

Oct. 16, 1962

W. A. MOCKER ET AL
METHODS FOR MAKING PREFORMED INSULATION FOR
STATIONARY INDUCTION APPARATUS

3,058,160

Filed Nov. 8, 1957

2 Sheets-Sheet 1

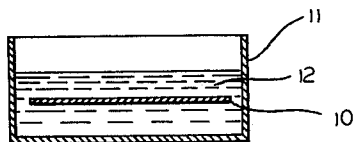


Fig. 1

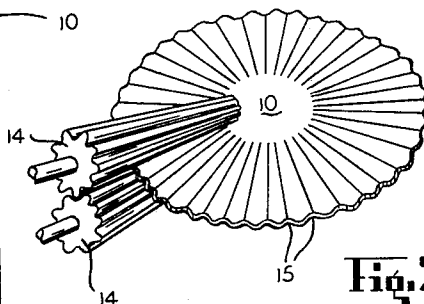


Fig. 2

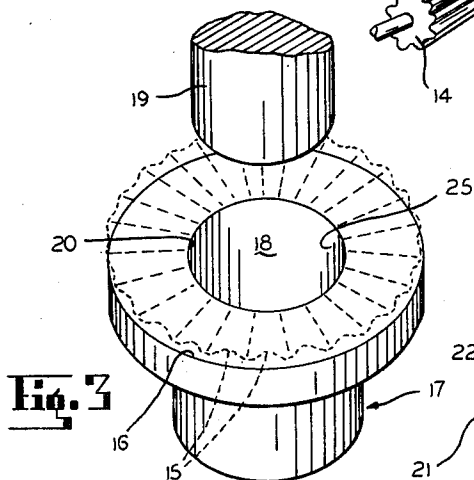


Fig. 3

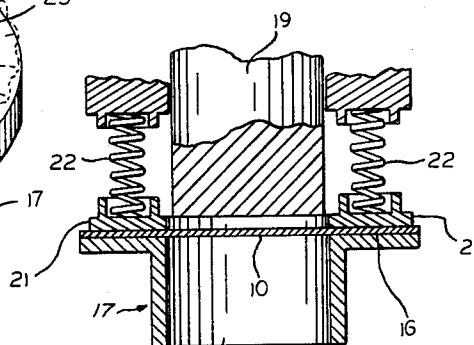


Fig. 4

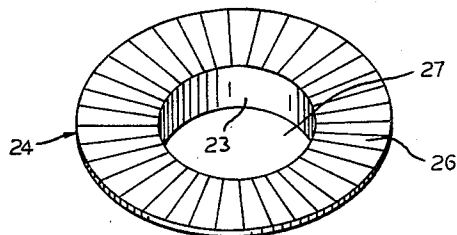


Fig. 5

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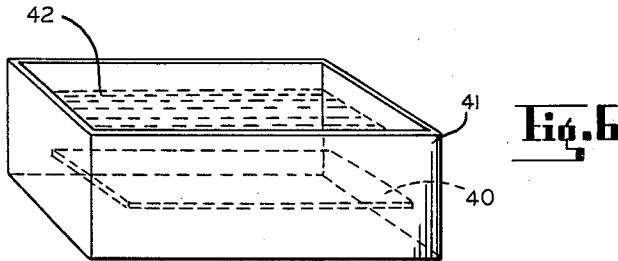


