May 4, 1943. H. V. PUTMAN 2,318,095

CORE STRUCTURE

Filed Aug. 17, 1940

Fig. 1.

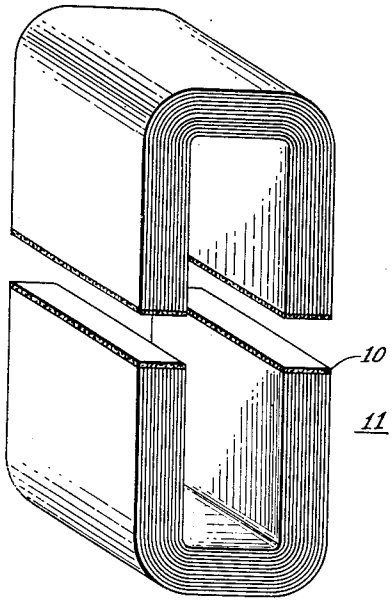
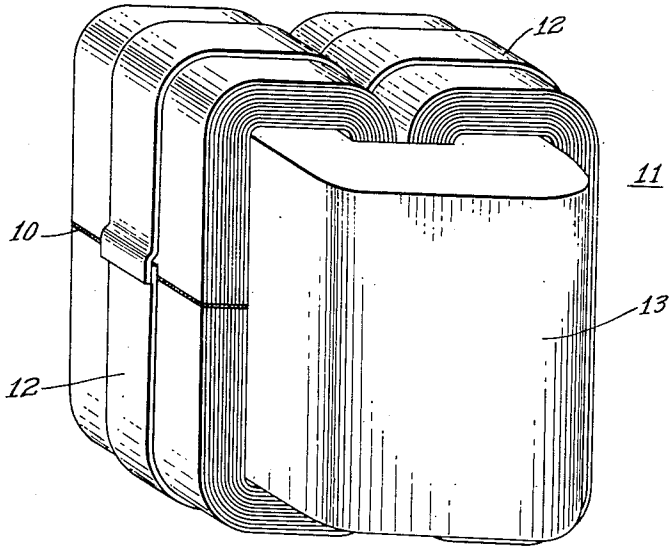


Fig. 2.



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Patented May 4, 1943

2,318,095

UNITED STATES PATENT OFFICE

2,318,095

CORE STRUCTURE

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Application August 17, 1940, Serial No. 353,024

7 Claims. (Cl. 175—356)

The invention relates, generally, to core structures and, more particularly, to core structures having butt joints suitable for use in dielectrics.

In the operation of transformers and other inductive apparatus utilizing magnetic cores immersed in dielectrics, considerable difficulty has been experienced with joints having worked faces. This results from the oil or other dielectric becoming acid in the course of time with the result that the acid dielectric attacks the iron.

The object of the invention is to provide in cores to be used in dielectrics a butt joint having a worked face which is protected from the dielectric and acids that may be developed.

It is also an object of the invention to provide a core structure in which the eddy current losses are small.

Other objects of the invention will, in part, be obvious and, in part, appear hereinafter.

The invention, accordingly, is disclosed in the accompanying drawing and comprises the features of construction, combination of elements, and arrangement of parts which will be exemplified in the structure hereinafter set forth and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference may be had to the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 is a view in perspective of a plurality of bonded core sections having worked faces assembled in accordance with the present invention; and

Fig. 2 is a view in perspective showing how the worked faces may be drawn together to give a predetermined thickness of the oil and acid resisting material.

A butt joint in a magnetic core may cause such high eddy current losses that the application of the core is limited and it has no place in electrical apparatus which is required to be efficient. The eddy currents which result from contacts in the butt joint can be reduced to the point where the eddy current losses are small and the core may be utilized without noticeably lowering the efficiency of the electrical apparatus.

In the making of butt joints it has been found to be desirable to work the meeting faces of the core sections in order to get a smooth surface. In working the faces the usual practice is to grind the surfaces to the desired contour. In the grinding operation burrs are produced which in some instances may extend between the laminations of the core sections. These burrs are objectionable since they establish electrical connection between adjacent laminations.

