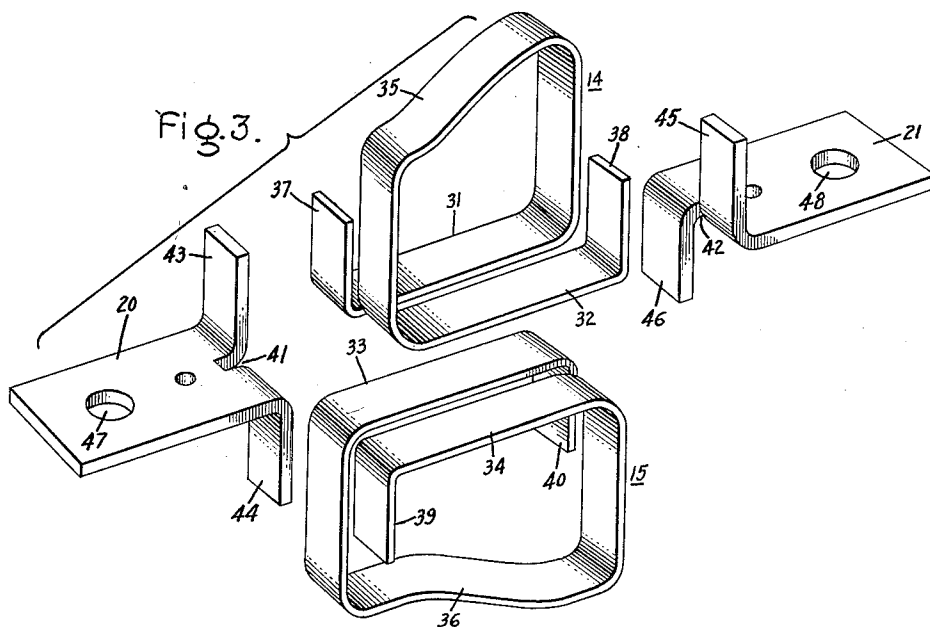
F. R. D'ENTREMONT

2,246,167

TRANSFORMER

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2 Sheets-Sheet 2



Inventor:
Franklin R. D'Entremont,
by *Harry E. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

2,246,167

TRANSFORMER

Franklin R. D'Entremont, Lynn, Mass., assignor
to General Electric Company, a corporation of
New York

Application March 16, 1940, Serial No. 324,396

4 Claims. (CL 175—358)

The present invention relates to transformers and more particularly to current transformers of the wound primary type.

Current transformers are generally connected permanently in series circuit with the power lines and accordingly will be subjected occasionally to heavy overloads, which may cause damage by mechanical stresses or by overheating the winding. Heavy current surges occurring on the power line may give rise to mechanical stresses not only through the bus connections but also within the transformer itself. Sustained heavy overloads may cause severe heating of the transformer windings to the point that the insulation thereof is damaged and with lesser overloads, even though the transformer may not appear to be damaged, its windings may have become short-circuited due to overheating thus producing an incorrect ratio of transformation. Fuse protection cannot be applied practicably to a current transformer because of its series connection in the line and accordingly, it must be designed so that it will carry all currents incident to the line.

It is, therefore, an object of this invention to provide a current transformer of the wound primary type having a new and improved primary and terminal structure whereby the transformer is given great mechanical strength and heavy current carrying capacity.

For a consideration of what I believe to be novel and my invention, attention is directed to the following description and the claims appended thereto taken in connection with the accompanying drawings.

In the drawings Fig. 1 is a side view of a current transformer, partly in section, constructed in accordance with one form of the invention; Fig. 2 is a view, partly in section, taken along the line 2—2 of the transformer shown in Fig. 1 but showing the upper primary coil structure in full; Fig. 3 is a view in perspective of the component parts of the primary winding structure before assembly; Fig. 4 is a view of the completed primary assembly; and Fig. 5 is a view of the primary assembly with insulation wrapping applied.

Referring now to Figs. 1 and 2 of the drawings, the transformer includes a rectangular laminated magnetic core 10. For obtaining greater accuracy in the electrical characteristics of the transformer, the primary and secondary windings are divided into two coils each, which are arranged upon opposite legs of the core structure. The two secondary winding coils 12 and 13

are relatively wide and are suitably wrapped with insulation such as varnished cambric, while the surrounding primary coils 14 and 15, respectively, are covered first with filler pieces 16 and 17 and then with wrapping 18 of suitable insulating material. An insulating spacer 19 is arranged between the adjacent inner turns of the primary coils, having been inserted in position before the wrapping 18 was applied. The two primary coils are connected in parallel between two terminal members 20 and 21 extending outwardly from the opposite sides of the transformer substantially along the axis thereof. The terminal members are preferably relatively wide so that they may be securely fastened to bus bars 22 and 23 in a good heat and current conducting relation by any suitable means such as bolts 24 and 25.

Referring now to Figs. 3 and 4, the structure of the primary winding coils will now be described in greater detail. The coils 14 and 15 are of similar configuration and are preformed of relatively wide copper strap wound flatwise in a single layer as regards the outer surface of the cooperating secondary coils. Each coil in this instance comprises two turns, that is, two portions 31, 32, and 33, 34 adapted to extend through the window of the core structure and which portions are connected together by side and cross over portions 35 and 36, respectively. The coil ends, that is, the ends 37, 38, and 39, 40 are bent at right angles to the portions of each coil extending through the core window and lie parallel with and adjacent to the corresponding coil side portions. The conductor strap is preferably of maximum width, or, of such a width so that the overall width of the coils is substantially equal to the width of the secondary coils. A maximum heat radiating surface for the primary coils is thus provided.