Fig. 6

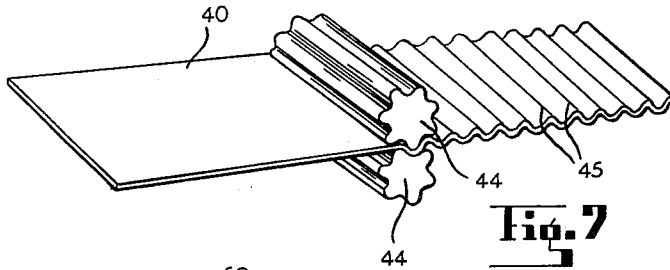


Fig. 7

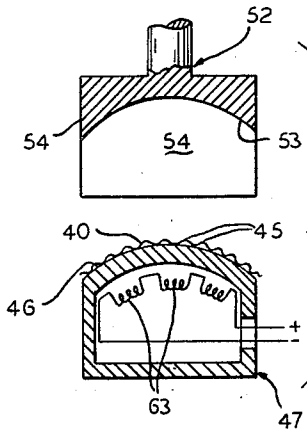


Fig. 8

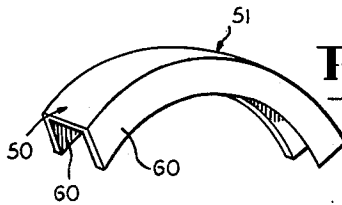


Fig. 10

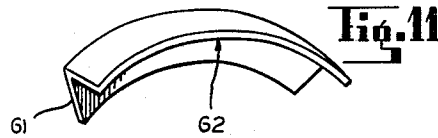


Fig. 11

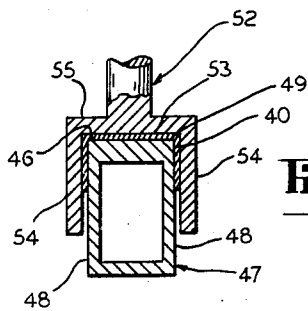
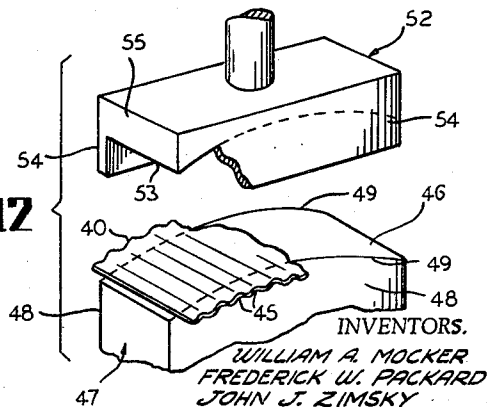


Fig. 9

Fig. 12



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Filed Nov. 8, 1957, Ser. No. 695,347

15 Claims. (Cl. 18—47.5)

This invention relates to methods of construction of preformed insulating members for stationary induction apparatus.

It is well known to use preformed insulating washers and collars of channel and angle cross section in the construction of insulating barriers for electrical transformers. In multiple coil core type transformers, circular, helical or stacked pancake type low voltage windings are usually surrounded by annular high voltage windings with a tubular insulating barrier therebetween, and preformed, full 360 degree pressboard or fullerboard collars having turned-over edges to provide an angle cross section may be interfitted with the cylindrical insulating barrier to increase the dielectric strength between the high voltage and low voltage columns. In multiple coil, shell type transformers having obround coils with low and high voltage windings interleaved, a plurality of preformed fullerboard or pressboard washers having turned-over edges to provide a channel or angle cross section may be disposed against the inner and outer peripheries of each approximately semiannular end of the obround coils to build up an insulating barrier simulating the contour of the coil and provide the required coil-to-coil and coil-to-ground insulation. The construction of such preformed insulation members has not been completely effective from the standpoint of insulation strength and mechanical rigidity and has been unduly expensive because of the excessive amount of time and labor required to construct the preformed arcuate angle or channel washers and collars. Insulating collars have heretofore been constructed by overlapping a plurality of layers of paperboard material to build up a laminated member of desired thickness, and such laminated member requires a considerably greater wall thickness to provide a given dielectric strength than an insulating member constructed from a single piece of paperboard material. For example, one conventional method of constructing preformed, closed, annular insulating collars involves wrapping a plurality of layers of adhesive-coated insulating tape at each circumferential point around the rectangular cross section of a closed, annular, form of desired diameter, wrapping sufficient layers about the rectangular cross section at each point around the ring-shaped form to build up the desired thickness, heating the adhesive-coated insulation to bond the layers of insulating tape together, and slitting the resulting ring-shaped, insulating member of hollow rectangular cross section circumferentially at two opposed sides of the rectangular-in-cross-section annular member to provide two insulating collars.

It has not heretofore been possible to form a full 360 degree collar having an angle cross section from a single sheet of paperboard due to the buckling and the extreme change of contour during the turning over of the edges of the collar. Further, it has not heretofore been possible to form arcuate fullerboard or pressboard insulating members of channel or angle cross section for use adjacent the curved ends of coils for shell type transformers with a radius of less than six inches or extending over an arc greater than approximately 55 degrees. In preformed, curved, "outside" insulating pieces of angle cross section for use adjacent the arcuate outer periphery of a coil for a shell type transformer, the paperboard

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material turned radially inward during the forming operation in accordance with one conventional method of construction buckles and builds up unevenly when the pieces extend over an arc greater than 55 degrees and the resulting insulating washers do not have the required mechanical and dielectric strength. Similarly, when attempting to form angle cross section "inside" washers of greater than 55 degrees for use adjacent the inner periphery of the approximately semiannular ends of coils for shell type windings, the material turned radially outward during conventional methods of construction stretches and is displaced unevenly so that the resulting washer does not have the required mechanical rigidity and insulation breakdown strength.

