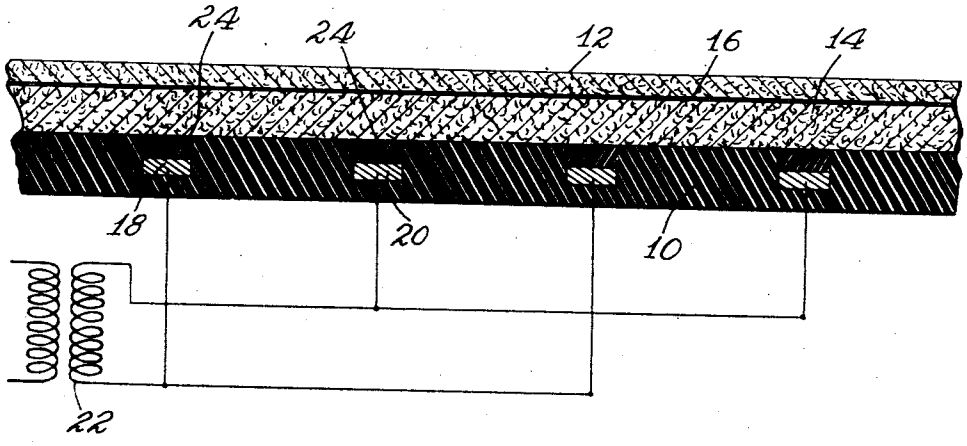
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HIGH-FREQUENCY ELECTRODE

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HIGH-FREQUENCY ELECTRODE

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This invention relates to electrode constructions suitable for the production of high-frequency electrostatic fields such as are used in setting up heat in pieces of work or in coatings thereon which are themselves dielectric materials.

One of the well-known ways of causing heat in dielectric materials is the application thereto of a high-frequency electrostatic field set up between electrodes. This may be a direct field between electrodes positioned at opposite sides of a piece of work, or it may be a stray field bulging outwardly from electrode members which are placed side by side outside of the work. In either instance, it is important that the electrode shall be supported by means of an insulating material of such dimensions and dielectric strength as to prevent either a corona discharge or a flash-over between electrodes at the voltages being employed. In some instances, the conductive portions of the electrodes are uncovered adjacent to the work but, more frequently, they are protected by an insulating material or medium to avoid danger to the operator and to reduce the possibility of damage to the work from accidental flash-over. It will be understood, further, that this danger of flash-over limits the amount of power which can safely be delivered to the work, since the voltages are of the order of several thousand volts and the frequencies employed extend over a considerable range, of which twenty megacycles may be considered as one typical value. In addition, the insulating medium should be a low-loss material to avoid any undesired heating thereof, with the incidental waste of power.

It is, accordingly, an object of the invention to provide an electrode construction of improved efficiency in which the part of the total power which is effective for treatment of the work will greatly exceed that ordinarily transferred.

In accordance with this object, one feature of the invention resides in the utilization of a cover for that face of the electrode which is adjacent to the work, which cover is composed of a low-loss material having a substantially higher dielectric constant than that of the adjacent insulating medium surrounding the electrode. The material of high dielectric constant and preferably low loss will be inserted between an electrode and a work piece in such a way as to control the path of electric force lines from the electrodes to the desired area of the work piece. By this arrangement, the field set up by the electrode is controlled as to path and intensity to make it most effective for its intended purpose. The result is that the heating of the dielectric material, such as the work piece which is in the field, is effected much more rapidly with the same amount of power than has been hitherto possible.

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This and other features of the invention will best be understood from a consideration of the following description taken in connection with the accompanying drawing in which there is illustrated diagrammatically a transverse section through a piece of work and an electrode pad associated with the work.

While it will be understood that the invention may be applied to arrangements utilizing a direct field, as well as to those in which the work is positioned in a stray field, it is found convenient for the purposes of this application to illustrate it as embodied in a stray field electrode employed for the activation of adhesive used, for example, for the attachment of a sole to a shoe. A description of an electrode especialy applicable to that purpose and the manner of its use will be found in United States Letters Patent No. 2,228,136, granted January 7, 1941, upon my application. For such a purpose, it is desirable to provide an electrode construction which will be flexible enough to assume the contour of the bottom of a shoe and in successive operations to change its contour as may be rendered necessary by the different sizes and shapes of shoes to be treated. Consequently, the pad is made up of an insulating material which will flex many times without cracking and which will have a reasonable resistance to wear so that replacements are not required within short periods of time. A pad of this kind is illustrated diagrammatically at 10 and supported upon it are pieces of leather 12 and 14 which are to be joined by means of a coating 16 of a thermoplastic adhesive. The body of the pad 10 will be made up of insulating material, such as rubber or glass cloth or the like, having a sufficient electrical resistance (i. e., dielectric strength) to prevent flash-overs between adjacent metal strips 18 and 20 arranged one after another in substantially the same plane. These strips, located in grooves in the pad, alternately are connected to opposite sides of a source of high-frequency current, such as a transformer 22 the primary of which is supplied with such energy in any desired fashion. The resistance of the insulating material forming the body of the pad 10 will also be sufficiently great to prevent a corona discharge between adjacent electrode bars of opposite polarity and will serve as a protection to the operator and to the work in thus preventing