The burrs may be removed by etching or any method known to the art. In order to etch the burrs away it may be necessary to impregnate the laminations constituting a core with some acid-resisting material to prevent the acid from penetrating between the laminations. An etching method set forth in the copending application Serial No. 295,750 filed September 20, 1939, now Patent No. 2,293,951, August 25, 1942, in the name of Seastone et al. and assigned to the Westinghouse Electric & Manufacturing Company may be employed.

When the core section has been prepared in this manner, the surface oxide or silicate films which ordinarily protect the laminated magnetic material from acids and the like are completely removed from the core faces. Therefore, when such material is immersed in a dielectric which upon continued use may become acid, there is a possibility that the acid dielectric will attack the worked faces.

In the present invention, an acid and oil-resisting thermoplastic resin 10 is applied to the worked faces of the core shown generally at 11. Many different oil and acid-resisting thermoplastic resins are available. Good results have been obtained by using certain resins sold to the trade as Bakelite. Experience indicates that the worked faces may be properly protected by the use of one or more of phenol aldehyde, alkyd, vinyl, or other suitable resins of this type.

It is found to be good practice to paint the worked faces with the thermoplastic resin selected. In the preparation of the thermoplastic resin, it will be prepared of the proper consistency to facilitate painting and of a softness which will permit the reducing of it to a predetermined thickness.

Any suitable method may be employed to bring the core faces together to reduce the thermoplastic material to the predetermined thickness suitable for the structure being built. In the perspective showing of Fig. 2 a signode strap or band 12 is provided for drawing the worked faces toward one another to reduce the thickness of the thermoplastic material 10.

Signode straps 12 may be applied to the assembled sections of the core structure 11 to take the place of clamping members. The pressure between the faces of the butt joint resulting from the use of the signode strap increases when the transformer is placed in an oven for the purpose

of drying it. Stresses of the order of 25,000 pounds per square inch are developed in the signode straps 12. It has been found that when stresses of this order are developed that the resin in the butt joint is reduced to a satisfactory thickness to give a satisfactory insulating film and to protect the worked and etched faces from the acid in the dielectric and provide the required gap. Films of the order of .00025 inch have been found to be satisfactory.

Good results have been obtained by applying a thermoplastic resin of a proper consistency to the worked faces and allowing it to air-dry. The core sections may then be assembled on the coil 13, subjecting them to pressure by means of signode straps. After the assembling operation, the transformer is heat-treated to effect the well known drying operation. The heating will result in the thermoplastic material bonding the core sections together giving a core which is not subject to attack from an acid dielectric.

The worked faces of the core sections may be brought together to reduce the thickness of the applied varnish to the predetermined amount suitable for the particular apparatus by energizing the coil 13 on the core with direct current. This latter method lends itself to shop practice wherever direct current is available and gives excellent results. Other methods of appyling pressure to the core sections which are known in the art may be employed.

A core having a butt joint prepared in accordance with the teachings of this invention is completely protected from acid dielectrics. Therefore, the efficiency of the transformer will not be impaired by corrosion. The cost of the making of a butt joint in this manner is very small and does not require expenditures in machinery and equipment which seriously add to the manufacturing costs.

Tests of transformer cores built according to the following specification have shown satisfactory losses. The following is an example.

General specifications:

Core made and baked at 200° C.
Core weight—69.5 lb.
Coil—32 turns
Voltage—98.5 (for normal induction)
Acid resistant material—
42½% vinyl acetal
42½% vinyl acetate
15% of a phenolic type resin
Thinned to viscosity of 17.2 sec. at 220 C., measured by Demler cup method. Allowed to dry before assembly.
Signode bands—Applied to iron circuits separately.