In order to avoid tearing the insulating material during the operation of turning over the insulating material, it has heretofore been necessary in accordance with one prior art method to cut away a portion of the material at the inside radius before the forming operation and to subsequently bond a separate piece of insulating material to the washer after it has been formed. The requirement of at least six inch radius on the insulating washers does not permit the electrical coil to conform to the contour of the magnetic core in many transformers, and consequently it has often been necessary heretofore to use a greater amount of core steel and copper wire than would be required if the insulating washers could be made with smaller radii.

It is a further object of the invention to provide a method of constructing preformed curvilinear insulating members of angle and channel cross section for electrical transformers which greatly reduces the amount of labor and time required to construct the insulating members in comparison to prior art methods.

It is a still further object of the invention to provide an improved method of constructing preformed insulating pieces for electrical transformers which permits forming insulating members of angle and channel cross section to smaller radii and through greater arcs than heretofore possible.

Still another object of the invention is to provide a method of constructing preformed insulation for electrical transformers which permits forming full 360 degree insulating collars of angle cross section from a single flat piece of paperboard insulation and which collars have high mechanical and breakdown strength.

Another object of the invention is to provide a method of constructing preformed paperboard insulating washers for shell-type electrical transformers which allows the coil to conform more closely to the core than in prior art transformers and consequently permits reduction in the amount of core steel and copper wire.

These and other objects and advantages of the invention will be apparent from the following description when taken in conjunction with the accompanying drawing wherein:

FIG. 1 illustrates a step of moistening a flat disc of paperboard insulation to aid forming a full 360 degree collar therefrom in accordance with a preferred manner of practicing the method of the invention illustrated in FIGS. 1-4;

FIG. 2 illustrates the method step of providing radial corrugations in the disc of insulation wetted as shown in FIG. 1;

FIG. 3 illustrates a drawing die for forming the insulation processed as shown in FIGS. 1 and 2 into an angle collar;

FIG. 4 illustrates the step of holding the outer marginal edge of the corrugated, wet insulation disc as it is formed in the die of FIG. 3 into an annular insulating member of angle cross section, i.e. into an angle collar;

FIG. 5 shows a preformed insulating collar of angle

cross section formed in accordance with the method of practicing the invention illustrated in FIGS. 1-4;

FIG. 6 illustrates the step of wetting an elongated sheet of insulation to aid forming thereof into an arcuate member of angle or channel cross section, i.e. an angle or channel washer, in accordance with an alternative method of practicing the invention illustrated in FIGS. 6-12;

FIG. 7 illustrates the step of providing corrugations in the insulation sheet wetted as shown in FIG. 6;

FIG. 8 is a vertical cross sectional view through a die for forming the insulation sheet, processed as shown in FIGS. 6 and 7, into an arcuate washer of channel cross section, the male and female members of the die being shown in open position;

FIG. 9 is a vertical cross sectional view taken at right angles to FIG. 8 with the male and female die members in closed position;

FIGS. 10 and 11 show curvilinear insulating washers of channel and angle cross section, respectively, formed in accordance with the method of practicing the invention illustrated in FIGS. 6-12; and,

FIG. 12 is a perspective view of the die illustrated in FIGS. 8 and 9 showing the moistened corrugated insulating sheet positioned between male and female members of the die.

The preferred insulation may be in the form of paperboard angle collars placed at the ends of the stack of pancake coils in a core type transformer and interfitted with the tubular insulating barrier between high voltage and low voltage coils to increase the dielectric strength between the high-voltage and low-voltage columns, for example, of the type illustrated in U.S. Patent 2,654,142 in the name of Samuel Horelick having the same assignee as the present invention. In shell type transformers the improved insulation may comprise preformed, curvilinear fullerboard or pressboard washers of angle or channel cross section positioned at the inside and outside edges of the obround, or oval, pancake coils to provide coil-to-coil insulation and insulation to ground.

