June 7, 1949. L. D. DRUGMAND 2,472,370

ELECTRODE FOR HIGH-FREQUENCY HEATING OF INSULATION PREFORMS

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Fig. 1

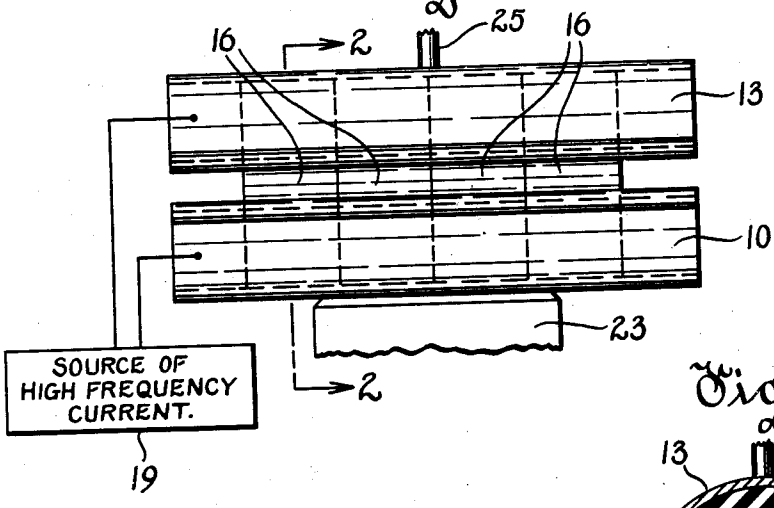


Fig. 2

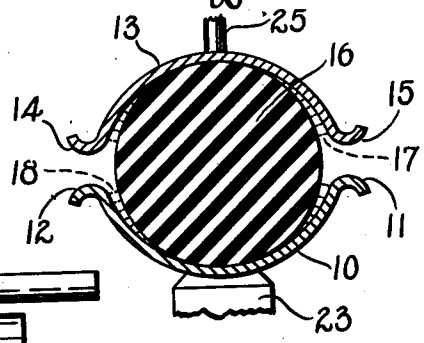


Fig. 3

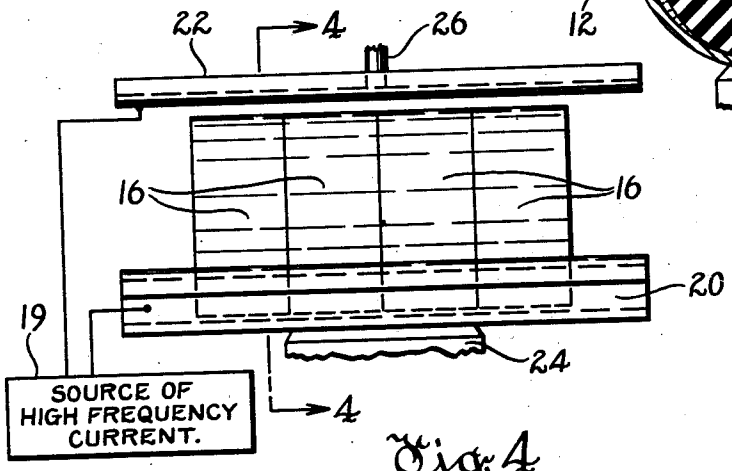
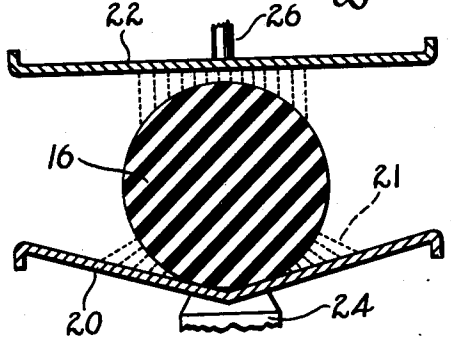


Fig. 4



Inventor
Lester D. Drugmand
By Frank H. Hubbard
Attorney

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ELECTRODE FOR HIGH-FREQUENCY HEATING OF INSULATION PREFORMS

Lester D. Drugmand, Milwaukee, Wis., assignor to Cutler-Hammer, Inc., Milwaukee, Wis., a corporation of Delaware

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3 Claims. (Cl. 219—47)

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This invention relates to improvements in electrodes for high frequency heating of cylinders of substantially constant diameter composed of dielectric material, and more particularly for heating thermoplastic and thermosetting moldings in such form.