The terminals 20 and 21 are each formed from relatively heavy flat strips of copper having a width substantially equal to the overall width of the coils 14 and 15. One end of the terminals is first slotted as indicated at 41 and 42, respectively, the width of these slots being substantially equal to the spacing between the adjacent turns of the primary coils. The bifurcated end portions of each terminal are bent at right angles with respect to the main terminal portion providing oppositely extending lugs 43, 44, and 45, 46. The lugs 43, 44 are suitably secured, as by brazing, flatwise to the ends 37 and 39 of the coils 14 and 15, while lugs 45, 46 are similarly secured to the other coil ends 38 and 40,

respectively, as shown more clearly in Fig. 4. The ends of the terminals may be provided with holes 47 and 48 for cooperatively receiving the fastening bolts 24 and 25.

After the primary windings have been assembled, the insulating spacer member 19 is inserted into the space between the adjacent turns 31, 32, and 33, 34 of the two primary coils engaging tightly therewith. The filler pieces 16 and 17, of insulating material such as pressed paper, are then fitted over the cores and the assembly is wrapped with a suitable insulation, such as crepe paper, the wrapper assembly being shown in Fig. 5. The secondary coils are then nested concentrically into the primary coils after which the laminations of the core are stacked through coils and fastened together by bolts 51. The transformer may then be thoroughly dried and dipped in an asphaltum insulating compound for filling any spaces which may exist within the assembly.

The primary coils constructed in this manner will possess relatively great rigidity and mechanical strength so as to effectively resist any deformation from their original shape due to any mechanical stresses which may be imposed thereupon through the bus bars or other connections to the terminals. The lugs 43, 44, and 45, 46 extending in opposite directions from the ends of the terminals and being securely fastened to the ends of the winding coils will provide sufficient rigidity for the terminals as regards any laterally imposed stresses. Any force acting longitudinally of the terminals will be transmitted to the portions of the primary windings extending through the core windows, but because of the fact that the primary coils fit tightly around the secondary coils there will be no play which may be taken up by a relative separation of the two terminals.

The thermal limit of transformers having a primary coil construction as described is very high due to various design features. The greatest heating will normally take place within the core window due to the fact that no space exists therein for the circulation of air currents. By the construction shown, the heat will be readily conducted from the core window portions of the primary turns since the terminals are directly connected thereto immediately adjacent the window. The broad flat terminals fastened in a good heat conducting relationship to the bus bars will in turn carry the heat away from the transformer at a high rate. The cross over portions of the primary winding being near the surface of the assembly will dissipate heat by radiation to the ambient atmosphere.

The symmetrical arrangement of the coils on the core and the primary coils closely surrounding the secondary coils reduces the leakage reactance of the transformer to a minimum and tends to improve materially the accuracy of the device.

Having described the invention in what I now consider to represent the best embodiment thereof, I desire to have it understood 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. In a transformer having a rectangular magnetic core structure, two secondary winding coils one being arranged around each of a pair of opposite core legs, two primary winding coils one surrounding each of said secondary coils, said primary coils each comprising a strap conductor wound flatwise around the corresponding secondary coil in a single layer, the ends of said conductor extending through the core window and short distances along opposite sides of said core, a pair of terminals each having at one end lugs substantially the width of said conductor extending at right angles on opposite sides thereof, said lugs being secured to said ends of said primary coil and an insulating member arranged in the window of said core and separating said two primary coils.

2. A transformer comprising a magnetic core structure, two secondary winding coils one surrounding each of a pair of opposite legs of said core, two primary winding coils one surrounding each of said secondary coils, said primary coils each comprising a relatively wide strap conductor extending flatwise around the corresponding secondary coil in a single layer to a width substantially equal to the width of said secondary coils, the ends of said conductor extending through the core window and terminating along the opposite sides of said core, and a pair of terminals each having at one end a pair of lugs extending at right angles on opposite sides of said terminals, said lugs being rigidly secured flatwise to corresponding ends of each of said primary coils.

3. In a transformer having a magnetic core structure and a secondary winding having portions arranged around opposite portions of said core structure, a primary winding comprising a strap conductor wound flatwise in a single layer around said secondary winding providing a plurality of turns through the window of said core structure, the ends of said turns extending along opposite sides of said core, and a pair of terminals having portions extending across the window of said core on opposite sides thereof, said portions being secured with respect to spaced portions of said primary winding, said ends of said turns being connected to corresponding terminal portions.

4. In a current transformer having a rectangular magnetic core and a pair of secondary windings arranged around opposite legs of said core, a pair of symmetrical and parallel connected primary windings arranged around said secondary windings, said primary windings each comprising a plurality of turns of a relatively wide conductor wound flatwise in a single layer, the corresponding ends of the two windings extending in opposite directions on opposite sides of the window of said core, relatively wide terminal members having a pair of lugs at one end extending substantially across the core window, the lugs of each terminal member being rigidly connected to corresponding winding ends.

FRANKLIN R. D'ENTREMONT.