Heretofore the preformed insulating collars at the ends of a stack of pancake coils for a core type transformer and the preformed curvilinear washers of angle and channel cross section for insulating the edges of pancake coils of shell type transformers were unduly expensive because of the excessive amount of labor and time required to construct such members. Insulating collars have heretofore been constructed by overlapping a plurality of layers of paperboard material to provide a laminated member, and such laminated member requires a considerably greater wall thickness to provide a predetermined dielectric strength than a similar insulating member constructed from a single piece of paperboard material. It has not been possible heretofore to form full, closed collars for use at the ends of a stack of pancake coils for a core type transformer from a single sheet of paperboard insulation. Further, it has not been possible to form angle or channel washers of greater than 55 degree arc or of less than six inch radius from a flat sheet of pressboard or fullerboard due to the buckling and extreme change in contour which occurs at the inside corner of the washer during the shaping operation. In fact, it was necessary in one prior art method to cut away a portion of the horizontal inside edge of the insulating material to permit forming thereof through the desired angle and to later bond a suitable piece of insulating material to the formed washer.

FIGS. 1-4 illustrate a preferred method in accordance with the invention for constructing full 360 degree insulating collars of angle cross section of the type illustrated in FIG. 5 from a single paperboard sheet. In a stack of core type transformer pancake coils, circular low voltage windings are usually surrounded by an annular stack of high voltage pancake coils and insulated therefrom by a tubular insulating barrier, and collars of the type illustrated in FIG. 5 may be used at the ends of the

stack of pancake coils, in order to increase the dielectric strength between the high voltage and low voltage columns. Paperboard insulating material, commonly referred to as fullerboard or pressboard, is made from suitable wood or rag pulp, or an admixture of rag and wood pulp, which is subjected to heat and pressure to dry the pulp into insulating sheet having considerable mechanical rigidity. Paperboard, when moistened, loses its mechanical rigidity and becomes somewhat plastic, thereby permitting the physical shape of the moistened portions to be changed, and as shown in FIG. 1 a circular disc, or blank, 10 of suitable sheet insulating material, preferably fullerboard or pressboard, cut to the desired outline is immersed in a tank 11 filled with water 12. Lengthy soaking of the paperboard material is not required in order to accomplish the method of the invention. Paperboard which has been dried and calendered will not return to a pulpy state. However, a long soaking period will cause the paperboard to become soft, pliable, and weak, and if the paperboard is soaked until this condition is reached, the insulating members formed in accordance with the invention will not have the desired mechanical and dielectric strength. In practicing the invention comparatively short soaking times, for example 10 minutes for 1/8 inch thick paperboard containing rag pulp, are utilized. The wet circular paperboard blank 10 is then placed between a pair of meshing, tapered, corrugating rollers 14, as illustrated in FIG. 2, and one, or both, of the tapered corrugating rollers 14 is rotated by suitable drive means (not shown) to form corrugations 15 extending radially of the circular disc 10. Although in preferred form the blank 10 is circular, it will be apparent that the insulating material sheet can be of any desired contour and that if the sheet material is corrugated along lines extending radially outward from a central point in the sheet, any excess material can subsequently be cut away, either before or after the shaping step.

The moistened paperboard disc 10 having radial corrugations 15 therein is then placed on the flat, annular surface 16 of the female member 17 of a suitable drawing die having a central cylindrical recess 18, and the blank 10 is so positioned that the central point from which the radial corrugations 15 emanate is in register with recess 18. The recess 18 is adapted to receive a cylindrical punch 19 corresponding to the recess 18 and having an outer diameter equal to the desired internal diameter of the preformed angle collar to be constructed. It will be noted that the flat surface 16 is planar and is perpendicular to the "cylindroidal" surface 25 defining recess 18, and it is intended in the description and appended claims to connote by the word "cylindroidal" a warped surface whose right sections are curvilinear but not necessarily arcuate or elliptic. It will further be noted that these planar and cylindroidal surfaces 16 and 25 intersect along a curvilinear edge 20 and that the radial corrugations 15 are substantially perpendicular to the edge 20. The outer circumferential margin of the moistened paperboard disc 10 is then clamped by a flat, annular, pressure plate 21 urged by suitable spring means 22 against the flat annular portion 16 of female die member 17. The punch 19 and female die member 17 are reciprocable relative to each other to move the punch 19 into the cylindrical recess 18 in female die member 17 and thus urge the central portion of the flat moistened fullerboard disc 10 into conformity with the wall 25 defining the cylindrical compartment 18. The corrugations 15 appear to greatly facilitate the turning-over of the insulating material at a right angle to form the tubular vertical wall 23 of the angle insulating collar 24 without wrinkling, buckling, tearing, or uneven buildup of the material, and the insulating material is apparently urged downwardly under radial tensile stress in a manner somewhat similar to a metal drawing operation. The insulating material is not torn during the shaping operation, and