A primary object of the invention is to provide cooperating high frequency electrodes adapted to insure substantially uniform heating of the entire mass of an insulation preform or group of preforms of cylindrical or disk form.

Another object is to provide a normally stationary electrode of such form as to insure proper positioning of insulation preforms of cylindrical or disk-shape when deposited edgewise in transverse relationship thereto.

Another and more specific object is to provide a trough-shaped supporting electrode which not only stabilizes the cylindrical or disk-shaped preforms when seated edgewise therein in transverse relationship thereto but also serves to improve current distribution through such preforms; thus overcoming the mechanical and electrical disadvantages of a flat electrode when used for such purpose.

Another object is to provide for use of an upper electrode of either inverted trough-shape or of flat form without sacrificing any of the advantages attendant upon use of a trough-shaped lower or supporting electrode.

Another object is to provide for use of complementary, reversely arranged, electrodes of trough-shape to accommodate therebetween a preform or preforms of circular form in transverse cross section, whereby said electrodes jointly surround a relatively large portion of the peripheral area of the preforms, with consequent substantially uniform heating of all portions of each preform.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate certain embodiments of the invention which will now be described; it being understood that the invention is susceptible of embodiment in other forms without departing from the scope of the appended claims.

In the drawings, Figure 1 is a side elevational view of a pair of upper and lower high frequency electrodes of approximately semi-circular form in transverse cross section to accommodate therebetween one or more preforms of dielectric material, of circular form in transverse cross section; the lower electrode serving as a stabilizing support for the preforms.

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Fig. 2 is a sectional view on the line 2—2 of Fig. 1.

Fig. 3 illustrates a modified form of my invention wherein the upper electrode is of the usual flat form, and the lower or supporting electrode is in the form of a trough; the same comprising a pair of longitudinally straight, flat sides converging at a relatively wide angle toward each other, and

Fig. 4 is a sectional view on the line 4—4 of Fig. 3.

In the art of transfer molding of thermoplastic or thermosetting insulating materials, of the "Bakelite" type, for instance; it has heretofore been proposed to provide preformed slugs or disks of such material, and to heat such slugs between a pair of high frequency electrodes to render the same of the desired degree of plasticity for use in the molding machine, especially where a transfer molding machine is employed.

In practice such preforms are generally in the form of round disks or cylinders; because that is the most convenient form of the pieces for use in the molding machines, and also because the die cavities for preforming such tablets are most economically made in that shape. The use of a pair of flat high frequency electrodes heretofore used for heating and plasticizing such preforms has not been satisfactory.

Thus, as is well known by those skilled in this art, although there is no difficulty in insuring a constant or like diameter of all of such disk-shaped preforms, there is an inherent likelihood that such preforms will differ from each other in thickness or axial length. Therefore, even though a plurality of such disk-shaped preforms are placed individually upon a flat lower supporting electrode there will likely be substantial difference in the distances between the upper ends thereof and an upper electrode of the flat type. When such preforms are placed end to end flatwise in groups of two or more, to form piles seated flatwise upon the flat supporting electrode, the aforementioned condition may be considerably aggravated. That is to say, there may be relatively wide differences in the air gaps between the tops of the several piles of preforms and the flat upper electrode, with resultant uneven or unequal heating of the preforms in the various piles. Moreover, the operation of so arranging the preforms in piles upon the flat lower or supporting electrode was time consuming, and the operation of gathering the piles of heated slugs from such supporting electrode and dropping them into the well of the transfer molding

machine was likewise slow; whereas speed of operation in such a system is very desirable to provide for attainment of the best results.