flash-over such as might result from the presence of moisture upon the work, for example.

The efficiency of such a pad is greatly increased by superposing, on the bars of the electrode, covering strips 24 having a substantially higher dielectric constant than the dielectric constant of the surrounding medium such as the material forming the body of the pad 10. For mechanical reasons, it is preferable to employ a material for these strips 24 which may be securely attached to the material of the body of the pad and which will have a similar degree of flexibility and resistance to wear. For electrical reasons, the material of the strips 24 should have a low power factor so that there is no undue heating thereof by the field set up between the electrode bars with the accompanying waste of energy. Both natural rubber and butyl rubber may be compounded to have a large dielectric constant of the order of ten as compared with a dielectric constant of two or three in the medium used to make up the pad 10 and without any marked increase in their power factor so that there is no detrimental heating of this cover material itself. Conveniently, that medium may be rubber, thus making it possible to vulcanize the strips directly to the body of the pad and providing what is, in effect, a unitary structure. One such material having the desired electrical characteristics may be obtained by compounding materials according to the following formula and then curing or vulcanizing this compound:

	Parts by weight
Butyl rubber, uncured	200
Filler material	10
Sulphur	3
Accelerator	2
Titanium dioxide (rutile)	800
Plasticizer	20

The resulting product has a dielectric constant of 10.9 and a power factor of .0058.

It is found that a construction such as has been illustratively described is effective to channelize the field set up between the adjacent strips so that its bulging or stray field is more than ordinarily effective for the activation of the adhesive 16. It has been found by experiment that, with the same amount of power, the time of operation required to produce sufficient heat to activate the adhesive coating 16 may be reduced by half, for example. If the voltage employed between the electrode bars is of more interest than the time consumed, then it is possible to reduce the voltage and hence the power while securing activation of the adhesive in the time which was formerly required.

It will be understood that the invention is applicable to many other uses than the particular one which has been described herein and that the particular material which has been utilized as a cover for the bars of the electrode pad is only illustrative since other materials having particular mechanical or chemical or electrical characteristics within the scope of the invention may equally well be utilized.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. An electrode for use in the production of a high-frequency electrostatic field, comprising a conductor, an insulating support therefor forming part of the surrounding medium, and a cover for one face of said conductor having a substantially higher dielectric constant than the dielectric constant of the surrounding medium.

2. An electrode for use in the production of a high-frequency electrostatic field, comprising a piece of conductive material partially imbedded in insulation and having a covering, for a portion of the piece which will be adjacent to the work, constructed of a dielectric having a higher dielectric constant than the first-named insulation.

3. An electrode for use in the production of a high-frequency electrostatic field, comprising strips of conductive material, such strips lying in substantially the same plane, insulating material between the adjacent edges of said strips having a dielectric strength sufficient to prevent a discharge between them, and dielectric material superposed upon one face of each of said strips and having a substantially higher dielectric constant than that of the insulating material.

4. An electrode for use in the production of a high-frequency electrostatic field, comprising a pad of flexible material, a plurality of conductive flexible strips arranged one after another and adapted to be alternately connected to opposite sides of a source of high-frequency electricity, the adjacent edges of said strips being spaced by an insulating material the dielectric strength of which is sufficient to prevent a flash-over between the strips, said insulating material extending above the level of the strips to form a groove above each strip, and a flexible dielectric material filling said grooves and bonded to the insulation, said material having a dielectric constant which is notably higher than that of the insulating material.

5. A high-frequency dielectric heating electrode system comprising two or more conductive members disposed in an insulating medium and arranged to set up a field in an associated piece of work, at least one of said members being spaced from the work when in operative position, a dielectric member disposed between and extending substantially the whole distance between the work and at least that one of said members which is spaced from the work as aforesaid and in the path of said field in the work, said dielectric member having a dielectric constant notably higher than that of said medium.

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