the flat, horizontal, circular section contiguous the bottom of punch 19 is mechanically strong and must be cut out to provide the central opening 27 in the angle collar 24. If desired, heat from suitable electrical coils or a high frequency heating source (not shown) may be applied to the insulating material of angle collar 24 compressed between female mold member 17 and punch 19 to effect drying thereof and to restore the insulating material to its original mechanical rigidity. Although preferably heat is applied to effect drying of the insulating material while collar 24 is still in the drawing die, the invention is not so limited and drying can be effected without heating to restore mechanical rigidity to the paperboard while the insulating material is still in the drawing die. Although the embodiment of FIGS. 1-5 has been illustrated and described with reference to angle collars of circular configuration, the invention is not so limited and also includes square, rectangular, triangular and other shape collars having straight sections between curved corner portions.

Although radial lines are visible on the top surface of the annular rim 26 of the preformed collar 24 formed in accordance with the invention, the rim 26 of the dried paperboard angle collar 24 is uniformly flat and mechanically strong, and similarly the surface of the turned-over tubular portion 23 is smooth and has high mechanical strength. Tests prove that angle insulating collars made from a single flat sheet in accordance with the method of the invention illustrated in FIGS. 1-4 have high mechanical strength and dielectric breakdown strength surpassing that of angle insulating collars of equal wall thickness formed by the more expensive and time consuming prior art methods of construction. The paperboard material is substantially homogeneous, i.e. non-laminar, throughout the angle collar 24 and of approximately uniform thickness in the tubular wall 23 and the rim 26.

FIGS. 6-12 illustrate an alternative method of practicing the invention in the construction of angle or channel insulating washers of the type having turned-over edges illustrated in FIGS. 10 and 11 of the drawing. As shown in FIG. 6 an elongated flat sheet 40 of suitable insulating material, preferably paperboard, is immersed for a short interval in a tank 41 filled with water 40 in a manner similar to that described for the method of FIGS. 1-4, and the moistened insulating sheet 40 is passed between a pair of meshing, generally cylindrical corrugating rollers 44 (see FIG. 7) driven by suitable drive means (not shown) to form parallel corrugations 45. The moistened and corrugated sheet 40 is then placed on the cylindroidal surface 46 (i.e. a warped surface whose right sections may be arcuate, elliptic, or of any curve) of a die member 47. Surface 46 is perpendicular to and intersects two spaced apart, parallel, planar surfaces 58 along curvilinear edges 49, and the sheet 40 is placed on surface 46 so that the corrugations 45 are perpendicular to the edges 49 and so that the moistened insulating material protrudes beyond the surface 46 as shown in FIG. 12. Preferably a right section through cylindroidal surface 46 is arcuate and of the radius to which it is desired to form the insulating washer, and preferably surface 46 is of a width corresponding to the desired height of the web 50 (see FIG. 10) of the channel washer 51 to be constructed. The male die member 47 and a female die member 52 are reciprocal relative to each other, and female die member 52 has a surface 53 complementary to cylindroidal surface 46 and also has a pair of depending wiping plates 54 spaced apart sufficiently to accommodate the male die member 47 and connected by a web portion 55. When the male and female die members 47 and 52 are engaged, the moistened insulating material is compressed between complementary surfaces 46 and 53 as shown in FIG. 9.

The moistened corrugated insulating sheet 40 protrudes beyond the surface 46 as shown in FIG. 12, and as male

die member 47 and female die member 52 are reciprocated relative to each other from the open position shown in FIG. 8 to the engaged position shown in FIG. 9, the wiping plates 54 simultaneously urge the protruding portions of the moistened insulating material sheet 40 downward into conformity with the planar sides 48 of male die member 47. It will be apparent that the wiping plates 54 first contact and start to turn over the corrugated material simultaneously at the uppermost point of each arcuate edge 49, and that the simultaneous urging of the material against the flat sides 48 holds the moistened material on cylindroidal surface 46 and prevents movement thereof as the plates 54 wipe the moistened material in conformity with the planar sides 48. Apparently the corrugations 45 greatly facilitate turning over the insulating material to form the arcuate rims 60 on the channel washer 51 (see FIG. 10) or the arcuate rim 61 on the angle washer 62 (see FIG. 11). The forming operation appears to be analogous to a wiping action in the forming of metal, and there is no tearing or uneven buildup of the insulating material in turning over the edges 60 at right angles to the web 50 in the channel washer 51. Preferably suitable electrical coils schematically shown at 63 within male die member 47, or a suitable high frequency heating source (not shown) are energized from a source of electric power (not shown) to heat the insulating material while it is compressed in the desired arcuate and turned-over shape between male die member 47 and female die member 52 when these members are engaged. After removal from the forming die, the preformed insulating washers so dried have uniformly smooth and mechanically strong walls, e.g., both in the web 50 and the turned-over rims 60 of the channel washer 51, and tests prove that the mechanical rigidity and dielectric strength of angle and channel washers of the invention surpasses that of similar laminated members of equal wall thickness formed by prior art processes. The paperboard material is substantially homogeneous throughout the insulating washers 51 and 62 in the sense that it is non-laminar and the material is of approximately uniform thickness in both the vertical wall portion and the turned-over edges.