As aforeindicated, although there are inherent differences in the heights of the preforms, due to the differences in the amounts of material embodying the same, variations in molding pressure, presence of molding fins, etc., such preforms will all be of like diameter, and I accordingly utilize this physical characteristic of such preforms to advantage.

As shown in Figs. 1 and 2 the lower or supporting electrode 10, composed of a suitable metal is of approximately semicircular form in transverse cross section, the same preferably having curved or downwardly curled edges 11 and 12 at opposite longitudinal sides thereof. The upper electrode 13 of like metal may be of exactly the same shape and dimensions as the electrode 10, and is arranged in reverse relationship to the latter so as to be complementary thereto for reception therebetween of a group of cylindrical preforms arranged in end to end relationship, or with their flat ends adjacent to or contacting with each other. The upwardly extending curled or curved edges of electrode 13 are designated by numerals 14 and 15, respectively.

Also as indicated in Figs. 1 and 2 the trough-shaped lower electrode 10 is preferably arranged lengthwise in a horizontal plane, to facilitate depositing of the insulation preforms 16 thereinto, either singly or in a cylindrical group. Said preforms when so deposited within the trough-shaped electrode 10 are mechanically stabilized in a central position transversely thereof, as best illustrated in Fig. 2; the same being seated against the central portion of the trough, and being spaced a gradually increasing distance from the trough on opposite sides of the center of the latter. The upper electrode 13 is preferably movable upwardly, or upwardly and laterally, a sufficient distance to facilitate depositing of the preforms within electrode 10, either manually or otherwise. Thereafter electrode 13 is lowered to a predetermined operative position, usually in contact with the preform or preforms, as shown in Figs. 1 and 2. By this means high frequency current is supplied and penetrates the preforms 16 in a large number of paths extending substantially throughout the periphery thereof, as indicated by the imaginary dotted lines 17 and 18 in Fig. 2. As a consequence, substantially the entire transverse or cross sectional area of the preforms will be subjected to a like heating effect of the high frequency current supplied to electrodes 10 and 13, as indicated diagrammatically at 19 in Fig. 1; it being understood that electrodes 10 and 13 act as the plates of a condenser, so that with the arrangement illustrated substantially uniform heating of the entire mass of the preforms is insured. In practice care is exercised to insure that the adjacent pairs of curved edges 11, 15 and 12, 14 of electrodes 10 and 13 are maintained spaced from each other a sufficient distance to avoid any possibility of arcing between the electrodes or short-circuiting thereof around the preforms.

After the preforms 16 have thus been subjected to a predetermined desired or required amount of heat treatment, the supply of high frequency current is interrupted in any suitable manner, whereupon the upper electrode 13 is preferably raised to permit ready and speedy removal of the preforms, either manual or otherwise, for

feeding thereof into the well of a transfer molding machine or the like (not shown).

In the modification illustrated in Figs. 3 and 4, the lower or supporting electrode 20 is also of trough-shape in transverse cross section; the same having a pair of longitudinally extending straight, flat portions arranged at an obtuse angle to each other, as best illustrated in Fig. 4. This form of supporting electrode is mechanically equivalent to the electrode 10 aforedescribed, in respect of centering and stabilization of the insulation preforms 16. Also as indicated in dotted lines at 21 in Fig. 4, imaginary paths 21 of the high frequency current from electrode 20 to the preforms 16 are electrically and functionally quite similar to those indicated at 18 in Fig. 2.