	Apparent watts loss	True watts loss	Approximate temperature
			° C.
Acid resistant material on cores	264	68.8	20
Acid resistant material applied	290		20
Bands on—			
Oven	282	67.2	20
Cycle	251	64.6	20

It will be noted in the foregoing report on performance that applying the acid resistant material to the worked faces of the core resulted in an increased air gap which caused the apparent watts loss to increase from 264 to 290. Applying the bands under tension brought apparent watts loss down to 282, and after the heating in the oven which permits the tension in the bands to bring the faces still closer together there was a further reduction in the apparent watts loss to 251. The reduction in the eddy currents in the faces due to the insulating effect of the acid resistant material is shown in the reduction of the true watts loss from 68.8 to 64.6.

In conclusion, it is pointed out that while the illustrated example constitutes a practical embodiment of my invention, I do not limit myself to the exact details described since the materials may be considerably varied without departing from the spirit of the invention as defined in the appended claims.

I claim as my invention:

1. In a transformer, in combination, a plurality of core sections, worked and etched faces for making a butt joint on the core sections, and an acid-resistant material applied to the faces, the faces being brought together in the making of a butt joint to reduce the acid-resistant material to a predetermined thickness.

2. In a transformer, in combination, a plurality of core sections built up from laminations of magnetic material, bending material for bending the laminations to one another in the making of the core sections, faces worked on the core sections for the making of a butt joint and an acid and oil-resisting theremoplastic resin applied to the worked faces, the thermoplastic resin being soft enough to permit the reducing of it to a predetermined thickness by the bringing of the worked faces toward one another and responsive to temperature to effect the bonding of the core sections to one another during the drying of the transformer by subjecting it to a heat-treatment.

3. In a transformer, in combination, a plurality of core sections comprising a plurality of laminations of magnetic material bonded to one another, faces on the core sections worked and etched for the purpose of making a butt joint and a resin selected from the group consisting of a phenol aldehyde, alkyd, or vinyl type of resin applied to the worked faces of the core sections, the resin being of such character that it may be reduced to a predetermined thickness under pressure applied to the core sections and dried, bonding the core sections to one another by the subjecting of the transformer to a heat-treatment to dry it.

4. A butt joint for electrical apparatus comprising a plurality of core sections built up of laminations of magnetic material bonded together, faces provided on the core sections, the faces being worked and etched to give the proper contour and remove burrs, and an acid and oil-resisting resin applied to the worked and etched faces, the resin being of a character to lend itself to the bonding of the worked faces when subjected to heat.

5. In a transformer core structure, in combination, a plurality of core sections built up from laminations of magnetic material, acid resistant bonding material for bonding the laminations to one another in the making of the core sections, faces worked on the core sections for the making of a butt joint, and an acid resistant thermoplastic material disposed between the worked faces, and means applied to the core sections for drawing the worked faces toward one another to compress the thermoplastic material to give an insulating film, the thermoplastic material being responsive to temperature to ef-

fect the bonding of the worked faces of the core sections to one another.

6. In a transformer core structure, in combination, a plurality of core sections comprising groups of laminations of magnetic material, resinous material for bonding the laminations to one another in the making of the core sections, faces worked on the core sections for the making of a butt joint, an acid resistant thermoplastic material disposed between the worked faces of the core sections and a binding member applied to the core sections for drawing the worked faces toward one another to compress the thermoplastic material to provide a film, the thermoplastic material being responsive to temperature and capable of bonding the worked faces of the core sections to one another.

7. In a transformer core structure, in combination, a plurality of core sections comprising groups of laminations of magnetic material, a resinous material for bonding the laminations to one another in the making of the core sections, faces worked on the core sections for the making of a butt joint, an acid resistant thermoplastic material disposed between the worked faces and a binding member applied to the core sections for drawing the worked faces toward one another to compress the thermoplastic material to provide a film between the worked faces of the order of .00025 inch in thickness, the thermoplastic material being responsive to temperature and capable of bonding the worked faces of the core sections to one another.

HENRY V. PUTMAN.