It is possible to form channel washers 51 and angle washers 62 in accordance with the method illustrated in FIGS. 6-12 with radii as small as three inches and extending over a full 90 degree arc. With prior art methods of construction it was impossible to form paperboard insulating washers having a radius of less than six inches, and it will be apparent that such washers did not always permit the inner periphery of the shell type transformer coil to conform with the magnetic core leg, and in order to obtain a close fit between core and coil it has heretofore often been necessary to use a greater amount of core steel and copper wire than required for the desired magnetic characteristics of the transformer. With preformed insulating washers in accordance with the invention having radius as small as three inches, no such problems are encountered in conforming the shell type transformer coils to the contour of the core leg.

It is possible to construct preformed arcuate insulating washers in accordance with the method of FIGS. 6-12 extending over an arc of 90 degrees and having straight portions (not shown) extending from the ends thereof. It will be apparent that only two such insulating washers are required at each approximately semiannular end of an "obround" coil for a shell type transformer and that such extending straight portions interfit ideally with the straight parts of the insulation simulating the contour of an obround winding.

While only two preferred methods of practicing the invention have been illustrated and described and the insulating members of the invention have not been illustrated in the position in which they are used in stationary induction apparatus, it will be apparent that many modi-

fications and variations thereof will be apparent to those skilled in the art, and consequently it is intended in the appended claims to cover all such modifications and variations as fall within the true spirit and scope of the invention.

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

1. The method of constructing curvilinear, turned-over edge, insulating members for electrical stationary induction apparatus from rigid paperboard insulating material sheet, comprising the steps of soaking the paperboard insulating material in a liquid, corrugating the material so soaked, placing said soaked and corrugated material on one of two mutually perpendicular surfaces, the first of which is planar and the second of which is cylindroidal and which intersect along a curved edge, with said corrugations transverse to said edge and said material protruding beyond said one surface, wiping said soaked and corrugated material to a single-thickness in conformity with said other surface to form a non-corrugated, turned-over edge on said insulating member, whereby said corrugations prevent tearing and wrinkling of said paperboard during said wiping, and heating said material while shaped in conformity with said other surface to effect drying thereof and to restore the material to its original mechanical rigidity.

2. The method of constructing curved, turned-over edge, insulating members for encasing the edges of coil sections of high voltage, oil-immersed, stationary induction apparatus from flat, mechanically rigid paperboard insulating material, comprising the steps of wetting the paperboard insulating material, providing straight corrugations in the material so wetted, placing said wetted and corrugated material on one of two intersecting surfaces the first of which is flat and the second of which is cylindroidal and which intersect along a curved edge, so that said corrugations are perpendicular tangents to said edge and said material protrudes beyond said one surface, holding said material in conformity with said one surface and simultaneously moving a member against said protruding material and parallel to and past said other surface to wipe said wetted and corrugated material in conformity with said other surface and form a single-thickness, non-corrugated, turned-over edge on said member, and heating said material while so held and shaped to effect drying thereof and to restore the material to its original mechanical rigidity.

3. The method of constructing curved, turned-over edge, insulating members for electrical transformers immersed in an insulating liquid from mechanically rigid sheet paperboard insulating material, comprising the steps of soaking the insulating paperboard material in a liquid, providing corrugations in the material so soaked, placing said soaked and corrugated material on one of two mutually perpendicular surfaces of a first die member, the first of said surfaces being flat and the second being cylindroidal, so that said corrugations are perpendicular to tangents to the curved edge along which said surfaces intersect and said material extends beyond said one surface, moving relative to each other said first die member and a second die member having a portion complementary to said one surface to permit holding said material against said one surface and having a second portion adapted to move parallel to said other surface during relative movement between said die members to wipe and shape said soaked and corrugated material to a single, non-corrugated thickness in conformity with said other surface, and drying said material while held against said one surface and shaped in conformity with said other surface to restore said material to its original mechanical rigidity.