The upper electrode 22 in Figs. 3 and 4 may be of the usual flat form, as shown; the same cooperating with electrode 20, in respect of the preforms 16, to afford substantially complete and equalized heating of the entire cross sectional area of the preforms. In practice such cooperation involves proper spacing of the upper electrode 22 from the preforms to insure the uniform heating aforementioned. The most closely adjacent portions of electrodes 20 and 22 are maintained separated a sufficient distance for reasons set forth in connection with Figs. 1 and 2. The edges of upper electrode 22 are preferably bent upwardly, and the edges of lower electrode 20 are bent downwardly, as shown, to assist in insuring against arcing therebetween. Electrodes 20 and 22 may be supplied with high frequency current from a suitable source 19, as aforedescribed.

The upper electrode 22 is movable, as described in connection with the device of Figs. 1 and 2, to facilitate insertion of the preforms into and removal thereof from the electrode 20.

The stationary lower electrodes 10 and 20 in the respective devices are preferably attached to suitable supporting members, fragments of which are shown at 23 and 24; whereas the respective upper electrodes are provided with adjustable supporting and lifting means, fragments of which are shown at 25 and 26.

Although, as illustrated herein, I prefer to provide for horizontal positioning of the pairs of electrodes 10, 13 and 20, 22 to facilitate depositing of the preforms, supporting the same for heat treatment, and thereafter removing the same; it is to be understood that certain electrical and/or functional advantages of my invention may be obtained by vertical mounting of the pairs of electrodes. This is especially true with respect to vertical mounting of the semicircular electrodes 10 and 13 of Figs. 1 and 2; in which case the vertical charge or pile of preforms might be separately supported in exactly centered relationship to both electrodes of the pair. Such centering of the preforms might be conveniently provided by positioning the same within a tube of suitable glass or ceramic composition.

I claim:

1. In combination, a trough-shaped sheet metal electrode for use in high frequency heating of cylindrical preforms of thermosetting dielectric molding material, means for mounting said electrode horizontally with the trough thereof opening upwardly whereby the same is adapted to act directly as a centering support for the preforms, the side edges of said electrode being equally spaced throughout the length thereof a distance greater than the diameter of the preforms to effect substantial equalization of the heating effect upon the latter of high frequency current

passed between the same and said electrode, a second electrode overlying the horizontal supporting trough formed by said first electrode throughout the length of the latter, and the longitudinal edges of said last mentioned electrode being alined with and spaced from those of the first mentioned electrode a sufficient distance to avoid any possibility of arcing between the electrodes or short-circuiting thereof around the preforms.

2. In combination, a pair of like trough-shaped sheet metal electrodes for use in high frequency heating of cylindrical preforms of thermosetting dielectric molding material, said electrodes being of approximately semicircular form in transverse cross section, means for mounting one of said electrodes with the open side thereof facing upwardly in a horizontal plane to form a directly supporting receptacle, means for mounting the other electrode in overlying relationship to the first electrode, to complementally accommodate therebetween a plurality of the cylindrical preforms arranged in end to end relationship, the longitudinal edges of each electrode being spaced apart a distance substantially greater than the diameter of the preforms, said edges of the respective electrodes being alined with each other and spaced apart a sufficient distance to avoid any possibility of arcing between the electrodes when in use, and associated means for effecting movement of at least one of said electrodes with respect to the other.

3. In combination, a trough-shaped sheet metal electrode for use in high frequency heating of cylindrical preforms of thermosetting dielectric molding material, means for mounting said electrode horizontally with the trough thereof opening upwardly to form a supporting receptacle, the side edges of said electrode being equally spaced throughout the length thereof a distance greater than the diameter of the preforms to effect substantial equalization of the heating effect upon the latter of high frequency current passed between the same and said electrode, a second electrode overlying the horizontal trough formed by said first electrode throughout the length of the latter, the longitudinal edges of said electrodes being vertically alined with each other, the longitudinal edges of said second mentioned electrode being spaced from those of the first mentioned electrode a sufficient distance to avoid any possibility of arcing between the electrodes or short-circuiting thereof around the preforms, at least one of said electrodes being movable with respect to the other, said first mentioned electrode being of a relatively wide V-shape in transverse cross section, and said second mentioned electrode being flat.

LESTER D. DRUGMAND.

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