4. The method of constructing an insulating collar for a coil section of a high voltage, oil-immersed, stationary induction apparatus from a flat, rigid, paperboard insulating material blank, comprising the steps of soaking said paperboard blank in a liquid, providing radial corruga-

tions in said soaked blank, placing said soaked and corrugated blank in a drawing die having relatively movable portions one of which is formed with a cup-shaped recess and the other of which is provided with a punch complementary to said recess so that said corrugations overlie and are transverse to the margin of said one die portion defining the open end of said cup-shaped recess, simultaneously compressing the outer margin of said blank against one of said die portions and drawing said soaked insulating material in conformity with said cup-shaped recess by moving said die portions relative to each other to form a non-corrugated, single-thickness, turned-over tubular portion of said collar and drying said material while so shaped to restore said material to its original mechanical rigidity.

5. The method of constructing angle insulating collars for the windings of high voltage, oil-immersed, stationary induction apparatus from rigid paperboard sheet insulating material, comprising the steps of wetting said sheet paperboard material, providing corrugations in said wetted material sheet extending radially from a central point therein, placing said wetted and corrugated insulating material sheet against the flat annular surface of a female die member having a cylindrical recess centrally of said annular surface with said central point in register with said recess, holding said wetted and corrugated insulating material sheet against said flat annular surface, drawing said wetted paperboard material in conformity with the contour of said cylindrical recess by moving relative to each other said female die member and a male die member having a portion complementary to said cylindrical recess to form a single-thickness, non-corrugated, turned-over tubular portion of said collar, and heating said paperboard material while so shaped to effect drying thereof and to restore said material to its original mechanical rigidity.

6. The method of constructing an angle insulating collar for encasing the edge of the coil section of a high voltage stationary induction apparatus immersed in an insulating liquid from a mechanically rigid flat paperboard insulating material blank, comprising the steps of soaking said paperboard blank in a liquid, providing corrugations in said soaked blank extending radially outward from a central point therein, clamping an annular portion of said blank having said point as its center, drawing the portion of said soaked and corrugated blank radially inward from said clamped annular portion into a cup-shaped member having a single-thickness, non-corrugated tubular wall perpendicular to said clamped annular portion, and drying said paperboard material while so formed to restore said material to its original mechanical rigidity.

7. The method of constructing turned-over edge, curvilinear insulating washers for electrical transformers from rigid sheet paperboard insulating material, comprising the steps of wetting said paperboard material, providing parallel corrugations in said material, placing said wetted and corrugated material on a cylindroidal surface which is perpendicular to and intersects a planar surface along a curvilinear edge so that said corrugations are perpendicular to said edge and said material protrudes beyond said edge, wiping the protruding portion of said wetted and corrugated material in conformity with said planar surface by moving a member against the protruding portion of said material and parallel to said planar surface in close proximity thereto to form a single-thickness, non-corrugated, turned-over edge of said washer, and heating said wetted material while so shaped to effect drying thereof and to restore the material to its original mechanical rigidity.

8. The method of constructing turned-over edge, curvilinear insulating washers for oil-immersed stationary induction apparatus from rigid sheet paperboard insulating material, comprising the steps of wetting said paperboard material providing parallel corrugations in said wetted material, placing said wetted and corrugated ma-

terial on a cylindroidal surface which orthogonally intersects a planar surface along a curved edge so that said corrugations are perpendicular to said edge and said material protrudes beyond said edge, compressed said wetted and corrugated material against said cylindroidal surface and simultaneously wiping the protruding portion of said material in conformity with said planar surface to form a single-thickness, non-corrugated, turned-over edge of said washer, and drying said material to restore its original mechanical rigidity.

9. The method of constructing channel cross section, curved insulating washers for encasing the edges of windings for high voltage stationary induction apparatus immersed in an insulating liquid from mechanically rigid paperboard sheet insulating material, comprising the steps of soaking said paperboard sheet material, providing parallel corrugations in said soaked material, placing said soaked and corrugated material on a cylindroidal surface of a male die member, which surface orthogonally intersects two parallel, spaced apart, planar surfaces along curvilinear edges, so that said corrugations are perpendicular to said edges and said material protrudes beyond said edges, wiping the protruding portions of said material in conformity with said planar surfaces by relatively moving said male die member and a female die member having side plates spaced apart to accommodate said male die member connected by a web portion complementary to said cylindroidal surface to form single-thickness, non-corrugated, turned-over edge of said washer, and heating said material while said male and female die members are engaged with said material compressed between said cylindroidal surface and said web portion and held in conformity with said planar surfaces by said side plates to effect drying thereof and to restore said material to its original mechanical rigidity.

10. The method of constructing channel cross section insulating washers for stationary induction apparatus immersed in an insulating liquid from mechanically rigid sheet paperboard insulating material, comprising the steps of wetting said paperboard material, providing parallel corrugations in said wetted material, placing said wetted and corrugated material on a cylindroidal surface which is perpendicular to and intersects two parallel, spaced apart, planar surfaces along curvilinear edges so that said corrugations are perpendicular to said edges and said material protrudes beyond said edges, simultaneously wiping the protruding portions of said wetted material in conformity with both said planar surfaces to form single-thickness, non-corrugated, turned-over edges on said washer, and drying said material while held in conformity with said planar surfaces to restore said material to its original mechanical rigidity.

11. The method of constructing an angle collar for stationary induction apparatus immersed in an insulating liquid from a rigid, flat paperboard insulating material disc, said method comprising the steps of soaking said paperboard disc in a liquid, providing straight corrugations in said soaked disc, placing said soaked and corrugated disc against the planar surface of a female mold having a recess therein defined by walls perpendicular to said planar surface, at least one of said walls being curvilinear, so that said corrugations overlie and are transverse to the edges along which said planar surface and said curvilinear wall intersect, drawing said soaked insulating material in conformity with the contour of said recess by moving relative to each other said female mold and a male die having a portion complementary to said recess to form a single-thickness, non-corrugated, turned-over tubular portion of said collar, and drying said insulating material while so shaped to restore said material to its original mechanical rigidity.

12. The method of constructing curvilinear, turned-over edge, insulating members for electrical transformers from mechanically rigid sheet paperboard insulating material, comprising the steps of soaking the paperboard insulating material in liquid, corrugating the material so soaked, forming said soaked and corrugated material to a desired angle along a curve tangents to which are perpendicular to said corrugations intermediate the ends thereof by a wiping action to provide a single-thickness, non-corrugated, turned-over edge portion of said insulating member, and drying said material while so formed to restore said material to its original mechanical rigidity.

13. The method of constructing a curvilinear, turned-over edge, insulating member for oil-immersed stationary induction apparatus from sheet paperboard insulating material, comprising the steps of immersing the paperboard insulating material in liquid, corrugating the material so wetted, forming said wetted and corrugated material to a desired angle along a curve transverse to said corrugations intermediate the ends thereof by a wiping action to provide a single-thickness, non-corrugated, turned-over edge, and heating said material while so formed to effect drying thereof and to restore the paperboard material to its original mechanical rigidity.

14. The method of constructing curved, turnedover edge insulating members for oil-immersed stationary induction apparatus from rigid sheet paperboard insulating material, comprising the steps of wetting the paperboard insulating material, providing corrugations in the material so wetted, placing said wetted and corrugated material on one of two intersecting surfaces, the first of which is flat and the second of which is curved and which intersect along a curved edge, so that said corrugations are perpendicular to tangents to said edge and said material protrudes beyond said one surface, holding said material in conformity with said one surface and simultaneously wiping said wetted and corrugated material to a single, non-corrugated thickness in conformity with the other surface to provide a turned-over edge on said insulating member, and drying said material while so formed to restore the material to its original mechanical rigidity.

15. The method of constructing an angle collar for oil-immersed stationary induction apparatus from a flat, mechanically rigid, paperboard insulating material disc, comprising the steps of wetting said paperboard disc, providing corrugations in said wetted disc extending outward from a central portion thereof, placing said wetted and corrugated disc against the flat surface of a female mold having a cylindrical recess centrally of said flat surface so that said central portion registers with said recess and said corrugations overlie and are transverse to the edge at the open end of said recess, drawing said wetted insulating material in conformity with the contour of said recess by moving relative to each other said female mold and a male die having a portion complementary to said cylindrical recess to provide a single-thickness, non-corrugated, turned-over tubular portion of said collar, and drying said insulating material while so shaped to restore said material to its original mechanical rigidity.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,058,160

October 16, 1962

William A. Mocker et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 7, line 71, before "insulating" insert -- angle --;
column 8, line 56, before "material" insert -- wetted --;
column 9, line 4, for "compressed" read -- compressing --.

Signed and sealed this 24th day of September 1963.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

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Commissioner of Patents